Chapter 2: Vaccine-Preventable Diseases: Dealing with the Threat of Potential Disease Outbreaks

12 Contact Hours

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Learning objectives

Upon completion of this course, the nurse will be able to:

- Identify diseases for which vaccines are administered.
- Discuss why some parents and other caregivers are reluctant to have their children immunized.
- Identify potential consequences of not obtaining recommended immunizations.
- Identify factors that contraindicate immunizations.
- Describe the pathophysiology of various vaccine-preventable diseases.
- Evaluate treatment initiatives, including prevention strategies, for various vaccine-preventable diseases.
- Discuss nursing considerations related to vaccine-preventable disease.

Introduction

A study published in the January 21, 2013 issue of JAMA Pediatrics reported that Kaiser Permanente researchers found that 49 percent of children ages 2 months to 24 months did not receive recommended vaccinations, according to the Advisory Committee on Immunization Practice schedules [1]. The number of reported cases of measles in 2014 through May 23, 2014 was the highest year to date total since 1994 [2]. Many adults do not receive their recommended vaccines as well. For example, only one out of five adults ages 19-64 with certain high-risk medical conditions received a pneumococcal vaccination [3].

Vaccines have been administered as a disease-prevention strategy for centuries. For example, attempts to inoculate people against smallpox were noted as long ago as in the 1100s when dried scab material from smallpox patients was transferred to healthy children and adults. [4].

Centuries later, in 1796, Dr. Edward Jenner inoculated an eight-year-old boy with matter from a fresh smallpox lesion and concluded that protection from the disease was complete [5]. Today, in the 21st century, vaccines have been developed for the prevention of numerous, potentially deadly diseases, including specific malignancies. Yet, a considerable number of people do not receive recommended immunizations.

Why do some people shun vaccination while others do not? What vaccine-preventable diseases pose a threat in the 21st century? What are the potential consequences of such diseases? This education program addresses these issues as well as important nursing considerations for dealing with vaccine-preventable diseases.

DISEASES FOR WHICH VACCINES ARE ADMINISTERED

Children and adolescents

Vaccines have been administered for hundreds, if not thousands, of years to prevent development of disease. According to historical literature Hippocrates described mumps, diphtheria, jaundice, and other diseases as long ago as 400 BC. Inoculation using dried scab material from smallpox patients was performed in the 1100s [4]. The celebrated work of Dr. Edward Jenner in the late 18th century regarding protection from smallpox is well known. The Marine Health Service, established in 1798, was the country’s first public health agency. It provided hospital care for merchant seaman as well as protective measures against diseases such as cholera, smallpox, and yellow fever [4].

Development of vaccines has progressed at a fairly slow rate until the last few decades, when dramatic advances in technology and scientific discoveries led to amazingly swift advances in molecular biology, virology, and vaccinology [4]. The following is a summary of the immunizations recommended for People aged 0 through 18 years of age [5].

Immunization alert! Due to a number of factors, including new discoveries pertaining to diseases and their prevention, and rapid advances in treatment and vaccine trials, healthcare professionals would be wise to consult the Centers for Disease Control and Prevention (CDC) website for the latest information on immunization schedules, recommendations, catch-up recommendations for children and adolescents who have not received immunization according to recommendations, and changes in recommendations at www.cdc.gov.

Diseases for which vaccines are recommended in children and adolescents

Some vaccines are recommended to be administered at birth, such as the hepatitis B vaccine. Diseases for which vaccines are recommended at specific intervals or times from birth through the age of 18 years include [5]:

- Hepatitis B.
- Hepatitis A.
- Rotavirus.
- Diphtheria.
- Tetanus.
- Acellular pertussis.
- Influenza.
- Pneumococcal conjugate.
- Polio.
- Measles.
Why are more parents refusing or delaying having their children vaccinated?

Why do parents and other caregivers refuse or delay having their children receive recommended immunizations? Results from a 2009 telephone survey conducted by the CDC showed that 44 percent of children who did not receive immunization were sick at the time of the scheduled vaccination appointment, 20 percent of parents surveyed delayed vaccination because the vaccination appointment was inconvenient, and 17 percent said they simply missed the appointment [6]. Other parents were worried about the safety and/or effectiveness of the recommended vaccines. Safety concerns mentioned include [6]:

- Too many shots were recommended.
- Parents questioned whether the vaccines really worked.
- Parents cited concerns that vaccines might cause autism.
- Parents were worried about side effects.

As mentioned earlier, on January 21, 2013, JAMA Pediatrics published results of a study conducted to determine compliance with recommended childhood immunizations. [7,8]. Kaiser Permanente researchers found that 49 percent of children ages 2 months to 24 months did not receive all recommended vaccinations or did not get vaccinated at all, according to the Advisory Committee on Immunization Practices schedule [8]. The researchers used the Vaccine Safety Datalink, a collaborative effort among the Centers for Disease Control and Prevention (CDC) and nine managed care organizations to analyze immunization records of 323,247 children born between 2004-2008. Although the majority of parents in the U.S. do have their children vaccinated, an increasing number of parents are “concerned about vaccine safety and choose not to vaccinate their children according to alternative immunization schedules [8].”

Some parents expressed worries that too many vaccines administered at one time could overwhelm their children’s immune system or that the components of the vaccines could cause long-term adverse effects. Because of these concerns, some parents request alternative vaccination schedules. However, research has yet to determine if these alternative schedules are safer or less safe [7]. Research shows that some vaccines are associated with serious adverse events. However, such events are quite rare and must be evaluated in terms of whether or not the benefits of immunization outweigh the risks [9,10]. A recent systematic review of the literature on the safety of vaccines that are recommended for routine immunization of children, adolescents, and adults showed that the strength of evidence is high that the [9,10]:

- Measles, mumps, and rubella (MMR) vaccine is not associated with the onset of autism in children.
- MMR, diphtheria, tetanus, acellular pertussis vaccination (DTaP), tetanus-diphtheria (Td), Haemophilus influenza type b (Hib), and hepatitis B vaccines are not associated with childhood leukemia.

Adverse events identified from this literature review shows that strength of evidence was high for a link between MMR and febrile seizures and that the varicella vaccine was associated with complications in immunodeficient people. There was modest evidence that rotavirus vaccines were associated with intussusception. Fortunately, these adverse reactions were rare [10].

Potential consequences of not obtaining recommended immunizations

The most obvious potential consequence of failure to obtain recommended immunizations is development of disease. Acquiring vaccine-preventable diseases may have serious, even fatal consequences. For example, the CDC reported that the number of influenza-associated pediatric deaths reported to the CDC during the 2012-2013 influenza season surpassed 100. Initial evaluation of data showed that [11]:

- 90 percent of deaths occurred in children who had not received an influenza vaccine.
- 60 percent of deaths occurred in children who were at high risk of developing serious flu-related complications.
- 40 percent of deaths occurred in children who had no recognized chronic health problems.
- The proportions of pediatric deaths occurring in children who were unvaccinated and those who had high-risk conditions are consistent with what has been seen in previous seasons.

**Immunization alert!** Some parents may believe that most vaccine-preventable diseases no longer occur in the United States. Therefore, they believe that vaccine administration is not necessary. It is important to teach parents and other caregivers that diseases such as whooping cough, measles, chickenpox, meningitis, and influenza still circulate in the United States. Effects of such diseases can range from mild to severe and life threatening [12].

If parents choose not to vaccinate or to delay vaccination of their children, they need to understand a number of important issues and take appropriate actions. Such actions include teaching parents to [12]:

- Maintain a written record of the child’s vaccination status. This record should be easily accessible. If a child becomes ill or injured, healthcare providers must know what immunizations the child has or has not received or if immunizations were not administered according to recommended schedules. Under stress, parents may not remember the details of the child’s immunization status; healthcare providers must be able to quickly access this information. Make sure that all of the child’s physicians and healthcare providers are aware of the child’s immunization status. This is especially important if an outbreak of vaccine-preventable diseases occurs. Physicians and other healthcare professionals can take steps to help protect the child against such diseases.
- Contact the child’s physician immediately if he/she has been exposed to a vaccine-preventable disease but has not been vaccinated against that disease. In some cases, vaccination may still be possible.
- Know that if an outbreak of vaccine-preventable diseases occurs in children’s school or daycare center, they may be asked to take their unvaccinated child out of school or day care until it is deemed safe for them to return. This can take from several days up to several weeks.
- Learn early signs and symptoms of vaccine-preventable disease. If a child develops such diseases, parents should notify his/her physician immediately. May sure that all members of the healthcare team who come into contact with the child know that he/she has not been vaccinated. This helps to prevent spread of the disease.
- Learn about possible exposure to diseases common in certain geographic areas, before traveling with an unvaccinated child. Vaccine-preventable diseases are common throughout the world, including Europe. Consult the CDC travelers’ information website prior to traveling at www.cdc.gov/travel.
- Consult with the child’s physician for the latest information about vaccines. Visit the CDC website www.cdc.gov/vaccines.

- Mumps.
- Rubella.
- Varicella (chicken pox)
- Human papillomavirus (HPV).
- Meningitis.
- Measles, mumps, and rubella (MMR) vaccine is not associated with the onset of autism in children.
- MMR, diphtheria, tetanus, acellular pertussis vaccination (DTaP), tetanus-diphtheria (Td), Haemophilus influenza type b (Hib), and hepatitis B vaccines are not associated with childhood leukemia.
- Measles, mumps, and rubella (MMR) vaccine is not associated with the onset of autism in children.
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**Exemptions from immunization law**

Laws regarding immunization and school attendance were first enacted to control smallpox outbreaks. As time went on, such laws have subsequently been used to prevent epidemics of vaccine-preventable diseases such as measles, mumps, whooping cough, and polio. As of this writing, all 50 states in the United States have some immunization laws. However, there are differences in requirements among the states [13].

There are legally allowable exemptions from immunization laws. As of July, 2012 [13]:
- All 50 states in the United States allow vaccination exemptions for medical reasons.
- Forty-eight states allow exemptions for religious reasons.
- Nineteen states allow exemptions for philosophical reasons.

**Adults**

Many adults are not aware that they need vaccines at regular intervals. In fact, according to a 2012 National Health Interview Survey, only [14]:
- One out of five adults ages 19-64 with identified high risk medical conditions received a pneumococcal vaccination.
- One out of five adults 60 years of age and older received a shingles vaccination.
- One out of six adults ages 60-64 received a Tdap vaccine in the last seven years to protect them from tetanus, diphtheria, and pertussis.

2014 recommended adult immunizations include [15]:
- An influenza (flu) vaccine annually for all adults.
- Tetanus, diphtheria, pertussis (Td/Tdap) once and then a Td booster every 10 years.
- Two doses of acetilcell vaccine.**
- Three doses of HPV vaccine for females. (Note that the CDC and partners, such as the American Academy of Pediatrics, state that HPV vaccination of females can begin as early as nine years of age. Vaccination is recommended for 13- through 26-year-old females [16]).
- Three doses of HPV vaccine for males. As of this writing there are two HPV vaccines, but only one, Gardasil, should be given to males. (Vaccination, if recommended by the CDC and its partners for males aged 13 through 21 and in males aged 22 through 26 who have not completed the vaccination series [16]).
- One dose of the shingles vaccine for adults 60 years of age and older.
- One or two doses of the MMR vaccine for People up to the ages of middle-50s.**
- One dose of pneumococcal PCV13 and one or two doses of pneumococcal PPSV23 in adults. Only one dose of PPSV23 for People over the age of 65.
- One or more doses of meningococcal vaccine.**
- Two doses of hepatitis A vaccine.**
- Three doses of hepatitis B vaccine.**
- One or three doses of Haemophilus influenza vaccine.**

**Immunization alert!** Certain vaccines may have been administered in childhood, which may alter timing and/or the need for adult immunizations. For example, adults receive the varicella vaccine only if they did not receive it as children or did not have varicella (chicken pox). Some vaccines are recommended for adults with certain risks related to their health, job, or lifestyle. Prior to receiving any type of vaccination, adults should review their immunization status with their healthcare providers. Additionally, the CDC website offers current information about recommended immunization schedules at www.cdc.gov/vaccines.

**Reasons for adults to receive recommended immunizations**

There are numerous reasons adults should receive recommended immunizations, including the following important issues [14].
- Many vaccine-preventable diseases, such as shingles, influenza, and pertussis, are common in the United States, spread easily, and can affect adults.
- Adults may be at increased risk for complications from vaccine-preventable diseases if they also have a chronic health condition or a compromised immune system.
- Vaccination reduces the risk both of acquiring these kinds of diseases and passing them on to family, friends, and co-workers.

Reducing these risks also helps to protect people who cannot receive vaccinations, such as pregnant women or people receiving treatment for cancer.
- Adults who contract vaccine-preventable diseases will likely miss work and may be unable to fulfill certain responsibilities such as caring for their children while they are ill.
- Adults who contract vaccine-preventable diseases may accrue considerable financial costs, including medical treatment, lost time from work, and hiring someone to provide child care.

**People who should not receive vaccinations**

Age, health status, and other factors influence whether or not people should receive certain immunizations. The following summary provides information about contraindications for certain vaccines. For detailed information about vaccine contraindications, patients should consult with their healthcare providers. The CDC website (www.cdc.gov/vaccines) also offers significant information about vaccine contraindications.
**GUIDELINES FOR VACCINE CONTRAINDICATIONS INCLUDE, BUT ARE NOT LIMITED TO, THE FOLLOWING GUIDELINES**

### Diphtheria, tetanus, and acellular pertussis

The diphtheria, tetanus, and acellular pertussis (DTaP) vaccine should not be given to [17]:

- Children who are moderately or severely ill. Vaccination should be delayed until they recover.
- Any child who developed a brain or nervous system disease within seven days after a dose of the vaccine should not receive another dose.

If a child collapsed, had a seizure, cried non-stop after a dose, or had a fever greater than 105 degrees Fahrenheit after a dose of the vaccine, the child’s physician should be informed prior to receiving another dose of the vaccine [17].

### Hepatitis A vaccine

Some people should not receive the hepatitis A vaccine or should wait to receive it, including the following: [17].

- People who have had a severe, life-threatening allergic reaction to a previous dose should not receive another dose.
- People who have had a severe, life-threatening reaction to any vaccine component should not receive the vaccine. Physicians should be informed of the existence of any severe allergies, including latex allergy.

- People who are moderately or severely ill at the time of the scheduled immunization should wait until they recover before receiving the vaccine. The patient’s physician should be consulted, because mild illness may not prevent vaccine administration.
- Pregnant women should discuss risks versus benefits before receiving the vaccine. Hepatitis A vaccine is inactivated so the risk to the woman or the unborn child is believed to be low, but benefits must outweigh the risks.

### Hepatitis B vaccine

People who should not receive the vaccine or should wait to receive it include the following [17]:

- Anyone who has a life-threatening allergy to yeast, or to any other component of the vaccine should not receive it.
- Anyone who has had a life-threatening allergic reaction to a prior dose of the vaccine should not receive another dose.

- People who are moderately to severely ill should not receive a dose of the vaccine until they have recovered.
- Note that people may be asked to wait 28 days before donating blood after receiving hepatitis B vaccine, since the screening test may mistake vaccine in the bloodstream for an actual hepatitis B infection.

### HPV-cervarix HPV vaccine

Some people should not receive the HPC vaccine or should wait [17].

- The vaccine should not be given to anyone who has ever had a life-threatening allergic reaction to any component of HPV vaccine. Physicians should be notified if patients have any severe allergies, including latex allergy.
- This HPV is not recommended for pregnant women. Breastfeeding women may receive the vaccine. If a woman learns that she was pregnant when she received the vaccine, it is not a reason to consider terminating the pregnancy. She should consult with her physician.

- People who are moderately or severely ill should wait until they recover.

### HPV-gardasil HPV vaccine

Some people should not receive this vaccine or should wait to receive it [17].

- Any person who has had a life-threatening allergic reaction to any component of this HPV vaccine or a previous dose of the vaccine should not receive it. The patient’s physician should be informed of any severe allergies, including an allergy to yeast.
- This HPV vaccine is not recommended for pregnant women, but receiving this HPV vaccine while pregnant is not a reason to consider terminating the pregnancy. The woman should inform and consult with her physician. Breastfeeding women may receive this HPV vaccine.

- People who are mildly ill may receive the vaccine, but people who are moderately or severely ill should wait until they recover.

### Influenza (live) vaccine

The person administering the vaccine should be told if the patient [17]:

- Has severe, life-threatening allergies, including allergies to eggs, had a life-threatening allergic reaction after a dose of flu vaccine, or a severe allergy to any part of this vaccine. These patients should not receive the vaccine.
- Has ever had guillain-barre syndrome. Some people with a history of this disease should not receive the vaccine, and patients should discuss the advisability of receiving the vaccine with their physician.

- Has received any other vaccines in the past four week, or if the patient is not feeling well. These patients may need to wait before receiving the live influenza vaccine.

Patients should receive the flu injection instead of the nasal spray form if they are pregnant, have a weakened immune system, have certain long-term health problems, or are young children with asthma or wheezing problems [17].
Measles, mumps, rubella (MMR) vaccine

Some people should not receive the MMR vaccine or should wait before receiving it [17].

- People who have had a life-threatening allergic reaction to the antibiotic neomycin or any other component of MMR vaccine should not receive the vaccine, and their physician should be notified of the existence of any other severe allergies.
- Anyone who has had a life-threatening allergic reaction to a previous dose of MMR or MMRV vaccine should not receive another dose.
- People who are ill at the time of a scheduled vaccination may be advised to wait until they are better before receiving the vaccine.
- Females who are pregnant should not receive the MMR vaccine. Females should avoid getting pregnant for four weeks after vaccination with the MMR vaccine.

Shingles (herpes zoster) vaccine

Individual should not receive the shingles vaccine if they [17]:

- Have ever had a life-threatening allergic reaction to gelatin, the antibiotic neomycin, or any other component of the shingles vaccine. The patient’s physician should be informed if the patient has any severe allergies.
- Have a weakened immune system because of disease, drug treatment, cancer treatment, or a cancer that affects the bone marrow or lymphatic system.
- Are pregnant or might be pregnant. Females should not become pregnant until at least four weeks after getting the shingles vaccines.

Prior to receiving the vaccine, the patients’ physicians should be told if they [17]:

- Have HIV/AIDS or other diseases that affect the immune system.
- Are being treated with drugs that affect the immune system.
- Have any type of cancer.
- Are being treated for cancer with radiation or drugs.

Vaccine-preventable diseases

Because immunization programs have significantly decreased the incidence of vaccine-preventable diseases, some healthcare professionals may not be as familiar as they should be with certain diseases. Even smallpox, a disease that has been declared eradicated, can pose a threat.

Smallpox

December 13, 2002 from the U.S. Department of Defense: “President Bush today announced he has ordered smallpox vaccinations to begin for military personnel. He has also recommended medical personnel and first responders receive the vaccine, but on a voluntary basis. Administration officials stopped short of recommending widespread vaccinations of the American public. ‘Men and women who could be on the frontlines of a biological attack must be protected,’ the president said during an afternoon press briefing in the Eisenhower Executive Office Building. The president stressed his decision was not based on a specific threat, but on the renewed focus on security brought about by the Sept.11,2001 terrorist attacks and the subsequent anthrax attacks through the mail[18]. ‘”

No one who lived through the horrific days following the terrorist attacks on September 11, 2001 can forget the fear and grief accompanied by the determination and courage of Americans as they worked to deal with a way of life and a world that changed forever in a few, brief, heartbreaking hours.

Some of those changes dealt with the health of the American public and the very real possibility of germ warfare as future terrorist weapons. Although the risk is considered to be low, there are concerns that the smallpox virus could be used for bioterrorism. In 2002, a joint working group consisting of members of the Advisory Committee on Immunization Practices and the National Vaccine Advisory Committee met in Atlanta as part of their review of smallpox vaccine recommendations. As a result of recommendations from this working group and the occurrence of terrorist events on American soil, there is now a stockpile of enough smallpox vaccine to vaccinate every person in the United States [19].

Storage of the smallpox virus

The last confirmed case of smallpox occurred in the U.S. in 1949. Routine smallpox vaccination ended in this country in 1972. The World Health Organization (WHO) certified that smallpox had been eradicated from the planet in 1979, becoming the first time in history that medical scientists and public health workers had completely purged the world of a devastating infectious disease [20].
However, even though the disease was declared eradicated, samples of the live virus were preserved for research purposes. The only verified repositories of the virus are in secure laboratories at the CDC in Atlanta and the State Center for Research on Virology and Biotechnology in Koltsovo, Russia. (VECTOR) [20].

**Smallpox alert!** It is believed that illegal, covert amounts of the smallpox virus exist in 10 or more countries [20].

The WHO called for the destruction of remaining stockpiles of the smallpox virus by June 1999. However, after fears developed that samples may have fallen into the hands of terrorists or rogue states, President Bill Clinton reversed an earlier U.S. government pledge to destroy smallpox virus stockpiles stored in the U.S. [21].

Fears and concerns focused on testimony given by Ken Alibek, a former VECTOR official who defected to the U.S. in 1992 [21]. During his Congressional testimony Alibek stated “that as recently as the early 1990s, dozens of tons of smallpox were being stockpiled in the former Soviet Union annually for use as weapons. He also reported that some of the more than 60,000 people involved in biological weapons research for the former Soviet government may be employed by governments wishing to develop biological weapons [20].”

**Background**

Smallpox, or variola, is an ancient, acute, highly contagious infectious disease caused by the poxvirus variola [23,24]. The disease was pronounced eradicated by the WHO on October 26, 1979 two years after the last naturally occurring case was reported in Somalia. Vaccination is no longer recommended, except for certain laboratory workers, and is offered to members of the military, health department officials, first responders, and key healthcare providers. If smallpox is used as an agent of bioterrorism, vaccination programs are ready to be initiated [24].

After the last known naturally occurring case of smallpox in Somalia, the only known cases were caused by a laboratory accident in 1978 in Birmingham, England, which killed one person and led to a limited outbreak [23].

**Types of smallpox**

There are several forms of smallpox:

- **Variola major:** Variola major or classic smallpox, causes extreme illness and has a death rate of 30 percent of unvaccinated people [20,24].
- **Variola minor:** Variola minor is a milder form of the disease that occurred in non-vaccinated people and is caused by a less virulent strain of the virus [24].
- **Varioloid:** A minor form of smallpox that occurred in those who were previously vaccinated but had only partial immunity [24].
- **Malignant smallpox:** This less common form of the disease caused death in more than 96 percent of its victims. It is characterized by an abrupt onset and flat, velvety lesions that never became pustular [20].
- **Hemorrhagic-type smallpox:** This form of the disease is characterized by bleeding into the skin and other body parts. Historically, pregnant women were very susceptible to hemorrhagic-type smallpox [20].

**Etiology and incidence**

Smallpox affected people of all ages throughout the world. It existed for at least 3,000 years and was fatal, on average, in up to 30 percent of cases [23]. In temperate zones, incidence was highest during the winter, and in the tropics, incidence was highest during the hot, dry months. Caused by the variola virus, smallpox was transmitted directly by person-to-person contact from respiratory droplets or from dried scales of virus-containing lesions. The virus was transmitted indirectly via contact with contaminated linens or other objects [24].

Smallpox had an incubation period of between seven and 17 days after exposure [23]. It was most infectious during the first week of illness, but was contagious from onset until after the last scab was shed [24]. Complications of the disease include arthritis, bronchitis, disfigurement, encephalitis, and pneumonia [20,23,24].

**Clinical manifestations**

Smallpox was generally transmitted at a slower pace compared to diseases such as measles or chickenpox. This was because by the time the patients were contagious, they were ill and in bed, and the disease was spread primarily to household members and friends. Large outbreaks in schools were not common [23].

Following the one- to two-week incubation period, the disease developed abruptly, causing chills, high fever, headache, backache, severe malaise, and, especially in children, vomiting, and possible seizures. Occasionally violent delirium, stupor, or coma occurred [24].

Soon after onset of the disease, patients developed sore throats, coughs, and lesions on the mucous membranes of the mouth, throat, and respiratory tract. Within days, skin lesions developed. These lesions progressed from macular (flat) to popular (changes in color or texture of skin), to vesicular (fluid-filled sacs) and pustular (lesions filled with white blood cells and serous fluid). All skin lesions existed in the same stage of development over the body [24].

About two days after disease onset, symptoms became more severe, but by day three, the patients began to feel better [24].

**Smallpox alert!** In the pustular stage of the disease, temperature rises and early symptoms reappear [24].

By day 10 of the disease, pustules began to rupture and ultimately dried and formed scabs. After two weeks, symptoms subsided, but desquamation (shedding) of scabs took another one to two weeks. As the scabs shed, intense itching occurred, and patients were often left permanently scarred [24].
**Smallpox alert!** In cases of fatal disease, the patient acquired a distinct dusky appearance over the face and upper chest. Death was due to encephalitis, extensive hemorrhage from body orifices, or secondary bacterial infections [24].

**Diagnosis and treatment**

Smallpox was easily recognized before it was eradicated. Today, however, most healthcare professionals are not aware of its characteristic clinical manifestations. It is important that they become familiar with these manifestations in the event of an outbreak caused by terrorist activities.

Laboratory tests that confirm diagnosis include [24]:
- Culture of the variola virus taken from aspirate of vesicles and pustules.
- Microscopic examination of smears from lesion scrapings.
- Blood analysis to detect antibodies to the smallpox virus.

**Points about vaccination**

Anyone who has received the smallpox vaccination has some level of protection. However, it may not still be fully effective but should protect people from the worst effects of the disease. If exposure is likely, a repeat vaccine would be recommended [23].

Currently, routine vaccination against smallpox is not recommended for the general public. Vaccine is still administered to protect researchers who work with the virus and to certain military personnel [18,23].

**Polio**

October 19, 1953: “To a polio victim who can no longer breathe for himself nothing is more disheartening than the thought of spending every hour of his life flat on his back in an iron lung. In the past few years, the iron lung has been radically altered to make life within it more bearable. By enclosing the patient’s head in a plastic bubble, air can be pumped in and out of his lungs while the rest of the machine is removed. Thus long periods of therapy and nursing care are possible. Doctors are also experimenting with a new lung in which patients can actually sit up. But most encouraging of all new developments is a breathing technique which enables patients to leave their iron prisons for hours at a time [25 pp 127-128].”

The preceding paragraph is an excerpt from the October 19, 1953 issue of Life Magazine. In just over 60 years, amazing strides have been made to prevent this devastating disease. Patients once feared spending their lives confined in a cylinder-like breathing apparatus, while others remained physically disabled for the rest of their lives. The development and administration of the polio vaccine has drastically reduced the occurrence of this disease to primarily small outbreaks among unvaccinated populations [24].

February 22, 1954: “The biggest experiment in U.S. medical history will take place during the next few months when at least 500,000 children will be injected with a vaccine against poliomyelitis. Inoculations probably will get under way next month, in towns throughout the country and will continue into June. Then local medical teams under the National Foundation for Infantile Paralysis will wait and watch as the annual curve of polio begins to climb, slowly in June, higher in July, highest in August and September, then falls steeply again with cool weather. Comparing the amount of polio among the inoculated children with that among the un inoculated ones, a committee of leading scientists will be able to judge the vaccine's effectiveness. In theory it should produce immunity against polio in most or all of the inoculated children. The expectation is that it will produce at least some. Conceivably, it may produce none. Suppose it should produce little or none. That would be a disappointment but would not alter the fact that an effective polio vaccine can be and will be made [26 pg. 121].”

Reading this 1954 excerpt from Life Magazine gives the reader some glimpse of what it was like to be on the edge of discovering a vaccine that would, in 1954, theoretically save hundreds of thousands of lives. Medical advances (and communicating such advances) occurred at a much slower pace in the 1950s, a pace that is difficult for 21st century practitioners to comprehend. The excerpt gives some idea of the hopes of researchers who had worked on a polio vaccine development since 1949.

A follow-up article on May 24, 1954 talked about the vaccination process that had taken place over the preceding months. It also discussed the use of gamma globulin as an anti-polio agent.

May 24, 1954: During the last few weeks, the famed Salk polio vaccine has been given to several hundred thousand children in a huge “field trial,” the biggest controlled medical experiment ever attempted. Although the results won’t be fully known until this winter, the trial has so far gone much more smoothly than anyone had a right to expect. The only ill effects have been a few fainting and lost lunches from the tension and excitement, and a few cases of allergic reaction from the penicillin included in the vaccine. About three weeks from now, the last shots will be given. The reason for stopping the program is the advent of the annual polio “season,” when, for reasons unknown, the danger of infection is worst. To prevent this seasonal factor from clouding the results of the test, the substance that holds such promise for ending polio must ironically be put aside just in time when people most need protection.”

Then what about the children who haven’t been vaccinated—is there any way to protect them? In 1951 and 1952, gamma globulin (GG) was tested in carefully controlled mass experiments, smaller but similar to the current vaccine trial. Results showed that if GG were given before a person was exposed to the virus, his chances of getting the disease would be reduced by 80 percent for about five weeks—not much protection but better than nothing. In 1953, GG was released for general use in different ways—one way entirely different from the method of 1951 and 1952. Behind the change of method lay a wrong but plausible scientific hunch which sprang from the worthy hope of using GG so as to do the greatest good for the greatest number [27, pg. 8].”

The preceding paragraphs are from a 1954 issue of the now out-of-print Life Magazine. “Traveling” back to the early 1950s shows that researchers were as concerned with objective evaluation of vaccine trials as are researchers today. The use of gamma globulin was also a strategy used in disease prevention, similar to some prevention efforts today.

In 2014, it is known that the polio vaccine strategies initiated in the 1950s have been a resounding success. But unlike smallpox, polio has not been eradicated.
Introduction

Thanks to extensive vaccination efforts, polio no longer causes the dreaded epidemics that occurred in the past. The last cases of naturally occurring polio in the U.S. were reported in 1979 among the Amish in several Midwestern states [28].

From 1980 through 1999, 162 confirmed cases of paralytic polio were reported. Of these 162 cases [28]:
- Eight were acquired outside the U.S. and imported.
- 154 cases were vaccine-associated paralytic polio (VAPP) caused by live oral polio virus.

Etiology and incidence

Polio is a highly contagious viral illness caused by the polio virus. The virus itself has three serotypes: type I, type II, and type III. All types cause polio [24]. Between the late 1940s and early 1950s, polio crippled about 35,000 annually in the U.S. alone [33].

Despite vigorous worldwide efforts to eradicate the disease, polio continues to affect children and adults in Afghanistan, Pakistan, and some African countries [29].

**Polio alert!** The CDC advises that previously vaccinated adults who plan to travel to countries where there is a risk of polio receive a booster dose of inactivated polio virus vaccine (IPV). This booster dose provides lifetime immunity [29].

Concerns that the spread of polio remains a danger continue to exist. For example, the polio virus was found in sewage samples collected in March, 2014 from Viracopos International Airport, in Campinas, Brazil. Campinas was the team base camp for both the Portuguese and Nigerian soccer teams during the FIFA World Cup tournament. The strain of the virus is a close match to one recently isolated in Cameroon because of the spread of the virus [31].

Vaccination recommendations

There are two types of polio vaccines: inactivated polio vaccine (IPV) and oral polio vaccine (OPV). Oral polio vaccine is no longer administered in the U.S., but it is still used throughout much of the world. Only IPV has been used in the U.S. since 2000. IPV is administered as an injection in the leg or arm, depending on the age of the patient [32].

Children should be vaccinated with four doses of IPV according to the following schedule: [24,32]
- A dose at two months.
- A dose at four months.
- A dose at six to 18 months.
- A booster dose at four to six years.

Adults traveling to areas of the world at high-risk for polio, working in a laboratory and handling specimens that may contain the polio virus, or who are healthcare workers treating patients who have or have had close contact with someone who could have polio and have never been vaccinated should receive three doses of IPV [32]:
- First dose at any time.
- Second dose one to two months later.
- Third dose six to 12 months after the second.

Adults in the preceding three groups who have had one or two doses of polio vaccine sometime in the past should receive the remaining one or two doses [32].

Pathophysiology and transmission

Polio affects only humans spreads by person-to-person contact with infected oropharyngeal secretions or feces [24,35]. The incubation period ranges from five to 35 days, with an average of seven to 14 days [24].

The virus usually enters the body through the alimentary tract. It multiplies in the oropharynx and lower intestinal tract and spreads to the blood and to regional lymph nodes [24].

A number of complications are associated with polio. These include [24]:
- Atelectasis
- Cor pulmonale.

- Deformities of the soft tissues and bones.
- Hypertension.
- Paralytic shock.
- Pneumonia.
- Pulmonary edema.
- Pulmonary embolism.
- Respiratory failure.
- Urinary tract infections.

Clinical manifestations

Fortunately, most people with polio have no or only mild symptoms [24,32]. In fact, about 72 percent of affected people have no symptoms at all [32]. These are referred to as inapparent or subclinical infections [24].

About 24 percent of affected patients have minor symptoms, such as slight fever, malaise, headache, sore throat, nausea, vomiting, neck and back stiffness, and pain in the limbs [24,32]. These patients usually recover completely within 72 hours, and most of these cases go unrecognized [24].
However, the remaining 4 percent of affected patients experience major poliomyelitis, which involves the central nervous system (CNS) and takes one of two forms: non-paralytic and paralytic [24].

**Polio alert!** Fewer than 1 percent of patients experience permanent paralysis of the limbs, usually the legs. About 5 to 10 percent of patients who are paralyzed die when the paralysis affects the respiratory muscles. Death rate increases with the age of the patient [32].

Non-paralytic polio involves the CNS and causes [24,32]:
- Moderate fever.
- Headache.
- Vomiting.
- Lethargy.
- Irritability.
- Neck, back, arm, leg, and abdominal pain.
- Muscle tenderness and weakness.
- Spasms of the extensors of the neck and back and sometimes of other muscles. Note that these spasms may occur during maximum range-of-motion exercises.

Non-paralytic polio generally lasts for about seven days. Meningeal irritation continues for about two weeks [24].

Paralytic polio is the most serious form of the disease and can be classified in the following ways [32]:
- Spinal: The disease affects the spinal cord.
- Bulbar: The disease affects the brainstem.
- Bulbospinal: Affects both the spinal cord and the brainstem.

Paralytic polio usually develops within five to seven days of fever onset. Signs and symptoms are similar to those of non-paralytic polio. However, within a week, signs and symptoms specific to this severe form of the disease develop. These include [24,32]:
- Asymmetrical muscular weakness.
- Severe muscular pain.
- Flaccid paralysis, often worse on one side of the body.
- Loss of superficial and deep reflexes.
- Paresthesia.

**Diagnosis, treatment and nursing considerations**

Diagnosis is confirmed when polio virus is isolated from [24]:
- Throat washings obtained early in the course of the disease.
- Feces throughout the course of the disease.
- Cerebrospinal fluid (CSF) cultures in CNS infection.

There is no cure for polio, so treatment is supportive. Analgesics are administered to reduce pain and leg spasms. Moist heat may also help to reduce pain and muscle spasm [24].

**Polio alert!** Note that use of morphine for pain relief is contraindicated because of morphine’s suppression of respiratory muscles [24].

Patients remain on bed rest only until extreme discomfort resolves, which may take quite some time. Patients who have paralytic polio require extensive rehabilitation. Convalescence is prolonged and patients need significant emotional support [24,32].

Critical nursing considerations include the following issues [24]:
- Nurses must meticulously monitor for signs of paralysis and other types of neurological compromise. These complications can occur quickly including respiratory compromise. Emergency respiratory equipment should be maintained at the patient’s bedside. Nurses must be prepared to assist in tracheotomy at the first signs of respiratory distress. Patients are placed on mechanical ventilation to maintain adequate ventilation.
- Vital signs and neurologic assessments are performed at regular intervals.
- Patients should be monitored for signs of fecal impaction that can occur with dehydration and lack of intestinal activity.
- Adequate fluid and nutritional intake must be facilitated.
- Good skin care is essential especially for patients who suffer from paralysis.
- High-top sneakers or a footboard are used to prevent footdrop.
- Patients are placed on contact precautions. Only nurses and other healthcare professionals who have been vaccinated against polio should provide patient care.
- All cases of polio must be reported to the public health department.

**Post-polio syndrome**

The majority of nurses in the U.S. are not likely to provide care for patients afflicted with polio. However, it is possible that they will encounter people dealing with post-polio syndrome.

Post-polio syndrome (PPS) is a neurological disorder that affects acute paralytic polio survivors many years after recovery from an initial acute attack of polio [33,34]. PPS is characterized by new and progressive muscular weakness, pain, and fatigue. Although rarely life-threatening, PPS can significantly interfere with a person’s ability to function independently. Some people experience only minor symptoms, while others develop serious muscle weakness and atrophy. Weakness of respiratory muscles can compromise breathing. Weakness in swallowing muscles puts the patient at risk for aspiration of food...
and liquids, and joint pain and generalized muscle weakness can significantly impair mobility [33].

Incidence and etiology

The precise incidence and prevalence of PPS is not known [33]. It is estimated that the incidence of PPS ranges from about 22 percent to 68 percent. Prevalence of PPS is estimated at 28.5 percent of all paralytic polio cases. Currently, about 1.6 million cases of PPS have been documented [34].

Some experts believe that if polio survivors are monitored long enough, 100 percent of them will develop some symptoms of PPS. Risk of developing PPS is significantly higher in females and in people who sustained significant, permanent impairment after having polio. Research shows that incidence of PPS peaks at 30-34 years after acute polio [34].

Post-polio syndrome alert! Incidence of PPS did not “vary with age at acute onset, acute severity, or level of physical activity after recovery” [34].

Diagnosis

Diagnosis is based on history and clinical manifestations. There are no laboratory tests specific for PPS, and symptoms vary among patients [33].

Diagnostic criteria for PPS are published by the March of Dimes and have been validated by a team of international experts [34]. These criteria are [33,34]:

- Prior paralytic poliomyelitis with evidence of motor neuron loss. Motor neuron loss is confirmed by a history of acute paralytic polio, signs of residual weakness and atrophy of muscles on neuromuscular exam, and signs of motor neuron loss on electromyography (EMG). On rare occasions, some people present with PPS symptoms who have had only subtle paralytic polio with no obvious deficit. These patients should have their original polio diagnosis confirmed with an EMG study rather than simply a reported history.

- A period of partial or complete functional recovery after acute paralytic poliomyelitis followed by an interval (of usually 15 or more years) of stable neurologic function.

- Gradually progressive and persistent new muscle weakness or decreased endurance, with or without generalized fatigue, muscle atrophy, or muscle and joint pain. Sudden onset of PPS may follow a period of inactivity, trauma, or surgery. Less often, symptoms associated with PPS may lead to new problems with breathing or swallowing.

- Signs and symptoms must persist for at least one year.

- Other neurologic, medical, and/or orthopedic problems must be ruled out as causes of symptoms.

Treatment and nursing points

At this time, there are no effective pharmaceutical treatments that can stop or prevent deterioration or reverse the adverse effects of the syndrome. Focus is on identifying interventions that reduce symptoms and improve quality of life. Several controlled research studies have shown that non-fatiguing exercises may improve muscle strength and reduce fatigue [33].

National Institutes of Health (NIH) researchers have tried treating PPS patients with high doses of prednisone. Although patients demonstrated mild improvement, results were not statistically significant, and the side effects of steroid treatment outweighed the benefits. Therefore, it was determined that steroid therapy should not be used to treat PPS [33].

Additional treatment options under investigation include [33]:

- Preliminary studies suggest that intravenous immunoglobulin may reduce pain and improve quality of life.

- A small trial that used the anticonvulsant lamotrigine to treat fatigue showed modest effects. However, larger, more controlled studies are needed in order to validate these findings.

Recommended PPS management strategies include [33,34]:

- Exercise under the supervision of healthcare professionals who have experience in PPS syndrome. Exercise must be carefully prescribed and meticulously monitored, and it is most likely to benefit muscle groups that were least affected by polio. Exercise prescriptions should address the specific muscle groups to include; groups to exclude; and the type of exercise, its frequency, and its duration.

- Cardiopulmonary endurance training is usually more beneficial than strengthening exercises. Frequent breaks should be implemented and energy conservation techniques utilized. Intense resistive exercises and weight-lifting may cause damage and can further weaken rather than strengthen affected muscles.

- Patients with PPS may benefit from joining support groups that encourage self-help strategies and positive recommendations.

PPS alert! Exercise should be reduced or discontinued if it leads to additional weakness, fatigue, or excessive recovery time from the effects of exercising. Muscles should not be exercised to the point of causing pain, fatigue, or weakness. All exercise programs must be monitored by experienced healthcare professionals [33].

There is no known way to prevent PPS. Polio survivors should take steps to live a healthy lifestyle, such as eating a well-balanced, nutritional diet; getting plenty of rest; avoiding smoking; using prescribed assistive devices; and following a medically prescribed exercise program. Taking anti-inflammatory medications under the supervision of a physician may help reduce PPS symptoms [33].

Pertussis

July 26, 2014 from The San Diego Voice & Viewpoint: “Pertussis (whooping cough) cases in San Diego County number nearly 900 for the year according to the San Diego County Health and Human Services agency. Nine new cases of the disease were confirmed this week in which the public may have been exposed.” “The county and the state are experiencing an epidemic of pertussis,” said Wilma J. Wooten, M.D., M.P.H., county public health officer. Infants are at greater risk for severe illness and death from pertussis, so we are...
Pertussis, commonly known as whooping cough, is an extremely contagious disease. Its effects can become serious, even deadly, especially in infants [36].

The incidence of whooping cough is believed to be increasing for two main reasons [37].
- The pertussis vaccine immunity received when vaccinated as a child has decreased, leaving most teenagers and adults susceptible to the disease during an outbreak.
- Children are not fully immune until they have received at least three injections. This means that infants who are six months old or younger at highest risk for contracting the disease.

There are several forms of the vaccine used to prevent diphtheria, tetanus, and pertussis. Some forms are combined with vaccines to prevent other diseases and, thus, reduce the number of injections received at one time [36].

In the U.S., DTaP is given to children younger than seven years of age to prevent diphtheria, tetanus, and pertussis. Children should receive five doses of this vaccine, one dose at each of the following ages: two, four, six, and 15 through 18 months, and four through six years [36]. The whooping cough booster vaccine for adolescents and adults is referred to as Tdap and protects against tetanus, diphtheria, and pertussis. Children and adolescents aged 11 through 18 should receive a single dose of Tdap. Td is a tetanus-diphtheria vaccine given to adolescents and adults as a booster shot every 10 years or after exposure to tetanus [36].

The CDC now recommends that pregnant women receive the pertussis vaccine for adolescents and adults (Tdap vaccine) during each pregnancy. Note that this replaces the original recommendation that pregnant women get the vaccine only if they had not received it previously. According to the CDC, the best time for pregnant women to receive the vaccine is between the 27th and 36th weeks of pregnancy [38].

The rationale for immunizing pregnant women is that protection will be transmitted to the infant. Since infants do not receive their first pertussis vaccine until they are two months old, the passage of antibodies to the disease from mother to baby provides some short-term protection against pertussis and its complications [38].

**Vaccination**

**Incidence and etiology**

Pertussis is caused by the non-motile, gram-negative coccobacillus called Bordetella pertussis (B. pertussis), and, less often, by related similar bacteria. Pertussis is characterized by a violent cough that becomes paroxysmal and usually ends in a high-pitched inspiratory “whooping” sound [24]. The disease is most severe in the elderly and in infants. Death in children less than one year of age is most often due to pneumonia and other complications of the disease [24].

Mortality from pertussis has been significantly reduced since the 1940s when immunizations became available, diagnosis was made more promptly, and vigorous treatment measures quickly initiated. Unfortunately, incidence of pertussis in the U.S. is increasing. The CDC continues to advocate for immunizations therapy among infants and children, pregnant women, and booster shots for adults [24,36].

Pertussis is transmitted via direct inhalation of contaminated respiratory droplets and indirectly from contact with soiled linen and other items contaminated by respiratory secretions [24, 37].

Pertussis is endemic throughout the world. It occurs most often in the late winter and early spring. About half of the reported cases of the disease occur in unimmunized children less than one year of age.

**Pathophysiology and signs and symptoms**

The incubation period is about seven to 10 days, after which the bacteria enter the trachea-bronchial mucosa. Pertussis follows a characteristic six-week course that includes three stages: catarrhal, paroxysmal, and convalescent. Each of these stages lasts about two weeks [24,39]. The disease is most communicable just before the catarrhal stage to three weeks after onset of the paroxysms or until coughing has stopped [39].

**Stage I: Catarrhal stage**

During the first stage of pertussis, symptoms are generally mild and resemble a common cold that lasts from one to two weeks [37]. Signs and symptoms of the catarrhal stage include [24, 37, 39].
- Anorexia.
- Dry, hacking cough that is often worse at night.
- Infected conjunctiva
- Low-grade fever.
- Nasal congestion.
- Red, watery eyes.
- Sneezing.

**Pertussis alert!** The catarrhal stage is highly communicable [24]!
Stage II: Paroxysmal stage

After about seven to 14 days, the paroxysmal stage begins. This stage is characterized by the accumulation of thick mucus that accumulates in the airways, leading to uncontrolled coughing and lasts for two to four weeks or longer [24,37,39]. The paroxysmal cough is characteristic of the disease and ends in a loud, crowing inspiratory whoop [24].

**Pertussis alert!** Not every patient with pertussis has a cough that causes paroxysms and the whooping sound. This is especially true for patients who have partial immunization to the disease. Therefore, every patient with a persistent cough should be evaluated for pertussis [24].

Sometimes, coughing is so severe and prolonged that the following clinical manifestations may be evident [24, 37, 39]:

- Atelectasis.
- Bruised or cracked ribs.
- Conjunctival hemorrhage.
- Detached retina that may lead to blindness.
- Epistaxis (nose bleed).

Stage II: Convalescent stage

The convalescent stage can last for two weeks to several months. Paroxysmal coughing gradually subsides. However, such coughing may reoccur with respiratory infections [39]. For months afterward, even slight respiratory infections may cause the patient to develop paroxysmal coughing [24]. In some patients, the convalescent stage may last as long as two years [39].

Diagnosis

Classic clinical manifestations and history suggest a diagnosis of pertussis. Tests that can confirm the diagnosis include the following [37]:

- Nose or throat culture: A nose, throat, or suction sample is obtained and cultured.
- WBC count: Although not specific for pertussis, an elevated white blood cell count suggests infection or inflammation.
- Chest x-ray: A chest x-ray may be performed to assess for pneumonia or fluid in the lungs.

Treatment

Treatment consists of vigorous supportive therapy, including fluid and electrolyte replacement, especially for infants who are generally hospitalized in the intensive care unit [24,37]. Older children and adults usually receive treatment at home. Additional treatment measures include [24,39]:

- Administration of antipyretics.
- Administration of antibiotics such as erythromycin, azithromycin, or clarithromycin to prevent secondary infections.
- Administration of mild sedation and codeine to reduce coughing.
- Administration of oxygen therapy as needed.

**Pertussis alert!** Erythromycin should be administered to all close and household contacts for 14 days [39].

Nursing concerns

There are a number of nursing concerns associated with pertussis. Although most older children and adults are treated at home, they (and their families) need to know how to facilitate recovery. Infants are usually hospitalized [24, 39].

- Droplet precautions (surgical masks only) should be in place for five to seven days after antibiotic therapy has been initiated. The wearing of masks for family/household members depends on the likelihood of transmission, the immune status of members of the household, and the health of people in close contact with the patient.
- The environment should be as quiet and calm as possible. Stressors should be reduced as much as possible. These interventions should help to reduce coughing.
- Since codeine contributes to the occurrence of nausea and constipation, patients should be observed for both. Patients should eat small, frequent meals to facilitate nutritional intake in the presence of anorexia, nausea, and paroxysmal coughing. Fluids and an adequate diet can help reduce constipation. If constipation becomes significant, laxatives may be administered.
- Infants may need suctioning, which should be gently performed. During suctioning, patients must be carefully monitored for respiratory distress, since suctioning removes oxygen while removing secretions.
- Soiled linens should be changed as often as needed and as soon as possible after contamination.
- Waste containers for the disposal of tissues and other disposable items that have been contaminated by respiratory droplets should be within easy reach and emptied often.
- Suction bottles should be emptied at least once a shift or more often if necessary to decrease exposure to contaminated contents.
- All cases of pertussis must be reported to public officials as soon as possible.

Family members, work colleagues, friends, day care personnel, and others who have had close contact with the patient should have their immune status evaluated. All close contacts should receive antibiotic therapy for two weeks [24,39]. The parents of infants with whooping cough need emotional support, since infants generally become quite ill. Nurses should ensure that parents receive accurate information about the pertussis vaccine and other vaccines available for the prevention of vaccine-preventable diseases.
DIPHTHERIA

Incidence

Diphtheria is an acute, toxin-mediated, upper respiratory infection caused by Corynebacterium diphtheriae [40,41]. Nontoxic strains also cause disease, which is usually mild [41]. Once a major cause of illness and death in children, diphtheria caused 15,520 deaths (out of 206,000 reported cases) in 1921. Fortunately, thanks to successful vaccination initiatives that began in the 1920s, the incidence of diphtheria decreased rapidly in the U.S. and other countries that implemented vaccination programs [42].

There have not been any reported cases of respiratory diphtheria in the U.S. since 2004 [24]. However, the disease continues to affect citizens of multiple other countries. In 2011, 4,887 cases of the disease were reported worldwide to the WHO. This statistic may not be completely accurate, since it is believed that many cases of diphtheria go unreported [42].

Prior to the development of effective treatment, diphtheria was fatal in up to 50 percent of reported cases. Currently, the overall case-fatality rate for diphtheria is 5 to 10 percent. Higher fatality rates of up to 20 percent are reported in children younger than five years of age and in adults over the age of 40 [42].

Vaccination

The vaccine options used to prevent diphtheria include protection against tetanus and pertussis as well. Children should receive five doses of the diphtheria, tetanus toxoids, and acellular pertussis (DTaP) vaccine, one dose at each of the following ages [43]:
- Two months.
- Four months.
- Six months.
- 15 through 18 months.
- Four through six years.

**Diphtheria alert!** DTaP vaccine may be administered at the same time as other vaccines [43].

Transmission and pathophysiology

Diphtheria is transmitted through intimate contact, by direct contact with contaminated articles and the environment [24,39]. Asymptomatic carriers, currently sick people, and convalescing patients may transmit the disease [24].

**Diphtheria alert!** Significantly more people carry diphtheria than develop active infection [24].

Although diphtheria can occur throughout the year, it is most prevalent during autumn and winter because people are indoors more during these times and close person-to-person contact is more likely [24,39]. The incubation period of diphtheria is about two to four days.

**Clinical manifestations**

There are several forms of diphtheria, the most common being tonsillar and pharyngeal diphtheria.

**Diphtheria alert!** Attempts to remove the membrane that develops with the disease usually cause bleeding, which is characteristic of the disease [24].

Tonsillar and pharyngeal diphtheria

This form of diphtheria usually begins with a sore throat. Fever, if it occurs, is usually less than 102 degrees Fahrenheit [41]. Patients may experience general malaise, anorexia, and headache, but these are not prominent characteristics of the disease [39,41].

More characteristic symptoms include the following clinical manifestations [24,39,41]:
- Formation of a patchy, thick, grayish-green membrane over the mucus membranes of the pharyngeal walls, tonsils, uvula, and soft palate. The membrane may extend to the larynx and trachea. This can cause airway obstruction and even suffocation.
- Swelling and edema of the tissues of the throat and neck. Edema of the neck may become so severe that a characteristic “bull-neck” appearance develops. Patients may throw back their heads to relieve pressure on the throat and larynx.
- Development of edema associated with pharyngeal diphtheria. It obliterates the angle of the jaw, the borders of the sternocleidomastoid muscle, and the medical border of the clavicles.
- Paralysis of the muscles of the palate, which makes it difficult to swallow.
- Development of lymphadenopathy. Fever and rapid pulse may also develop.

**Diphtheria alert!** The extent of the disease correlates with significant prostration, presence of bull neck, and airway compromise [41].

Neurological complications correspond to the extent of the primary infection. These include [24,41]:
- Paralysis of the soft palate.
- Weakness of facial, laryngeal, and pharyngeal nerves, which makes it difficult to swallow, thereby increasing the risk of aspiration. Such weakness also makes the voice sound harsh, with an accompanying nasal quality.
● Development of cranial neuropathies during the fifth week of infection. This can cause blurred vision, strabismus, and compromised visual accommodation.
● Development of motor function deficit and diminished deep tendon reflexes.

Diphtheria alert! Paralysis of the diaphragm can occur, seriously compromising respiratory status and leading to respiratory arrest [24,39,41].

Laryngeal and nasal diphtheria

Signs and symptoms of laryngeal and nasal diphtheria include [39,41]:
● Low grade fever.
● Stridor.
● Barking cough.
● Hoarseness that can progress to loss of voice.
● Whitish-gray membrane over nasal septum.

Diphtheria alert! Laryngeal and nasal diphtheria occurs most commonly in infants [41].

Cutaneous diphtheria

Cutaneous (affecting the skin) diphtheria may occur at one or multiple sites. It is generally localized to areas of the skin that have sustained mild trauma [41]. Clinical manifestations include [24,41]:
● Pain, erythema, and exudate at the infection site.
● Ulceration develops. Lesions have clearly defined borders with a brownish-gray membrane.

The extremities are the most likely sites of infection. Cutaneous diphtheria may linger for weeks to months [41].

Diphtheria alert! Diphtheria infections have also been found in the eyes, ears, and genital mucosa [39,41].

Complications

A number of complications associated with diphtheria include [24]:
● Cardiac compromise.
● Gastritis.
● Hepatic compromise such as hepatitis.
● Myocarditis.

Diphtheria alert! Neurologic compromise.
● Paralysis.
● Renal involvement such as nephritis.
● Thrombocytopenia.

Diagnosis

Diagnosis is made based on the characteristic membrane and a culture of the throat or other suspected lesions for Corynebacterium diphtheria [24].

Treatment and nursing considerations

People who have probable or confirmed diphtheria are eligible to receive diphtheria antitoxin (DAT), intramuscularly or intravenously, which is the mainstay of treatment [40,41].

DAT neutralizes free toxin only. It is not recommended for asymptomatic carriers. Asymptomatic carriers receive the following interventions [41]:
● A seven- to 10-day course of prophylactic anti-microbial therapy.
● An age-appropriate form of diphtheria toxoid if the person has not received a booster within one year.
● Placement in respiratory or contact isolation (for cutaneous findings) until at least two subsequent cultures taken 24 hours apart after therapy has stopped are negative.
● Repeat cultures are taken at a minimum of two weeks after therapy is completed. If results are positive, a 10-day course of oral erythromycin is initiated.

Diphtheria alert! Antimicrobial agents do not eliminate carrier status in 100 percent of carriers [41]!

In addition to DAT, symptomatic patients with diagnosed diphtheria receive the following treatment interventions [24,39,41]:
● Antibiotic therapy (penicillin, erythromycin) is administered to eliminate the organisms from the upper respiratory sites and other affected areas.
● Cardiac monitoring is performed.
● Respiratory support measures are initiated as needed.
● Bed rest may be initiated for two to three weeks.
● Hydration of the patient is a key consideration.

Diphtheria alert! Isolation with contact and droplet precautions until two to three consecutive nasopharyngeal cultures are negative at least one week after completion of drug therapy.
● Environment is maintained at high humidity, especially for laryngeal diphtheria patients.
● All cases of diphtheria must be reported to the public health department.

Diphtheria alert! People who have had close contact with patients diagnosed with diphtheria should receive an age-appropriate diphtheria toxoid booster [42].

Patients must be monitored for signs of shock, which can develop abruptly. They must be constantly monitored for respiratory distress, and equipment for immediate life support, such as intubation and tracheotomy, must be kept near the bedside.

Diphtheria alert! Nurses must monitor patients for signs of myocarditis, such as electrocardiogram changes and heart murmurs. Additionally, it is important for nurses to know that a common cause of sudden death in patients with diphtheria is ventricular fibrillation [24].

Prevention through proper immunization is the best practice. Nurses should teach patients of all ages about the need for not only age-appropriate childhood immunization but for adolescent and adult immunization as well. Protective immunity does not last more than 10 years after the last vaccination. Therefore, people should receive a booster every 10 years [24].
Tetanus

Jason is a 55-year-old farmer in a rather isolated rural area. His family has farmed the same land for generations, and he is proud of this heritage. Jason enjoys excellent health and has not had any preventive healthcare in many years. In fact, the last time Jason saw a healthcare provider was when he broke his arm over 10 years ago. One day, while working in the fields of his farm, he sustains a puncture wound by stepping on a nail on the property. He thinks little of it and pauses in his work only long enough to wash the wound with soap and water. About 10 days later, he begins to suffer from painful spasms of his neck and facial muscles, and his back is becoming rigid. Jason doesn’t feel “sick” and dismisses his wife’s concerns. He says that he works long hours and that the spasms are just a side effect of hard physical labor. However, the spasms grow worse, and eventually, Jason suffers a tonic seizure. His frightened wife calls an ambulance, and Jason is rushed to the closest hospital, a distance of nearly 30 miles. Upon arrival, emergency department staff members are puzzled by his symptoms. In addition to the sever muscle spasms, Jason has a low-grade fever and is diaphoretic. His electrocardiogram is normal as are his cardiac enzymes. Jason insists he has not been sick and that nothing unusual has happened to cause his symptoms. It takes hours of questioning to finally find out that Jason sustained a puncture wound 10 days ago, a wound that Jason dismisses as “nothing.” After learning that Jason has not had any immunizations in decades, the concerned hospital personnel suspect that Jason has tetanus.

Tetanus, commonly referred to as “lockjaw,” is an acute exotoxin-mediated infection characterized by generalized, rigidity and convulsive skeletal muscle spasms [24, 45]. In People who have not been immunized, tetanus is fatal in up to 60 percent of patients within 10 days of onset. Prognosis is poor when signs and symptoms develop within three days of exposure [24].

Vaccination

Tetanus is almost completely preventable through immunization [45]. Unless contraindi cated, a single dose of combination vaccine to prevent tetanus, diphtheria, and pertussis is given to children at each of the following ages: two, four, six, and 15-18 months, and four to six years [46].

Incidence, etiology, and pathophysiology

Tetanus is caused by the spore forming, gram-positive bacillus called Clostridium tetani. The infection is generally systemic, but can also, less frequently, be localized [24]. Clostridium tetani spores are the dormant form of the organism and are found in soil, dust, or animal or human feces [24, 45].

The spores enter the body through breaks in the skin that occur from puncture wounds, lacerations, or burns [24]. The spores germinate under low oxygen conditions. The spores produce a potent toxin tetanospsamin that is absorbed into the patient’s bloodstream and lymphatic system and eventually reaches the tissue of the central nervous system (CNS). Puncture wounds and wounds that cause a considerable amount of tissue injury are most likely to facilitate germination [24,25]. Tetanus is not transmitted from person to person [45].

Tetanus alert! When the toxin reaches the CNS, painful and frequently violent muscular contractions occur [45].

In the U.S., the incidence of tetanus has declined steadily since the early 1990s. In 2009, a total of 19 cases of tetanus and two fatalities were reported to the CDC’s national tetanus surveillance system [45].

Several factors have contributed to the decrease incidence of the disease, including [45]:

- Effective immunization programs for the prevention of tetanus.
- Improved management of wounds, lacerations, and burns.
- Prophylactic treatment of wounds and burns.
- Increased movement of the population from rural to urban areas, thereby decreasing exposure to tetanus spores.

Tetanus alert! Tetanus can be almost completely prevented through immunization [45]. Nearly all cases of tetanus occur in unimmunized people or in those who have not had a tetanus booster shot within the past 10 years [24].

Although tetanus occurs throughout the world, it is most often found in agricultural regions and in developing countries that do not have aggressive immunization programs. In the U.S., approximately 75 percent of tetanus cases occur between the months of April and September [24].

Tetanus alert! In developing countries where mothers have not been immunized, babies may be delivered in unsterile environments. Under these conditions, spores can enter through the unhealed umbilical cord [24].

Complications

A number of complications are associated with tetanus and include the following problems [24,39]:

- Death. (Tetanus has a high fatality rate, as high as 90 percent in infants and the elderly).
- Acute gastric ulcers.
- Atelectasis.
- Bacterial shock.
- Cardiac arrest.
- Cardiac arrhythmias.
- Flexion contractures.
- Pneumonia.
- Pulmonary edema.
- Pulmonary emboli.
- Seizures.

Clinical manifestations

The incubation period for tetanus ranges from three to 21 days, with an average of 10 days. However, the range of incubation can be as little as one day or as long as several months [39].

Tetanus alert! In general, the shorter the incubation period, the more severe the disease [39].

If tetanus is localized, signs of onset of the disease are spasms and increased muscle tone at the site of or near the wound [24]. Systemic tetanus is characterized by abdominal rigidity, painful, involuntary muscle contractions, especially of the masseter and neck muscles, and generalized spasms that are often triggered by sensory stimuli [39]. Other signs include muscle hypertonicity, hyperactive deep tendon reflexes, profuse diaphoresis, tachycardia, and low-grade fever [24].
Additional characteristics of presenting signs and symptoms of tetanus include the following manifestations [24,39]:

- The neck and facial muscles (especially those of the cheek) are prominently affected. Spasms cause trismus or “locked jaw,” thus providing the nickname for tetanus (“lock jaw”). Patients have difficulty opening their mouths and develop a facial expression that resembles a bizarre, distorted grin (sardonicus) caused by facial muscle spasm.
- A characteristic rigid arching of the trunk of the body (opisthotonos) occurs and severe abdominal rigidity.

Diagnosis

There is no detectable antibody response, and the pathologic organism is seldom obtained from the site of infection [39]. In fact, only about 33 percent of patients have a positive wound culture. Therefore, diagnosis is based on patient history, lack of tetanus immunization, and clinical signs and symptoms [24,39].

Treatment and nursing considerations

The best treatment strategy for tetanus is prevention through age-appropriate immunization. If and when a patient sustains a wound, the following initial steps should be taken to help prevent tetanus and other infections [24,39]:

- Rinse the wound thoroughly with clean water. Then, clean the wound (and the area around it) with soap, water, and a washcloth. If dirt or other foreign material is imbedded in the wound, patients should seek medical attention. Patients should consult with their healthcare providers if the wound is particularly dirty, deep, or due to the bite of an animal.
- After cleaning the wound, apply antibiotic cream or ointment such as a form of Neosporin or Polysporin.
- Cover the wound with clean bandages. Cover blisters that are draining as well. Patients change the dressing at least once daily or whenever the dressing becomes dirty or wet.

*Tetanus alert! Patients should keep a written record of their immunization status so that in the event of sustaining a wound or animal bite, they can inform healthcare providers of the last date of tetanus vaccination [24,39].*

Nurses should implement the following actions within 72 hours of sustaining a puncture wound [24,39]:

- If the patient has no previous history of receiving tetanus immunization, tetanus immune globulin (TIG), or tetanus antitoxin is administered. This counteracts toxins and offers temporary protection against the disease. After administration of TIG or antitoxin, tetanus toxoid is given.
- In patients with a history of immunization but who have not received tetanus booster injection within 10 years, a booster injection of tetanus toxoid is administered.

**Tetanus alert!** When considering a diagnosis of tetanus, healthcare professionals must rule out other diseases that mimic tetanus. Examples of such diseases include meningitis, rabies, and drug toxicity [24].

Additional nursing considerations include the following initiatives [24, 39]:

- Maintain the airway. Tracheostomy and mechanical ventilation may be necessary. Emergency equipment for the performance of tracheostomy should be at the bedside.
- Administer muscle relaxants such as diazepam to decrease muscle spasms and rigidity. If muscle relaxants fail to reduce spasms and rigidity, a neuromuscular blocker may be administered.
- Intravenously administer high doses of antibiotics such as penicillin, clindamycin erythromycin, or metronidazole.
- Surgically explore and debride the wound to identify the source of the toxin, remove it, and destroy it.

**Tetanus alert!** Exposure to tetanus does not provide immunity. It is imperative that people follow immunization guidelines for initial vaccination and booster injections to prevent the disease [24].

Additional nursing considerations include the following initiatives [24,39]:

- Teach patients and families about the importance of tetanus immunization for children and the need for a tetanus booster every 10 years for adolescents and adults.
- Keep the environment calm and quiet with a minimum of visual and auditory stimuli since even the most minor of stimuli can trigger spasms. Caution visitors not to upset the patient or increase the amount of stimuli in the room. Keep the patient’s room dimly lit.
- Maintain a patent intravenous line.
- Facilitate adequate nutritional intake. Patients may not be able to tolerate oral intake. In this case, nurses should initiate nasogastric feedings or administer total parenteral nutrition.

Influenza

February 10, 1967: “Breakthrough by Du Pont: A Drug that Blocks Viruses.” “Only last year, when a model of the flu virus appeared on Life’s cover, there existed no pill or capsule a doctor could prescribe to combat it, or, for that matter, any other virus. But a fascinating new drug called Symmetrel is just going on the market and will forever change the situation. Because of it, the flu virus—at least the dreaded A2 variety popularly known as Asian flu—has lost its supreme chemical invulnerability, offering hope that other virus enemies will soon lose theirs [47, p 60A].”

The preceding excerpt from the February 10, 1967 issue of Life Magazine shows how the quest for agents to combat influenza has progressed. In 1967, Symmetrel was considered a break-through drug in the fight against the disease.

Today, the generic form of Symmetrel, amantadine, is used as an anti-Parkinson agent. For the past several years, the CDC has advised physicians not to use amantadine to treat or prevent influenza, since it has not shown to effectively prevent most types of influenza virus [48, 49]. However, in 1967 the drug was one of the starting points for antiviral drug investigation and is still prescribed by some physicians as an anti-viral agent to treat influenza today [24,39].
Vaccination

The most effective way to treat influenza, or the “flu” as it is commonly known, is to prevent it through an annual vaccination for the specific strain(s) predicted to cause the disease in a given year.

Recent research emphasizes the importance of vaccinating healthcare personnel as a means of reducing the spread of influenza. Research findings indicate that for every 15 healthcare providers who get vaccinated, one fewer person in the community will contract an influenza-like illness. Findings such as these have led some healthcare organizations to mandate that employees receive vaccination as a condition of employment [50].

However, mandating flu vaccination has created some controversy among healthcare professionals. Some employees refused on religious or medical grounds, while others objected to having to receive a mandatory vaccination they did not want [51].

One of the first healthcare organizations to mandate flu vaccination for all employees was Loyola University Medical Center, where a four-year study of the mandatory flu immunization program found that the program did not lead to excessive voluntary termination. During the first year of the program (2009-2010 flu season), 99.2 percent of employees were vaccinated, 0.7 percent were exempted for religious/medical reasons, and 0.1 percent refused vaccination and chose to terminate employment. The results have remained fairly consistent, with 98.7 percent of employees vaccinated in 2012, 1.2 percent were exempted, and 0.06 refused vaccination. Over a four-year time period, less than 15 staff members (including volunteers) out of about 8,000 total employees chose termination over vaccination [51].

Johns Hopkins is another healthcare organization mandating influenza vaccination for all employees. The policy regarding mandatory influenza vaccination delineates who must comply, the rationale for mandating vaccination, and how to apply, in writing, for a medical or religious exemption. The policy also clearly explains the consequences of failing to comply with the mandate [52].

Many experts agree that whether or not a healthcare organization chooses to mandate vaccination, it is still the organization’s responsibility to increase vaccination rates among employees [51].

The influenza vaccine generally contains three virus strains and changes annually, based on predictions of predominant strains that are expected to dominate the upcoming flu season. It is recommended that age-appropriate forms of the influenza vaccine be administered annually to people the age of six months and older unless medically contraindicated [24, 39].

Influenza alert! Live-attenuated influenza vaccine (LAIV) is now available as a nasal spray. It is approved for healthy people two to 49 years of age who are not pregnant [24].

Etiology and incidence

Influenza (also referred to as the flu, or the grippe) is an acute, extremely contagious viral infection of the respiratory tract. Influenza is caused by three different types of Myxovirus influenzae. Influenza occurs sporadically throughout the year or in epidemics, usually during the colder months [24]. The disease is usually self-limiting [39].

People of all ages contract influenza, but the incidence is highest in school-age children. Influenza is most severe and most often leads to complications in young children, the elderly, and those who suffer from chronic diseases [24, 52].

Influenza alert! Influenza can be serious and even fatal. For example, the pandemic of 1918 led to about 20 million deaths. The most recent pandemics began in mainland China and occurred in 1957, 1968, and 1977 [24].

Influenza is transmitted directly through inhalation of infected respiratory droplets and/or indirectly via contact with an object contaminated by respiratory secretions such as a drinking glass or article of clothing [24,53].

Tens of millions of people in the U.S. get the flu annually. An estimated 114,000 affected people are hospitalized, and about 36,000 die [24].

Risk factors

Certain factors increase a person’s risk for contracting influenza or developing complications. These include the following issues [24,53]:

- Age: The people most often affected by seasonal influenza are young children and people over the age of 65. However, occasionally, strains of the virus may target other groups. For example, The H1N1 virus responsible for the pandemic of 2009 targeted teenagers and young adults.
- Chronic Illnesses: Chronic health problems such as cardiovascular disease, diabetes, or COPD increase the risk of complications of influenza.
- Compromised Immune System: People whose immune systems are compromised due to treatment for cancer, having HIV/AIDS, or taking anti-rejection drugs or corticosteroids are at higher risk for the development of influenza and for suffering from its complications.
- Environment/Living Conditions: People who live in close contact with others, such as residents in long-term care facilities or soldiers in barracks, are at higher risk for contracting influenza.
- Occupations: Healthcare workers and people who work with children (e.g. day care personnel, teachers) are at a higher risk of contracting influenza.
- Pregnancy: Women who are pregnant are more likely to develop complications of influenza, especially in their second and third trimesters.

Complications

Influenza can cause a number of complications, including the following [24, 53]:

- Bronchitis.
- Ear infections.
- Encephalitis.
- Exacerbation of chronic obstructive pulmonary disease (COPD).
- Myocarditis (rare).
- Pericarditis (rare).
- Pneumonia (the most common complication).
- Reye’s syndrome.
- Sinus infections.
Pathophysiology

The influenza virus causes disease by invading the epithelium of the respiratory tract where it causes inflammation and desquamation. The virus is classified into one of three categories [24,39].
- Type A: Most common type of influenza virus. It occurs every year with various new serotypes that cause epidemics every three years.
- Type B: Occurs annually and is the cause of epidemics only every four to six years.
- Type C: Is endemic and is the cause of only sporadic outbreaks.

The influenza virus multiplies within the respiratory system as follows [24,39]:
- The influenza virus contains RNA that is covered and protected by a layer of protein. The RNA carries the code for viral replication. The virus's genetic material has an astonishing ability to mutate, leading to various new viral strains.
- Influenza alert! The influenza virus has an amazing ability to alter its genetic makeup into multiple distinct strains. This allows such strains to infect new populations that have minimal, if any, immunity to the new virus [24].

Clinical manifestations

After an incubation period of one to three days, there is an abrupt onset of symptoms that include [24,39]:
- Chills.
- Conjunctivitis.
- Fatigue.
- Fever of 101 to 104 degrees Fahrenheit.
- Headache.
- Hoarseness.
- Laryngitis.
- Malaise.
- Myalgia (especially predominant in the limbs and in the back).

Diagnosis

Generally, diagnosis requires only a patient history, physical assessment, and the presence of signs and symptoms. The diagnosis may be confirmed by isolating the virus from pharyngeal or nasal secretions or identifying viral antigens in nasopharyngeal cells by fluorescent antibody test, known as the enzyme-linked immunosorbent assay, or ELISA [39].

Treatment and nursing concerns

Treatment of uncomplicated influenza consists largely of supportive measures, such as [24, 53]:
- Over-the-counter age-appropriate medicines to reduce fever and relieved aches and pains, such as acetaminophen (e.g. Tylenol), aspirin, or ibuprofen (e.g. Advil, Motrin IB).
- Cough medicines (antitussives) to relieve non-productive coughing.
- Rest and sleep to help the immune system combat the infection.
- Increase fluid intake to help prevent dehydration and reduce fever. Avoid fluids with caffeine, which may make it difficult to sleep.
- Cases of the flu should be reported to the public health department.

Influenza alert! Aspirin should not be given to children or teenagers because of the risk for the development of Reye’s syndrome [24,53].

Antiviral agents may be prescribed to reduce the duration of signs and symptoms associated with influenza infection. According to the CDC, influenza antiviral medications can be used to treat influenza or to prevent influenza. The CDC recommendations for the 2013/2014 flu season included the following information [54]:
- Two Food and Drug Administration FDA-approved influenza antiviral medications recommended for the 2013-2014 influenza season include: oral oseltamivir (Tamiflu®) and inhaled zanamivir (Relenza® ). These drugs are chemically related antiviral medications that are used to treat both influenza A and B viruses.
- Amantadine and rimantadine are antiviral drugs in a class of drugs known as adamantanes. These are active against influenza A viruses but not against influenza B viruses. In the past several “flu” seasons, there has been a high prevalence of influenza A viruses that are resistant to adamantanes. Thus, the CDC is not recommending these drugs for antiviral treatment of prophylaxis of currently circulating influenza A viruses.

Since most uncomplicated cases of influenza do not require hospitalization, nurses should teach patients and family members about the supportive measures described above. They should also advise that friends and family who do not live in the home with the patient avoid visits to prevent spread of the disease and to protect the patient from acquiring additional infections from such visitors [24].

In addition, healthcare professionals should encourage patients and family members to wash their hands frequently, especially after touching potentially contaminated articles such as telephones, bedclothes, and tissues [24,53]. Healthcare professionals should teach patients and their family members to recognize the signs and symptoms of complications and what action to take if they occur. The recommendations for influenza vaccination should be explained. Recommendations from the CDC include [24]:
- People six months of age and older should receive an annual flu vaccine.
- People at high risk for serious complications of influenza such as young children, people older than 65, individuals with chronic health conditions, and pregnant women should receive an annual flu vaccine.

Influenza alert! Fever that lasts longer than three to five days indicates the onset of complications [24].
● Those who care for children younger than six months of age should be vaccinated, because these infants are at high risk for serious forms of the disease. In addition, transmission of the disease from unvaccinated people to children is a significant risk.

**Prevention**

The best preventive strategy against influenza is appropriate vaccination. However, since not everyone with whom vaccinated people come into contact has been immunized, good hygiene measures should be implemented to help reduce the spread of influenza and other communicable diseases [53].

● Frequent, thorough hand-washing has proven to be the best way to prevent the transmission of many communicable diseases. Individuals should wash their hands vigorously for at least 15 seconds. If soap and water are not available, they should use an alcohol-based hand sanitizer.

● People should cover their mouths and noses with a tissue, dispose of contaminated tissues in a covered trash container, and wash their hands with soap and water or alcohol-based hand sanitizers.

● During peak flu season, individuals should avoid crowds as much as possible to reduce chances of infection.

**Measles (Rubeola)**

The U.S. is currently (summer 2014) experiencing a record number of measles cases. From January 1, 2014 to July 3, 2014, there have been 554 confirmed cases of measles reported to the CDC’s National Center for Immunization and Respiratory Diseases (NCIRD). This is the highest number of cases since “measles elimination” began documentation in 2000 [55].

Why the resurgence in measles (rubeola) in the U.S.? Experts say that the current problem began with unvaccinated people who traveled overseas. Although the CDC in 2000 declared that the U.S. had eliminated measles as an indigenous (no longer year-round endemic transmission of the virus) disease, it is still subject to measles outbreaks [56].

For example, experts believe that the current epidemic began with unvaccinated people who traveled overseas. The first cases of measles were brought into this country initially by people who traveled to one of 18 countries where measles is still quite prevalent, including some countries in Europe, the Pacific, and Asia [55]. In fact, the country with the most prominent incidence of measles is the Philippines. During 2013, there were 32,000 cases of measles in that country and 41 disease-related deaths. [57].

In some cases, unvaccinated people visit countries where measles is prevalent, acquire the disease, and, upon returning to the U.S., begin to spread the disease among other groups of unvaccinated people. Evaluation of these patients who acquired the disease while outside the U.S. showed that 90 percent were unvaccinated. All of these unvaccinated people were unvaccinated because of philosophical or religious reasons. No one had refused to be vaccinated due to medical reasons [57].

Experts recommend that Americans with international travel plans receive two doses of the measles, mumps, and rubella (MMR) vaccine if they have not been vaccinated or if they do not know their immunization status. Pregnant females and people with suppressed immune systems should not receive the vaccine [56].

**Vaccination**

Vaccination is recommended for the prevention and transmission of measles. Guidelines (as of this writing) include these important factors [24,39].

● Measles vaccine is usually administered between 12 and 15 months. However, in high-risk areas, the vaccine should be given at 12 months. During an epidemic, infants as young as six months may receive the vaccine and then be re-immunized at the age of 15 months, with the second dose given between four and six years of age. Another option for infants between the ages of six and 15 months who are likely to be exposed to measles is for them to receive gamma globulin.

● A second dose of measles vaccine is recommended between ages four and six years.

● It should be determined, whenever possible, if patients have any allergies, especially allergies to neomycin, since each dose contains a small amount of the drug. Patients who are allergic to eggs may receive the vaccine because it contains only minimal amounts of albumin and yolk components.

● Pregnant females should not receive the measles vaccine. Females should not become pregnant for at least three months after receiving the vaccine.

● Those who care for children younger than six months of age should be vaccinated, because these infants are at high risk for serious disease-related deaths. [57].

**Etiology and incidence**

Measles (rubeola) is an acute, extremely contagious disease caused by the paramyxovirus. It is one of the most common, as well as one of the most serious, communicable childhood diseases [24]. In 2013, there were 20 million reported cases of measles throughout the world that resulted in 122,000 deaths [57]. Prior to effective immunization programs, epidemics occurred every two to five years in large urban areas [24]. Currently, in 2014, a record number (554) of cases of measles has been reported [55]. There are several reasons for this increase, including international travel by unvaccinated people, failure of children to receive the vaccine, and refusal of the vaccine due to religious and philosophical grounds [55,56,57].
Measles alert! The administration of measles vaccine has significantly reduced the occurrence of measles among children, but the disease is becoming more prevalent in adolescents and adults [24].

Complications

Measles can cause serious complications, including [24,39]:
- Appendicitis.
- Cervical adenitis.
- Encephalitis.
- Laryngitis.
- Mastoiditis.
- Otis media.
- Pneumonia.

Clinical manifestations

After an incubation period of between eight to 14 days, symptoms begin. The greatest communicability takes place during the prodromal phase, about 11 days after patients are exposed to the virus. The prodromal phase lasts from four to five days, and signs and symptoms may be mistaken for a severe cold or flu [24, 39]. They include [24, 39]:
- Fever.
- Lethargy.
- Photophobia.
- Malaise.
- Anorexia.
- Conjunctivitis.
- Coryza.
- Hoarseness.
- Hacking cough.

Diagnosis

Diagnosis of measles is generally made by the evaluation of presenting clinical manifestations, particularly the appearance of the characteristic Koplik’s spots. If it is deemed necessary, the measles virus may be isolated from the blood, urine, or nasopharyngeal secretions when the patient is in the febrile period.

Measles alert! When seeking to diagnose measles by the presence of serum antibodies, it is important to note that such antibodies appear three days after onset of the rash. Peak titers are reached two to four weeks later [24].

Treatment and nursing considerations

Measles alert! In the U.S., prognosis is usually excellent. However, measles remains a major cause of death in children living in underdeveloped countries [24].

Treatment focuses on relieving symptoms and monitoring for possible complications. Parents and other caregivers of people who develop measles should be taught the following supportive interventions [24, 39]:
- Encourage bed rest.
- Maintain a calm, quiet environment.
- Keep the room dark to reduce the discomfort of photophobia.
- Keep the room comfortably warm and initiate the use of a vaporizer to increase humidity and decrease respiratory irritation.
- Administer over-the-counter, age-appropriate medicines to reduce fever and relived aches and pains, such as acetaminophen (e.g. Tylenol) or ibuprofen (e.g. Advil, Motrin IB). Do not give aspirin to children or teenagers because of the risk for the development of Reye’s syndrome.
- Offer fluids frequently.
- Keep unvaccinated family members away from the patient.
- Prevent visitors from entering the patient’s environment to avoid transmitting the disease.
- Report all cases of measles to the public health department.

Sedation may be medically prescribed if necessary. Patients and caregivers must also be taught to recognize signs and symptoms of impending complications and to seek immediate medical help if they occur.

Mumps

Mumps, (also referred to as infectious or epidemic par otitis) is an acute viral disease that causes a painful enlargement of the parotid glands. The parotid glands are one of three pairs of salivary glands located below and in front of the ears. Mumps was quite common in the U.S. until the mumps vaccination became part of routine childhood immunization programs [58].

Vaccination

The mumps vaccine was licensed in 1967. It is usually given in combination with measles and rubella vaccine and is known as the MMR vaccine. Two doses of the vaccine are recommended: the first dose is administered at 12-15 months of age, and the second before entering school at four to six years of age [58,59].
It is recommended that anyone born during or after 1957 who has not had mumps or has not been vaccinated receive at least one dose of MMR. Two doses are recommended for adults at higher risk, including those who [58, 59]:
- Are students attending college, trade school, or other education facilities beyond high school.
- Work in healthcare facilities.
- Plan on traveling outside the U.S. or are passengers on a cruise ship.
- Are women of childbearing age.

People who do not need the vaccine include those who [58]:
- Have had two doses of MMR vaccine after 12 months of age or one dose of MMR plus a second dose of measles vaccine.
- Have had one dose of MMR and are not at high risk of exposure to measles or mumps.
- Have had blood test results that show immunity to measles, mumps, and rubella.
- Are women born before 1957.
- Are women born before 1957 and do not plan to have more children or who have already had the rubella vaccine or have a positive rubella test.

The vaccine is not recommended for the following [58]:
- Women who are pregnant or who plan to become pregnant within the next four weeks.
- People who have had a life-threatening reaction to gelatin or neomycin.
- People with compromised immune systems and/or those who take oral steroids unless the benefits of the vaccine surpass the risks.

The MMR vaccine is quite effective. However, immunity against mumps is not complete. Two doses of MMR are 88 percent effective at protecting against the disease. One dose of the vaccine is 78 percent effective. Thus, outbreaks can still occur, even in countries such as the U.S. where extensive vaccine efforts are in place. For example, in 2014, mumps outbreaks were reported in at least four U.S. universities [60].

Mumps is most prevalent in children between the ages of six and eight. It is seldom found in infants less than one year old because of passive immunity received from their mother’s antibodies to the disease. Mumps most often occurs during late winter and early spring [24].

**Incidence**

Fortunately, mumps is no longer common in the U.S. Only a few hundred cases are reported annually in this country. Prior to the initiation of the mumps vaccine program in 1967, about 186,000 cases were reported every year. Since the initiation of the MMR vaccine, the number of reported mumps cases in the U.S. decreased by more than 99 percent [60].

**Etiology and pathophysiology**

Mumps is caused by the paramyxovirus, which is found in the salivary glands of infected people. The virus is spread by direct contact or through airborne infected droplets, saliva, and, possibly, urine [39].

The virus is present in the patients’ saliva for six days before and up to nine days after the onset of parotid gland swelling. The period of greatest communicability is most likely the 48-hour period immediately before swelling begins [24, 39]. The incubation period of the disease ranges from 14 to 25 days, with an average of 18 days [24]. The concentration of virus in saliva is greatest just before and after swelling begins [39].

**Mumps alert! One attack of mumps almost always provides the patient with lifelong immunity. This is true even if the disease only affects salivary glands on one side of the face (unilateral) [24].**

**Complications**

Complications associated with mumps include [24, 39]:
- Arthritis.
- Encephalitis.
- Involvement of the auditory nerve that can cause unilateral deafness.
- Mumps meningitis.
- Myocarditis.
- Nephritis.
- Oophoritis.
- Pancreatitis.

**Mumps alert! Pregnant women who contract mumps are at risk for miscarriage, especially in the first trimester of their pregnancy [24].**

Epididymo-orchitis (inflammation of the testicles) may also occur. This produces abrupt onset of [24):
- Testicular swelling and tenderness.
- Erythema of the scrotum.
- Nausea and vomiting.
- Fever.
- Chills.
- Lower abdominal pain.

**Clinical manifestations**

The severity of presenting signs and symptoms varies significantly among patients. About 30 percent of people susceptible to the disease have a subclinical form of the illness or extremely mild symptoms [24, 58].

After an incubation period of about 18 days prodromal symptoms that last for about 24 hours become evident [24]. These include [24, 39, 58]:
- Anorexia.
- Malaise.
- Headache.
- Low grade fever.

These prodromal signs and symptoms are followed by earache that is exacerbated by swallowing or chewing, especially when drinking acidic or sour fluids. In addition, pain and swelling of the parotid glands, and a fever of 101 to 104 degrees Fahrenheit may accompany these symptoms. Other salivary glands, in addition to the parotid glands, may become swollen [24, 58].

Mumps meningitis is a complication that affects as many as 10 percent of patients and is three to five times more common in males compared to females [24]. Signs and symptoms of mumps meningitis include [24, 39]:
- Fever.
- Evidence of meningeal irritation, such as nuchal rigidity, headache, and irritability.
- Cerebrospinal fluid lymphocyte count of 500 to 2,000/ul.

Fortunately, most patients recover completely from mumps meningitis [24].
Diagnosis

Diagnosis is usually made based on history of exposure to the disease and characteristic presenting signs and symptoms, especially parotid gland enlargement. Diagnosis may be confirmed by isolating the virus from a throat swab culture [24, 39]. If there is uncertainty about the diagnosis, a blood specimen taken during the acute phase of the illness followed by another specimen obtained three weeks later shows a four-fold increase in antibody title, the patient has probably had mumps [24].

Treatment

Prognosis is good, although some patients do experience the previously mentioned complications [24]. Treatment consists of supportive measures, including [24,39]:

- Isolation (droplet precautions) for five days from symptoms onset and/or until the swelling of the parotid glands has subsided.
- Bed rest to promote adequate rest, sleep, and recovery.
- Adequate fluid intake to prevent dehydration. Note that in cases where patients are unable to swallow because of swelling and pain when chewing and swallowing, intravenous fluid replacement may be necessary.
- Warm salt water gargles to relieve pain.
- Soft, bland diet to avoid unnecessary discomfort when chewing and swallowing. Spicy, irritating foods (e.g. citrus juices) should be avoided.

Mumps alert! Immunization within 24 hours of exposure to mumps may prevent or reduce the severity of the disease. Immunity to mumps lasts about 12 years [24].

Healthcare professionals should teach parents and adult patients the importance of immunization. They should stress that immunization is the best way to prevent contraction and transmission of the disease.

Rubella (German 3-day measles)

Karen is 26 years old and in the first trimester of her first pregnancy. She and her husband are thrilled at the prospect of becoming parents. Today, she is looking forward to picking up her three-year-old niece Allison from day care. Karen loves spending time with her niece and eagerly anticipates the day when she will be spending time with her own child.

A few days later, Karen receives a call from her sister, who is obviously distressed. "Oh, Karen, I have some bad news. One of the children at the day care center has come down with German measles. They tell me the child was never vaccinated! Her parents received an exemption because of philosophical reasons. She was there the day you picked up Allison. You need to call your obstetrician right away! You’ve been exposed to German measles!"

Rubella, common referred to as German measles or three-day measles, is an acute, mildly contagious viral disease. It is usually self-limiting, considered to be a relatively mild illness, and seldom causes complications. However, the most serious form of the disease, congenital rubella syndrome, occurs when the disease is transmitted from a mother to the unborn child. Congenital rubella syndrome can lead to spontaneous abortion, stillborns, and multiple birth defects [24]. Therefore, appropriate vaccinations must be administered to prevent the transmission of the disease.

Vaccination

Children should receive two doses of MMR (measles, mumps, rubella) vaccine. The first dose should be given at 12-15 months of age, and the second dose administered at four to six years of age. These are the recommended ages, but children can receive the second dose at any age, as long as it is at least 28 days after the first dose [61].

Adults may need to be immunized, as well as children under certain circumstances. Adults do NOT need to receive the MMR vaccine if [61]:

- Blood tests show that the patient is immune to measles, mumps, and rubella.
- The patient is a male born before 1957.
- The patient is a female born before 1957 who is sure that she is not having more children, has already had rubella vaccine, or has had a positive rubella test.

Incidence and etiology

Rubella usually affects children ages five to nine, adolescents, and young adults [24]. Thanks to aggressive immunization efforts, rubella seldom occurs in the U.S., but is endemic in many parts of the world [62]. In 1969, live, attenuated rubella vaccines were licensed in the U.S. Following vaccine initiatives, the number of reported cases of rubella decreased drastically [62]. According to the CDC fewer than 16 cases of rubella have been reported annually from 2004-2011. Only two cases of congenital rubella syndrome were reported during this time period [63].

The rubella virus is transmitted via contact with nasopharyngeal secretions, blood, urine, or stools of infected people. It may also be transmitted by contact with items (e.g. clothing, bedding) that have been contaminated by the secretions of infected people [24]. The virus is also passed via the placenta from mother to unborn child [39].

Rubella is contagious from about 10 days before the appearance of its distinctive three-day rash until five days after it appears [24]. The incubation period ranges from 11 to 21 days after exposure to the virus [39].
Complications

Complications are rather rare in children. When they do occur, they often manifest as hemorrhagic problems such as thrombocytopenia. Young women may experience fleeting joint pain or arthritis that occurs just as the rash is fading. Fortunately, these complications are usually self-limiting and resolve within five to 30 days [24, 39].

Other complications associated with rubella in children include [24, 39]:
- Encephalitis.
- Myocarditis.
- Hepatitis.

Clinical manifestations

**Rubella alert!** About 20 to 50 percent of patients with rubella are asymptomatic [24].

Following an incubation period of 11-21 days, a maculopapular rash appearing as distinct rose spots erupts abruptly [24, 39]. Characteristics of this rash include the following [24, 39]:
- The rash usually begins on the face.
- The rash spreads rapidly, often covering the trunk and extremities within hours.
- By the end of the second day, the facial rash begins to fade.
- The rash continues to fade in the order in which it appeared.
- The rash usually disappears by the third day, but may last for four or five days.
- Low-grade fever may accompany the rash but usually does not last after the first day of the rash. On rare occasions, temperature may reach 104 degrees Fahrenheit.

**Rubella alert!** Rarely, patients may have rubella without developing a rash [24].

**Rubella alert!** The rapid appearance and disappearance of the rubella rash differentiates it from rubeola.

Other signs and symptoms, particularly in adolescents and adults, include [24]:
- Headache.
- Anorexia.
- Malaise.
- Coryza.
- Lymphadenopathy.
- Conjunctivitis.

Diagnosis

A history of exposure helps to make a diagnosis, since the rubella rash can mimic scarlet fever, measles (rubeola), infectious mononucleosis, roseola, and other viral rashes [24]. Therefore, cultures of throat, blood, urine, and cerebrospinal fluid can isolate the virus [24,39]. “Convalescent serum that shows a fourfold rise in antibody titers corroborates the diagnosis [24, pg 884].”

Treatment

Prognosis is generally excellent, and treatment is supportive. Over-the-counter medications such as Tylenol may relieve fever and joint pain. Aspirin should not be given to children or adolescents because of the danger of Reye’s syndrome [24, 39]. Droplet precautions should be instituted during the period of communicability [24, 39]. All cases of rubella should be reported to public health officials [24].

Congenital rubella syndrome

Although rubella is generally a mild, self-limiting illness, it can have devastating consequences on an unborn child. Congenital rubella syndrome (CRS) is defined as an illness that results from rubella virus infection during pregnancy [62]. In general, the earlier the infection occurs during a woman’s pregnancy, the greater the damage to the fetus [24].

Prior to vaccination, during the 1962-1965 worldwide epidemic, about 12.5 million rubella cases were reported in the U.S. causing 20,000 cases of CRS [64]. As previously noted, after vaccination programs were initiated, the incidence of rubella and CRS drastically decreased.

Intrauterine rubella infection can cause spontaneous abortions, stillbirths, or a multitude of birth defects, some of which do not appear until later in life [24]. Research shows that the risk of congenital infection and defects is greatest during the first 12 weeks of gestation and decreases after the first 12 weeks of gestation. Birth defects are rare after the 20th week of gestation. Common congenital defects associated with CRS are cataracts, congenital heart disease, hearing impairment, and developmental delay. Hearing deficit is the most common single defect [62].

CRS is characterized by the presence of the following [29, 62]:
- Cataracts.
- Deafness.
- Cardiac disease.

Other common manifestations include low birth weight, mental retardation, and microcephaly (the head is significantly smaller than normal for age and sex) [29, 62]. Experts now believe that congenital disorders can also cause problems that do not appear until later in the affected child’s life. These problems may manifest themselves as thrombocytopenic purpura, dental abnormalities, hemolytic and Hypoplastic anemia, encephalitis, diabetes mellitus, and seborrheic dermatitis, and giant-cell hepatitis [24].

**Rubella alert!** The mortality rate for infants born with CRS is 6 percent [24].

Infants born with CRS should be placed on contact precautions, since research has determined that these children excrete the virus for periods of time ranging from several months to a year after birth [24]. Parents of infants with CRS need a significant amount of emotional support as they attempt to deal with the physical problems of the disease as well as emotions that range from anger and despair to feelings of guilt. Referrals to appropriate support groups, including mental health consultations, should be initiated promptly. Sources of financial assistance may also help, since treatment of a multitude of birth defects may be expensive and beyond what health insurance covers. Women of childbearing age should be aware of their immunization status for rubella and have their antibody levels checked as deemed appropriate. Women who are pregnant who believe that they may have been exposed to rubella should immediately contact their healthcare providers.
**Chickenpox (Varicella)**

Varicella, more commonly known as chicken pox, is an acute, common disease caused by the herpes varicella-zoster virus. It is quite contagious, but is generally found to be a mild, self-limiting disease [24, 65].

This same virus, in its latent stage, can cause herpes zoster (shingles) infection in adults, which can be a more serious disease [24].

**Vaccination**

The varicella virus vaccine contains live, attenuated virus. It is approved for use in children 12 months of age and older and for adults as well. The vaccine is administered subcutaneously at 12 to 15 months of age. A second dose is given at four to six years, or at least three months after the first dose. The varicella virus vaccine may be given to older children and to adults who do not have immunity to the disease. In people older than 13 years of age, the second dose may be delayed only four weeks after the first dose is given [39].

**Incidence**

Before the availability of vaccine, varicella was quite widespread in the U.S. and affected about four million children annually. The disease caused as many as 100 deaths in children every year and was responsible for an estimated $400 million in medical costs and lost work time. The initiation of vaccination against varicella in 1995 significantly reduced the incidence of varicella as well as morbidity and mortality rates. Currently, fewer than 10 deaths related to varicella are reported annually, most of them occurring in unvaccinated people [65].

Varicella can affect people of all ages, but is most common in children aged two to eight.

**Risk factors for development of severe varicella**

Congenital varicella may affect infants if their mothers had acute varicella infections during their first, or early in the second, trimester. Neonatal infection is rare, most likely because of immunity passed to infants from their mothers. However, neonates who are born to mothers who develop varicella five days before or up to two weeks after delivery are at risk for developing severe varicella [24].

These are risk factors for the development of severe varicella in neonates who develop the disease. These include the following factors [65]:

- Neonates are especially susceptible for severe varicella in the first month of life. This is especially true if the mother is not immune to the disease.
- Early delivery is also a risk factor for severe forms of the disease. Birth before 28 weeks' gestation increases susceptibility because transmission of immunoglobulin antibodies from the mother to the baby occurs after this time.

**Complications**

Although rare in healthy children, several complications are associated with varicella [24, 39].

- Arthritis.
- Pneumonia.
- Encephalitis.
- Hemorrhagic varicella.

- Hepatitis.
- Myocarditis.
- Nephritis.
- Reye’s syndrome.
- Secondary bacterial infections of varicella lesions.
- Thrombocytopenia.

**Etiology and pathophysiology**

Varicella is caused by the herpes varicella-zoster virus and is highly communicable [24, 39]. The virus is transmitted by direct contact (especially with respiratory secretions), by contact with skin lesions, droplet spread, and airborne transmission [24, 39]. The incubation period ranges from 14 to 17 days, but can be as short as 10 days or as long as 20 days [24]. The disease is most likely communicable from the onset of fever, which is about one to two days before the first lesion appears, until the last vesicle dries, which takes about five to seven days [39].

**Varicella alert!** Varicella is probably most communicable from the first day before lesions erupt to six days after vesicles form [24].
The varicella virus enters the body through the respiratory system and colonizes in the upper respiratory tract. The virus replicates in regional lymph nodes. After about a week, the virus moves to the viscera and skin, causing the eruptions of the lesions characteristic of varicella.

Clinical manifestations

Varicella causes characteristic signs and symptoms, the most predominant of which is a pruritic (extremely itchy) rash [24]. During the prodromal phase of the disease, the patient develops a low-grade fever, malaise, and anorexia. Within 24 hours, the patients develop a rash that is characteristic of varicella [24, 39].

The rash associated with varicella usually starts as crops of small, red, flat spots (macules) on the trunk or scalp. The macules become papules (elevated lesions) and then progress to clear vesicles on an erythematous (red base), sometimes referred to as “dewdrop on a rose petal.” These lesions become cloudy and break easily, which causes the formation of scabs [24,39].

Diagnosis

Diagnosis seldom requires laboratory testing, since the clinical manifestations are generally quite characteristic and are usually accompanied by a history of exposure. The virus can be isolated from vesicular fluid within the first three or four days of the appearance of the rash, however [24]. Therefore, if needed, diagnostic tests that can be performed include [24, 39]:

- Tzanck smear, which shows multinucleated giant cells.
- Giemsa stain, which differentiates varicella-zoster from vaccine and variola viruses.

Varicella alert! The patient’s serum contains antibodies seven days after the onset of the disease [24].

Treatment and nursing considerations

Prognosis for healthy children is excellent. In children aged one to 14 years who are not otherwise healthy, the estimated mortality rate is two deaths per 100,000 cases. Children with deficient immune systems are at higher risk for severe disease and death. The mortality rate among children who have leukemia and develop varicella is 7 percent [65].

Treatment is primarily symptomatic and consists of the following interventions [24, 39, 39]:
- Droplet and contact isolation until all vesicles and the majority of the scabs dry and no new lesions appear. This is usually about one week after onset of the rash.
- Lukewarm oatmeal or baking soda baths and the application of calamine lotion to reduce pruritus.
- Oral, age-appropriate antihistamines to reduce pruritus.
- Over-the-counter medications such as Tylenol may be given for fever, but aspirin and other salicylates should be avoided in children and adolescents because of the danger of Reye’s syndrome.
- Fingernails should be shortened to prevent scratching. Mittens may be put on children’s hands to help avoid scratching.

Varicella alert! Children who have only a few remaining scabs may return to school. Note that congenital varicella does not require isolation [24].

Patients who are at risk for severe disease may be given varicella-zoster immunoglobulin within 72 hours of exposure. This may offer some passive immunity. Antiviral agents such as acyclovir (Zovirax) may be administered within the first 24 hours to help slow formation of vesicles, facilitate skin healing, and control the spread of infection systemically [24, 39].

Parents and other caregivers should be advised to take their children (or patients of other ages) to an emergency department if the following signs and symptoms occur [65]:
- Refusal to drink fluids.
- Signs of dehydration such as oliguria, increasing drowsiness, and excessive thirst.
- Unusual redness, pain, or swelling over the rash.
- Confusion.
- Unusual weakness.
- Inability or difficulty walking.
- Complaints of severe headache, and/or stiff neck and back pain.
- Frequent vomiting.
- Difficulty breathing.
- Chest pain.
- Severe cough.
- Fever that lasts more than four days or a fever that returns after the original fever has subsided.

Shingles (herpes zoster)

Janice is 54 years old and a professor of nursing at a large metropolitan university. She suffers from severe arthritis and has just finished a course of steroid therapy in the hopes of decreasing the inflammatory effects of the disease. For the past few days, however, Janice has not been feeling very well. She has a slight fever, is unusually fatigued, and complains of having no energy. Janice wonders if she has a virus or if the steroid therapy is affecting her in an unusual way. However, within two days, she begins to experience severe deep pain and pruritus over the cervical area of her back. Within another day or two, Janice develops a rash consisting of small red nodular lesions over the painful areas. These lesions are quickly turning to vesicles. Janice’s husband drives her to their family doctor where, as Janice fears, she is diagnosed with shingles.

Shingles, or herpes zoster, is an inflammatory condition that occurs when the varicella-zoster (chickenpox) virus reactivates and causes vesicular eruption along the pathway of the nerves from one or more dorsal root ganglia (dermatome) [24,39]. Shingles almost always affects adults [24].
Although most people recover completely, there may be scarring and visual impairment if the cornea is affected [24]. Anyone who has had varicella should receive the shingles vaccine to prevent occurrence of the disease.

**Vaccination**

Although there is a shingles vaccine that has been shown to be effective in preventing the disease, only one out of five adults 60 years of age and older have received the recommended shingles vaccination [14].

Since most older adults had varicella (chickenpox) as children, millions of people are vulnerable to the development of shingles. The shingles vaccine has been approved for people age 50 and older. The CDC recommends a single dose of the vaccine for people aged 60 and older, even if they have already had a case of shingles [66].

The shingles vaccine, Zostavax, contains a weakened varicella virus, which helps to stimulate the immune system to combat disease caused by the varicella-zoster virus. Research shows that the shingles vaccine reduces the risk of developing shingles by approximately 50 percent [66].

Side effects of the vaccine include pain, redness, swelling, or itching at the injection site. Headaches may also occur [66]. The CDC advises that the following groups of people should not receive the shingles vaccine [66].

**Etiology and incidence**

Shingles is a reactivation of the varicella virus that primarily affects adults, especially those who are more than 60 years of age. The virus has been dormant in the cerebral ganglia of the cranial nerves or the ganglia of posterior nerve roots after having had varicella (chickenpox) [24,39].

The reason for this reactivation is not specifically known. After the primary infection (chickenpox), the varicella-zoster virus may live in a dormant state in the dorsal nerve root ganglia. Years later, the virus may emerge from its dormant state, either spontaneously or as the result of immunosuppression [39]. Some experts believe that the virus multiplies as it becomes reactivated, and antibodies that remain from the initial infection of varicella deactivate it. But if an adequate number of effective antibodies do not remain, the virus continues its multiplication process in the ganglia, destroying the neurons that harbor it. The virus then moves down the sensory nerves to the patient’s skin [24].

The following statistics pertain to the incidence and prevalence of shingles [67].

- The incidence of shingles is about four cases per 1,000 U.S. population every year.
- The incidence among people 60 years of age and older is approximately 10 cases per 1,000 U.S. population annually.
- There are about one million cases of shingles reported in the U.S. annually.
- Almost one out of three people in the U.S. will develop shingles at some point in their lifetimes.
- The annual incidence of recurrence is not known. However, second and even third cases of recurrence have been reported.
- About one to four percent of people affected by shingles are hospitalized due to complications of the disease.
- About 30 percent of those who are hospitalized have compromised or suppressed immune systems.
- Results from current research studies indicate that about 96 deaths occur every year in which shingles were the underlying cause.

Unfortunately, the rate of shingles is increasing among adults in the U.S. This increase has been gradual and progressive, but the reason for this increase has yet to be identified. Some experts in the field are concerned that routine varicella vaccination may actually increase the incidence of shingles in adults, because they will have decreased exposure to varicella [67]. But two recent CDC studies found that the rates of shingles began to increase before the varicella vaccine was initiated in the U.S. (1996), and that the rate did not increase after the routine varicella vaccination program began. Other countries without routine varicella immunization programs have also reported similar increase in the rate of shingles occurrence [67].

**Risk factors**

Some factors can increase the risk of contracting shingles. People with compromised immune systems are at particular risk, including those who [67]:

- Have cancer, especially leukemia and lymphoma.
- Have HIV/AIDS.
- Have undergone bone marrow or solid organ (e.g. heart, liver, lung) transplantation.
- Are taking drugs that suppress the immune system, such as steroids, chemotherapy, or immunosuppressive medications related to transplantation.

Other possible risk factors are under investigation but have not been conclusively supported by research findings as of yet. These include [67]:

- Women seem to develop shingles more often than men. Most studies support this finding.
- Some research findings (from studies in the U.S. and other countries as well) indicate that shingles is less common in African-Americans (by about 50 percent) than in Caucasians.

**Complications**

Complications associated with shingles include [39]:

- About 20 percent of patients develop chronic pain syndrome. This syndrome is characterized by pain that can be described as a constant aching and burning sensation, intermittent, sharp, and cutting, or hyperesthesia (excessive physical sensitivity) of affected areas of the skin after it has healed.

- People who have had a life-threatening reaction to gelatin, neomycin, or any other component of the shingles vaccine.
- People with compromised immune systems due to HIV/AIDS; steroid therapy; cancer treatment; a history of cancer of the bone marrow or lymphatic system; or active, untreated tuberculosis.
- Women who are pregnant or might be pregnant.

**Shingles alert!** Women should not become pregnant until at least three months after receiving the shingles vaccine [66].

Although shingles seldom recurs, even people who have had shingles should receive the vaccine since it may protect recurrence [66].

**Shingles alert!** Some physicians may offer off-label shingles vaccine to patients less than 50 years of age. This is a legal practice and refers to drugs that are used in ways that have not been approved by the Food and Drug Administration (FDA). Patients should consult with their healthcare providers about receiving any type of shingles vaccine [66].

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• Visual complications may also occur. Examples include corneal ulcers, keratitis (corneal inflammation), uveitis (inflammation of the middle layer of the eye), and even blindness.

• Damage to the facial and/or auditory nerves, which can lead to hearing loss, vertigo, and facial weakness.

• Inflammatory processes that can cause pneumonitis, esophagitis, myocarditis, and pancreatitis.

Clinical manifestations

Initially, shingles causes fever, headache, and malaise. Within two to four days, the patient begins to experience severe, deep pain; pruritus; and paresthesia or hyperesthesia on the trunk and sometimes on the arms and legs. The pain can be constant or intermittent and generally lasts from one to four weeks [24]. Inflammation is usually unilateral and involves the cranial, cervical, thoracic, lumbar, or sacral dermatome (area of skin that is innervated by a single spinal nerve) in a “band-like” configuration [39].

Small, red, nodular-like skin lesions erupt over the painful areas of the skin often within three to four days of initial symptoms, but can take as long as up to two weeks to appear [24, 39]. Characteristics of the lesions include the following [24, 39]:

• These lesions usually spread unilaterally around the thorax or vertically over the arms and legs. They appear as patches of vesicles that erupt in groups and appear on erythematous, edematous skin.

• The lesions quickly become vesicles that fill with pus or clear fluid.

• These vesicles later rupture and form crusts about 10 days after they appear. Fortunately, scarring seldom occurs unless the vesicles are located deep within the skin and involve the dermis.

• If vesicles rupture, they often become infected and can lead to lymphadenopathy of regional lymph nodes. Some infected, ruptured vesicles can even become gangrenous.

Diagnosis

Diagnosis is usually made based on the patient’s clinical presentation of characteristic skin lesions. Prior to the appearance of the lesions, the intense pain may be mistaken for appendicitis, pleurisy, or other conditions that trigger severe pain [24].

The varicella-zoster virus can be cultured from vesicular fluid and infected tissue to confirm diagnosis. Lumbar puncture shows increased protein levels [24, 39].

Shingles alert! To differentiate between a localized herpes simplex infection and shingles, antibodies from vesicular fluid are stained under fluorescent light [24].

Treatment and nursing considerations

The foundation of shingles treatment is antiviral therapy, which is administered to stop the progression of the characteristic rash and to prevent complications [24]. Such drugs include acyclovir (Zovirax), famciclovir (Famvir), and valacyclovir (Valtrex). They interfere with viral replication and can be prescribed for all patients, but are especially helpful when treating patients who have compromised immune systems or who are debilitated. Antiviral treatment must be initiated within 72 hours of disease onset [39]. If ruptured vesicles have been infected by bacteria, appropriate systemic antibiotics are prescribed [24]. If the disease has affected the cornea, ophthalmic antiviral ointments are prescribed [24].

Pain management is crucial. Aspirin, acetaminophen, NSAIDS, and opioids help during the acute stage of illness. However, these analgesics are not generally effective if used to relieve the pain of lingering post-herpetic (persistent shingles pain that lasts for more than one month after a shingles infection) neuralgia. Such pain may last for months or even years [39]. Current treatments of choice for this pain include Capsaicin, percutaneous electrical nerve stimulation, and low-dose amitriptyline [24]. Post-herpetic neuralgia may also be treated with anticonvulsant agents such as gabapentin (Neurontin) or pregabalin (Lyrica), and 5-percent lidocaine patch [39].

Other treatment initiatives include the following interventions [24,39]:

• Administration of agents such as systemic corticosteroids may be prescribed to reduce inflammation, but their use is not routine and is controversial.

• Administration of tranquilizers, sedatives, or antidepressants may be prescribed to help the patient rest and deal with the pain.

• Application of cool, wet dressings and/or calamine lotion to reduce pruritus and discomfort.

• Initiation of drying therapies such as oxygen therapy or application of Silvadene ointment may be prescribed to dry vesicles.

• Initiation of droplet and contact precautions.

• Provision of a calm environment.

• Shortening patients’ fingernails can help to avoid scratching and vesicular rupture.

Patients need emotional support as they deal with severe pain. Patients should be encouraged to take analgesics on a regular schedule to help them cope with severe discomfort. They should be reassured that the pain will eventually subside and instructed in relaxation strategies (e.g. meditation, deep breathing exercises) [24].

Patients should also be taught proper hand-washing techniques and encouraged to wash their hands frequently to avoid spreading the infection. It is also important to explain to the patients how important it is to avoid scratching, since this can cause vesicular rupture, which can cause bacterial infection and scarring [39].
### Hepatitis A and B

Viral hepatitis is a rather common systemic disease characterized by destruction of hepatic cells, necrosis, and autolysis [24]. To date, there are five forms of viral hepatitis, but there are vaccinations available only for type A and type B [39].

#### The five forms of viral hepatitis include [24, 39]:

- **Type A (HAV):** Also called infectious or short-incubation hepatitis, HAV has an acute onset and most commonly affects children and young adults.
- **Type B (HBV):** Also referred to as serum or long-incubation hepatitis, HBV has an insidious onset and affects people of all ages.
- **Type C (HCV):** Formerly called non-A, non-B and accounts for about 20 percent of all cases of viral hepatitis. It is most often associated with injectable drug use.
- **Type D (HDV):** Also called delta hepatitis, HDV is responsible for about 50 percent of all cases of fulminant (sudden and severe in onset) hepatitis, which is often fatal.
- **Type E:** Primarily occurs in people who have recently returned from endemic areas such as India, Africa, Asia, or Central America.

#### Hepatitis A

Type A hepatitis (HAV) is caused by the hepatitis A virus and primarily affects children and young adults. HAV is very contagious and is usually transmitted by the fecal-oral route, most often via ingestion of food or fluids that have been contaminated with the virus. Many outbreaks of HAV are traced to ingestion of seafood from contaminated water [24, 39]. The disease is often linked to unsafe water, inadequate sanitation, and poor personal hygiene [68].

**HAV alert!** HAV may also be transmitted parenterally, through sexual contact (especially with oral or anal contact), and perinatally [24].

#### Incidence

HAV is one of the most common causes of food-borne infection and occurs sporadically and in epidemics throughout the world. In 2008, for example, more than 25,000 acute cases of HAV infection were reported in the U.S. Children and young adults are the populations most often affected [24]. In developed countries with proper sanitary conditions, infection rates are low. In developing countries with regions of inadequate sanitation, 90 percent of children have been infected with HAV before the age of 10. However, epidemics are uncommon in these countries because older children and adults are generally immune [68].

#### Risk factors

People at risk include those who have not been vaccinated or previously infected and those who live in areas where the virus is widespread, such as developing countries. Also at high risk are men who have sex with men and people who have chronic hepatic disease [68]. Other risk factors include [68,69]:

- Living in conditions that have poor sanitation and lack of safe water.
- Using injectable drugs.
- Living in close contact with an infected person.
- Traveling to areas where the disease is endemic without being immunized.
- Having chronic liver disease.
- Needing to frequently receive blood products.

#### Disease course

The incubation period for HAV ranges from approximately two to five weeks with the average being four weeks [39, 68]. Prognosis is generally good with complete recovery likely. Mortality rate is 0 to 1 percent [39]. However, it can take weeks or even months for complete recovery (and a return to work, school, or normal activities of daily living). This can have a significant interpersonal and economic impact on patients and families [68].

#### Signs and symptoms

Some people infected with HAV have no symptoms. Signs and symptoms range from mild to severe and can include [24, 39, 68]:

- Low-grade fever.
- Malaise.
- Anorexia.
- Headache.
- Clay-colored stools.
- Vomiting.
- Diarrhea.

**HAV alert!** Adults are more likely to have severe symptoms and a prolonged disease course [39].

**HAV alert!** Patients shed large amounts of the virus in their feces beginning about two weeks before symptom onset and continuing for one to three months [69].

#### Diagnosis

Diagnosis is confirmed when antibodies to HAV are detected [24].

**HAV alert!** HAV infection does not cause chronic hepatic infection. Once someone has recovered from HAV, he/she is immune to the disease for life [69].
**Hepatitis A vaccination**

Hepatitis A vaccination is recommended for all children at one year of age and for people of all ages who are deemed to be at high risk. The HAV vaccine consists of killed HAV, which causes the body’s immune system to produce specific antibodies to this virus. In most people, antibodies begin to develop immediately after the first dose of the vaccine, but do not reach protective levels for two to four weeks. A second dose of the vaccine is recommended at least six months after the first dose to provide prolonged protection [69]. There are two approved HAV vaccines currently available in the U.S. These are Havrix and Vaqta. Both are injected into the deltoid muscle of the arm. There is also a combination vaccine to protect against HAV and HBV infection called Twinrix. This combination vaccine requires three doses over a period of six months [69].

**Hepatitis B (HBV)**

Type B hepatitis (HBV) is caused by the hepatitis B virus, which can cause both acute and chronic liver disease. It affects all age groups, but poses a significant hazard for healthcare workers, since it is transmitted via contact with blood or other body fluids that are infected with the virus [70].

**Incidence and transmission**

HBV is a global health problem with the highest prevalence in sub-Saharan Africa and East Asia. The majority of people living in these regions become infected with the virus during childhood, and it is estimated that between 5 and 10 percent of the adult population suffers from chronic infection [70]. HBV is transmitted primarily through contact with infected blood [39]. However, other means of transmission include [24,39,70]:

- Sexual contact through blood, semen, saliva, or vaginal secretions. HBV is deemed to be a sexually transmitted disease (STD).
- Orally through breast-feeding or saliva.
- Parenteral route through equipment, needles, syringes, etc. that have been contaminated.
- Parenteral route among people who are injection drug users.
- Contact with contaminated body fluids in the healthcare setting, often due to wearing defective gloves. The HBV virus is shed in all body fluids.

**Complications**

A number of serious complications accompany HBV. These include [24, 39, 70]:

- Chronic active hepatitis.
- Liver cancer.
- Cirrhosis of the liver.
- Pancreatitis.
- Lymphoma.

Mortality associated with HBV can be as high as 10 percent. An additional 10 percent of patients progress to carrier status or develop chronic hepatitis [39].

**Risk factors**

People at risk for HBV infection include [39,69, 70] the following:

- People who live in geographic regions where the disease is prevalent.
- People who travel to geographic regions where the disease is prevalent.
- Those who use injectable drugs.
- People who receive blood products frequently.
- Healthcare workers who are exposed or have a risk of exposure to infected patients’ body fluids.
- Household and intimate contacts of patients who have HBV infection.

There are also identified risk factors for HBV becoming chronic. It depends on the age at which the person becomes infected. People most likely to develop chronic infections are children less than six years old. About 80-90 percent of infants infected with HBV during the first year of life develop chronic infections, while 30 to 50 percent of children infected before the age of six years develop chronic infections [70].

**Disease course**

HBV has an incubation period of 30 to 180 days, with an average of 75 days [24,70]. The HBV virus can survive outside the body for at least seven days, during which it can cause infection if it enters the body of someone who has not been immunized [70]. People infected in adulthood are less likely to progress to chronic infection than children. Less than 5 percent of otherwise healthy adults progress to chronic infections. However, 15-25 percent of adults who become chronically infected as children die from cirrhosis or hepatic cancer related to HBV [70]. The disease itself is usually severe, and prognosis deteriorates with age and debility. Mortality can be as high as 10 percent [24, 39].
Signs and symptoms

HBV has an insidious onset, and some people do not have symptoms during the acute infection phase. Those who do may experience one week to two months of prodromal symptoms including [39]:

- Anorexia.
- Fatigue.
- Nausea.
- Vomiting.
- Headache.
- Transient fever.
- Abdominal pain.

As the disease progresses, patients may experience the following [39, 70]:

- Jaundice.
- Dark urine.

Diagnosis

Diagnosis is confirmed when antibodies to HBV are detected [24]. Other laboratory tests of significance that support a diagnosis of hepatitis include [24]:

- Elevated serum alkaline phosphatase levels.
- Elevated serum bilirubin levels.

Vaccination for HBV

HBV vaccine has reduced the number of new cases of the disease by more than 75 percent in the U.S. There are several types of approved HBV vaccine in the U.S. including Engerix-B and Recombivax-HB. A dose of the vaccine is given at zero, one, and six months of age. A total of three doses are necessary to ensure adequate immunization. Older children and adolescents should receive the vaccine if they did not receive it as infants. Adults at high risk (e.g. healthcare professionals) who have not been vaccinated are also advised to receive the HBV vaccine [69].

Combination vaccines that provide immunization against HBV and certain other diseases are also available. Examples of these combination vaccines include [69]:

- Twirix: Provides protection against HBV and HAV.
- Comvax: Provides protection against HBV and Haemophilus influenzae (a cause of meningitis).
- Pediarix: Provides protection against HBV, tetanus, pertussis, and polio.

Vaccination lasts for at least 20 years and may be lifelong [70].

Management of hepatitis A and hepatitis B and nursing considerations

Chronic hepatitis B can be treated with antiretroviral medications such as interferon alfa, lamivudine, telbivudine, and tenofovir. But the majority of treatment interventions are supportive in nature and similar for all forms of hepatitis [24, 39].

- Facilitate rest and sleep according to the patient’s age and level of fatigue.
- Provide a quiet and calm environment with diversionary activities that combat anxiety and boredom but do not over-excite or stress the patient.
- Hospitalize patients who have excessive vomiting or life-threatening complications.
- Provide small, high-calorie, high-protein meals to fight anorexia.
- Encourage fluids to at least four quarts per day. Ice chips and effervescent soft drinks should be offered, since they help to hydrate the patient without triggering vomiting.

- Administer anti-emetics about 30 minutes before meals to relieve nausea and prevent vomiting. Phenothiazines have a cholestatic effect and should not be administered.
- If signs or symptoms of pre-coma such as lethargy, confusion and mental changes develop, reduce protein intake. If the patient is not hospitalized, seek immediate emergency medical help if such symptoms develop.
- Gradually increase physical activity after jaundice resolves.
- Implement enteric precautions and teach members of the same household and close contacts how to implement enteric and standard precautions.
- Provide emotional support and encouragement. Explain that it may take months for jaundice to clear completely and/or physical energy to return.

Meningococcal meningitis (Bacterial meningitis)

History of Vaccines, January 29, 2014: “After eight cases of group B meningococcal disease at Princeton University and four cases at University of California, Santa Barbara, health authorities have taken an unusual pathway to using a vaccine that is not licensed in the United States. More than 5,000 Princeton students and staff members with certain medical conditions have received one dose of a meningitis B vaccine (Bexsero) approved for use in the outbreak by the FDA under an Expanded Access to Investigational New Drug protocol.

Students will receive the second of the two needed doses in February. Regulatory agencies in the European Union, Canada, and Australia approved this meningitis B vaccine in 2013, but the U.S. FDA has not reviewed it for use here. The vaccine uses four antigens from serogroup B strains that provide protection from about 78 percent of the more than 1,000 identified strains of type B [71].”
The virulence of certain strains of meningococcal disease has led to changes in the vaccination of people at risk for the disease under certain circumstances, as shown by the preceding excerpt from www.historyofvaccines.org. Meningococcal meningitis can have severe consequences, including death [24, 72]. Outbreaks occur in populations that live in close quarters such as college dormitories, which are the locations of the outbreaks described in the opening paragraph.

**Etiology and incidence**

Meningitis is defined as an inflammation of the pia mater and arachnoid membranes that surround the brain and spinal cord. The most common form of meningitis is viral in nature and is usually a self-limiting disease [39].

Meningococcal meningitis, commonly referred to as bacterial meningitis, is a bacterial form of meningitis caused by the gram-negative bacteria Neisseria meningitidis and is a much more serious form of the disease compared with viral meningitis [24, 39]. The incidence of acute, bacterial meningitis in the U.S. is about three cases per 100,000 annually. It is associated with a mortality rate of 10 to 30 percent. Many patients who recover from the disease suffer from long-term, often permanent, problems such as hearing loss [39]. Untreated bacterial meningitis is associated with a 50 percent mortality rate and the possibility of severe brain damage [72]. Especially virulent forms of the disease may be fatal within a matter of hours [24].

The highest rates of the disease are found in sub-Saharan Africa. In the 2009 epidemic season, 14 countries in Africa reported 88,199 suspected cases, including 5,352 deaths [72].

**Transmission and pathophysiology**

The disease is transmitted from person to person via respiratory droplets or secretions of the throat [24, 39]. Close, prolonged contact (e.g. kissing) or living with large groups of people in close quarters, such as in military barracks or college dormitories, facilitates the spread of the disease [39]. The Neisseria bacteria infect only humans. The bacteria can overwhelm the body’s immune system and spread rapidly through the bloodstream to the brain. It is believed that about 10 to 20 percent of the population carries Neisseria meningitidis in their throats at any given point in time. Why some people develop the disease and others do not is still not understood [72].

**Complications**

A number of complications are associated with bacterial meningitis. Children who acquire the disease are especially vulnerable to become deaf, have learning difficulties, spasticity, paresis, or cranial nerve disorders [39]. Seizures occur in 20 to 30 percent of all patients. Edema of the brain may cause herniation or compression of the brain stem [39]. Other complications that may occur include [24]:

- Respiratory failure.
- Septic arthritis.
- Pericarditis.
- Endophthalmitis.
- Neurologic deterioration.
- Death.

**Clinical manifestations**

The average incubation period for meningococcal meningitis is four days but can range from two to 10 days [72]. Classic symptoms of the disease include fever, headache, and nuchal rigidity (stiff neck) [24, 39]. More than 50 percent of patients experience vomiting, diarrhea, cough, and myalgia (muscle pain) [39].

Confusion and altered mental status may become evident, especially in older patients. Patients may also complain of photophobia. A petechial rash (resembles a rug or brush burn) or purpuric rash may develop [24, 39].

A bulging anterior fontanel may become apparent in infants. Children may refuse to eat or feed, have behavioral changes, exhibit arching of the back and neck, and develop seizures [39].

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Patients often exhibit positive Brudzinski’s and Kernig’s signs [39].

- Brudzinski’s sign: The patient is placed in the supine position and the head is flexed upward. Meningeal irritation is indicated if neck flexion causes flexion of hips, knees, and ankles.
- Kernig’s sign: The patient is placed in the supine position. The thigh of one leg is flexed at the hip and knee to form a 90-degree angle. Then the leg is slowly, completely extended at the knee joint. If the leg cannot be completely extended because of pain, the sign is positive and meningeal irritation is indicated.

In about 10 to 20 percent of patients, the disease progresses to fulminating meningococcemia. This extremely severe, serious form of the disease causes prostration, shock, enlargement of skin lesions, and disseminated intravascular coagulation (DIC). Unless patients affected by this form of the disease receive immediate treatment, death from respiratory or heart failure occurs in six to 24 hours [24].

Onset of bacterial meningitis may take several hours or several days and depends on the patient’s age, immune status, the co-existence of any other medical conditions, and the causative organism. Severe forms of the disease may progress with startling rapidity, even leading to death in a matter of hours [39, 72].

**Diagnosis**

In addition to patient history and physical examination, the following diagnostic tests are used to confirm diagnosis [24, 39, 72].

- Blood or cerebrospinal fluid (CSF) stain: The presence of gram-negative diplococci is highly suggestive for Neisseria meningitidis.
- Blood culture, CSF culture, or culture of lesion scrapings: A positive result for the bacterium confirms diagnosis. Note that nasopharyngeal infections positive for the bacterium are not conclusive, since they are part of the normal flora of the nasopharyngeal area.
- Complete blood count (CBC) with differential: Elevated leukocyte count is present in bacterial meningitis.
- CSF evaluation: CSF is evaluated for elevated pressure, elevated leukocytes, elevated protein, and low glucose, which are suggestive of the disease.
- MRI/CT scan (with and without contrast): Performed to rule out other disorders such as abscesses.
Treatment and nursing considerations

*Bacterial meningitis alert!* Effective evaluation and management of bacterial meningitis should be accomplished by a team effort with physicians, nurses, infectious disease specialists, neurologists, internal medicine specialists, and laboratory personnel working closely together [39].

The majority of patients are given high doses of intravenous (I.V) antibiotics as soon as bacterial meningitis is suspected. However, cultures should be obtained prior to starting the antibiotic therapy (39). Examples of antibiotics used, depending on the specific pathogen causing the disease and whether or not the patient is allergic to any medications, include aqueous penicillin G, ampicillin or cephalosporins [24].

*Bacterial meningitis alert!* The increase in bacterial resistance to antibiotics has made it very difficult to treat come cases of bacterial meningitis [39]!

Additional treatment measures include administration of [24, 39]:
- Mannitol to treat cerebral edema.
- I.V. heparin for DIC.
- Digoxin and a diuretic to treat heart failure if it develops.
- I.V. dexamethasone or another corticosteroid to manage inflammation. Steroid therapy should be given before or with the first dose of antibiotics, and given only to those patients older than six weeks of age. Note that steroid therapy may trigger gastrointestinal bleeding and mask treatment response.

Supportive interventions include [24, 39]:
- Fluid and electrolyte replacement.
- Maintenance of a patent airway and administration of oxygen as needed.
- Bed rest.
- Meticulous monitoring of vital signs and intake and output.
- Droplet precautions until the patient has been on antibiotic therapy for 24 hours.
- Report all cases of bacterial meningitis to public health authorities.
- Administration of prophylactic antibiotics to anyone who has come into close contact with the patient. Healthcare professionals who work in close contact with the patient may need to receive prophylactic antibiotics as well.

*Bacterial meningitis alert!* Transport all bacterial meningitis specimens to the laboratory as swiftly as possible since the bacteria are quite sensitive to changes in the environment such as temperature and humidity [24].

Vaccination

Meningococcal conjugate vaccine (MCV4) is recommended for children nine months through ten years of age who are at increased risk for meningococcal disease. Booster doses may be needed if the child remains at high risk (73).

Vaccine with meningococcal conjugate is routinely recommended for all children and adolescents ages 11 through 18. The first dose should be administered at 11-12 years of age and a booster administered at 16 years of age. Boosters may be needed depending upon the age of the child when he or she receives the first dose and the risk status of each individual [73].

HPV and cervical cancer

The human papilloma virus (HPV) can affect the genital areas of males and females as well as the mouth and throat. There are more than 40 HPV types, and infection is so common that it is identified as the most common sexually transmitted disease (STD) in the U.S., it is estimated that almost all sexually active men and women will get at least one type of HPV at some point in their lives [74].

The majority of people infected do not develop symptoms or health problems. In fact, most HPV infections, nine out of 10 cases, resolve themselves within two years without treatment. But because the disease is often asymptomatic, affected people can pass the infection to sexual partners without knowing it. Approximately 79 million Americans are now infected with HPV, and about 14 million people are newly infected every year [74].

Even though most infected people do not develop significant disease, HPV infections may persist and cause significant, even fatal, health problems. These include [74]:
- Genital warts (do not cause malignancies).
- Cervical cancer.
- Anal cancer.
- Vulvar and vaginal cancer.
- Penile cancer.
- Oropharyngeal cancer (cancer in the back of the throat, the base of the tongue, and the tonsils).

*HPV alert!* About 17,500 women and 9,300 men are affected by cancers caused by HPV [74].

Cervical cancer

Cervical cancer is the third most common cancer of the female reproductive system and is, arguably, the most commonly mentioned disease associated with HPV infection [39]. It is classified as preinvasive or invasive. Preinvasive cancer can range from minimal cervical dysplasia, meaning the lower third of the epithelium contains abnormal cells, to carcinoma in situ, meaning the full thickness of epithelium contains abnormally proliferating cells. Preinvasive cervical cancer is curable 75 to 90 percent of the time if detected early and if the patient receives prompt, appropriate treatment. If untreated, the disease may progress to invasive cervical cancer. With invasive cervical cancer, malignant cells penetrate the basement membrane and can then spread to other pelvic structures or travel to distant sites through the lymphatic system [24].

Etiology and incidence

Seventy percent of all cases of cervical cancer are caused by HPV. Two strains of the virus (types 16 and 18) cause most cases of this cancer [75]. Ninety-five percent of all cases of cervical cancer are squamous cell cancers. Five percent are adenocarcinomas. Invasive cancers are...
usually found in women between 30 and 50 years of age and are rarely found in women younger than 20 years of age [24].

At one time, cervical cancer was the leading cause of cancer deaths for women in the U.S. Fortunately, in the past 40 years, the number of cases of cervical cancer and the number of deaths from cervical cancer has significantly decreased [76].

The CDC reports that in 2010, the most recent year statistics are available [76]:
- 11,818 women in the U.S. were diagnosed with cervical cancer.
- 3,939 women in the U.S. died from cervical cancer.

HPV is transmitted during sexual activity such as vaginal, anal, and oral sex and sex play [74].

**Risk factors**

Risk factors associated with the development of cervical cancer include [24,77]:
- Participating in frequent sexual intercourse when less than 16 years of age.
- Having multiple sexual partners.
- Having other sexually transmitted infections.
- Having a weakened immune system.
- Smoking.

**Complications**

Complications associated with cervical cancer include [24, 39]:
- Flank pain.
- Hematuria.
- Renal failure.
- Metastasis to bladder, rectum, lungs, mediastinum, bones, and liver.
- Complications associated with intracavity radiation therapy such as cystitis, proctitis, vaginal stenosis, and perforation of the uterus.
- Complications associated with external radiation including bone marrow depression, obstruction of the bowel, and fistula.

**Clinical manifestations**

Preinvasive cervical cancer usually produces no symptoms. Some patients may report a watery, vaginal discharge [39]. Early invasive cervical cancer causes [24, 39]:
- Post-coital bleeding and pain.
- Irregular vaginal bleeding.
- Spotting between periods or after menopause.
- Foul smelling vaginal discharge.

As the disease progresses and becomes more advanced, the following signs and symptoms are reported [24, 39]:
- Bleeding becomes more constant.
- Abdominal pain and pelvic pain that radiates to buttocks and legs.
- Leakage of urine and feces from the vagina due to fistula.
- Anorexia.
- Weight loss.
- Anemia.
- Edema of the lower extremities.

**Diagnosis**

Pap smear, a routine screening measure, can detect cervical cancer prior to the appearance of clinical symptoms. Abnormal results indicate the need for further diagnostic testing [24, 39].
- Colposcopy: Examination of the cervix with bright light and magnification of 10 to 40 times is performed to detect presence and extent of lesions that require biopsy.
- Biopsy: Biopsy of abnormal tissue to detect the presence of malignant cells.
- Additional testing to determine the presence and extent of metastasis: X-rays, IVP, CT scans, barium studies of the lower colon and rectum and ultrasounds may be performed.

**Staging**

Treatment depends on accurate disease staging. Stages of cervical cancer include [77]:
- Stage I: Cancer is confined to the cervix itself.
- Stage II: Cancer includes the cervix and the vagina, but has not yet spread to the pelvic wall or lower portion of the vagina.
- Stage III: Cancer has moved from the cervix to the pelvic side wall or the lower portion of the vagina.
- Stage IV: Cancer has spread to nearby organs, such as the bladder or rectum or it has spread to other areas of the body, such as the lungs or liver.

**Treatment and nursing considerations**

Treatment depends on the clinical staging of the disease. For example, preinvasive lesions may be treated with [24, 39]:
- Cryosurgery: Malignant tissue is removed or destroyed by freezing.
- Total excisional biopsy: Malignant tissue is removed as part of the biopsy process.
- Loop electrosurgical excision procedure (LEEP): A low-voltage electrified wire loop is used to excise the malignant or pre-malignant tissue.
- Conization: Cone-shaped wedge of tissue is removed from the cervix. This wedge includes abnormal tissue as well as an area around the abnormal tissue so that there is a margin free of abnormal cells remaining in the cervix.

Cervical cancer alert! Nurses should explain to patients that some vaginal discharge, bleeding, pain, and cramping generally occur with these procedures [39].

Invasive cervical cancer may be treated with hysterectomy, radiotherapy, and/or chemotherapy depending on the extent and progression of the disease [24, 39].

Radiation can be administered internally and externally. Intracavity radiation is used for localized cancer in earlier stages. External radiation is administered for later stages. Cisplatin, a radiation sensitizer, is a chemotherapeutic agent used in combination with radiation to enhance survival [39]. Fluorouracil is another chemotherapeutic agent used in combination with radiation therapy [24].
Acidosis due to dehydration caused by severe vomiting and
● Severe dehydration.
Complications associated with rotavirus infection include [24]:
● Severe dehydration.
● Acidosis due to dehydration caused by severe vomiting and diarrhea.

Preventive measures

Women can take a number of to prevent cervical cancer. Patients should be advised not to smoke or to stop smoking. Patients also need to be informed that delaying the first sexual intercourse experience may help reduce risk of the disease, and that having fewer sexual partners may also decrease risk [24].

Females should have routine Pap test screenings according to the following guidelines [24].
● Initial Pap test screenings should begin within three years of the first sexual intercourse but no later than the age of 21.
● Annual screenings should be done until age 30.
● At age 30, women who have had three normal Pap tests in a row may be screened every two to three years depending on personal health and lifestyle history. Screening timelines should be discussed with healthcare providers.
● Screening is optional in women who are 70 years of age and older who have had three or more normal Pap tests in the past 10 years.

Vaccination has been an option since 2006, when the quadrivalent HPV recombinant vaccine became available [24]. Two HPV vaccines are licensed by the FDA. Bivalent HPV vaccine (Cervarix) prevents two HPV types, 16 and 18, which cause 70 percent of cervical cancers. Quadrivalent HPV vaccine (Gardasil) prevents four HPV types. In addition to preventing HPV infection from types 16 and 18, it also prevents infection from types six and 11, which cause 90 percent of genital warts. Gardasil has also been shown to be effective in providing protection against cancers of the anus, vagina, and vulva [75].

HPV alert! Only Gardasil is licensed for use in males [75].

Both vaccines are given as a three-dose series and are recommended for 11- and 12-year-old boys and girls. The series can be stated as early as age nine. Vaccination is also recommended for 26-year-old females and 13- through 21-year-old males who have not completed the vaccination series. Men 22 through 26 years of age may also be vaccinated. Vaccination is also recommended for homosexual and bisexual men or any man who has sex with men and for people whose immune systems are compromised through age 26 if they did not complete the series of three doses when they were younger [75].

HPV alert! The vaccines have no effect on existing HPV infections that were contracted prior to vaccination. Thus, they cannot be used to treat existing diseases or conditions caused by HPV [75].

HPV alert! The vaccines should not be given to pregnant women [75].

Incidence

Globally, rotavirus is the most common cause of severe diarrhea in infants and young children. Prior to the approval of rotavirus vaccine in 2006, nearly all children in the U.S. were infected with rotavirus before the age of five. Currently, the virus continues to affect children. Rotavirus leads to the following events on an annual basis among children younger than five years of age in the U.S. [78].
● More than 400,000 visits to physicians.
● More than 200,000 emergency department visits.
● 55,000 to 70,000 hospitalizations.
● 20 to 60 deaths.

In countries with a temperate climate, such as the U.S., rotavirus has a winter seasonal pattern, with epidemics occurring annually from November to April. It occurs most often in infants and young children and affects most children in the U.S. by the age of two [24].

On a global basis, rotavirus is still the leading cause of severe diarrhea in infants and young children. In 2008, the virus caused about 453,000 deaths throughout the world in children less than five years of age [78].

Risk factors

The most severe cases of rotavirus disease occur primarily among unvaccinated children aged three to 35 months of age. Children at greatest risk for contracting rotavirus disease are those who are in child care settings [78].

Older adults have a greater risk of contracting the disease, as do those who [78]:
● Provide care to children who have rotavirus disease.
● Have compromised immune systems.
● Are traveling to geographic regions where the disease is present.

Complications

Complications associated with rotavirus infection include [24]:
● Shock.
● Skin breakdown.
Transmission and pathophysiology

The disease is transmitted primarily through the fecal-oral route, although there have been reported low titers of the virus in respiratory tract secretions and other body fluids. Transmission may occur by ingesting contaminated water or food and contact with surfaces and objects contaminated by the virus [24]. Infected patients pass billions of rotavirus particles in their stools. It only takes a small number of such particles to cause infection. For example, babies or small children can touch contaminated objects, put their fingers in their mouths, and become infected [24].

Rotavirus alert! Infection leads to only incomplete immunity. However, recurrent infections are usually less severe than the original infection [24].

Clinical manifestations

After an incubation period of one to three days, signs and symptoms develop including fever, nausea, vomiting, and profuse, watery, non-foul-smelling diarrhea [39]. Effects of the disease can range from mild to severe, and it usually lasts from about three to nine days [24].

Rotavirus alert! Vomiting and diarrhea can lead to significant dehydration [24, 39].

Diagnosis

Diagnosis is confirmed by rapid antigen detection of rotavirus in feces [24]. Acute diarrhea may also be caused by bacteria, parasites, side effects of antibiotic therapy, and food poisoning [24]. Signs and symptoms similar to those of rotavirus may also be caused by [24]:

- Overfeeding.
- Irritable bowel syndrome.
- Celiac disease.
- Lactose intolerance.
- Cystic fibrosis.
- Inflammatory bowel syndrome.

Rotavirus alert! Ongoing or frequent bouts of vomiting and diarrhea should be investigated and causes other than rotavirus ruled out [24, 39].

Treatment and nursing considerations

In otherwise healthy patients, rotavirus is usually a self-limiting illness, lasts only a few days, and without serious complications. Treatment focuses on supportive interventions such as fluid and electrolyte replacement and rest [24, 39]. Patients, especially infants and young children, should be carefully monitored for signs of dehydration, such as extreme fussiness or sleepiness in infants and children, irritability and confusion in adults, very dry mouth, skin, and mucus membranes, greatly reduced urinary output, sunken eyes, and dizziness [24, 39].

Parents and other caregivers should be instructed to [24, 39]:

- Wash hands after touching patients’ body fluids.
- Clean objects that have been in contact with body fluids such as toys, bed linens, etc.
- Clean perineum gently and thoroughly to avoid skin breakdown.

Rotavirus alert! Lactating mothers should continue to breast feed their babies without restrictions [24].

Vaccination

Since the introduction of rotavirus vaccine in 2006, the disease has decreased significantly in the U.S. Annually; the vaccine prevents about 40,000 to 50,000 hospitalizations among U.S. infants and young children. Incidence of the disease has also decreased among older children and adults who have not been vaccinated, since vaccinated children are less likely to contract the disease and transmit it to others [78]. Vaccination has been shown to prevent 74 percent of all cases and 98 percent of severe cases [39].

There are two FDA-approved rotavirus vaccines in the U.S.: RotaTeq® and Rotarix®. They are liquids and administered orally [79]. Guidelines include [79]:

- RotaTeq® is given in a three-dose series at ages two, four, and six months.
- Rotarix® is administered in a two-dose series, with doses given at ages two and four months.

Pneumonia

Pneumonia is an acute inflammatory infection of the lungs that involves the terminal airways and alveoli of the lung. Pneumonia is classified according to the pathogens that cause the disease and the specific location of involvement [24, 39].

For example, pneumonia can be classified according to [24, 39]:

- Pathogen: Pneumonia can be due to viral, bacterial, fungal, protozoan, mycobacterial, mycoplasmal, or rickettsial pathogens.
- Location in the lung: Lobular pneumonia affects part or parts of a lobe, lobar pneumonia affects an entire lobe, and bronchopneumonia affects the distal airways.
- Type: Primary pneumonia is due to inhalation or aspiration of a pathogen; secondary pneumonia may follow lung damage due to a noxious chemical or superinfection.

In otherwise healthy patients, the prognosis is generally good with adequate treatment and an adequately functioning immune system. Unfortunately, pneumonia is the sixth leading cause of death in the U.S. [24].

For the purpose of this education program, which focuses on vaccine-preventable diseases, the emphasis is on pneumococcal pneumonia. This type of pneumonia is caused by a group of bacteria called Streptococcus pneumonia. This type of pneumonia can cause not only pneumonia but infections of the blood and the brain (meningitis) [80].
**Risk factors**

Risk factors for the development of pneumonia include [24, 39]:

- Smoking.
- Alcoholism.
- Bronchial asthma.
- Immunosuppression.
- Cardiac or respiratory disease.
- Advanced age.
- Chronic illness.
- Cancer (especially lung cancer).
- Malnutrition.
- Sickle cell disease.
- Aspiration.
- Immunosuppressive therapy.
- Exposure to noxious gases.

**Pneumonia alert!** In patients who are elderly, or in those people who are debilitated, bacterial pneumonia may follow influenzae or even a common cold [24].

In children ages two to three, respiratory viruses are the most common cause of pneumonia. In children of school age, mycoplasmal pneumonia is more common [24].

**Pneumonia alert!** Patients who are over the age of 65 have a high mortality rate, even with appropriate antimicrobial therapy [39].

**Complications**

Complications associated with pneumonia include [24, 39]:

- Atelectasis.
- Bacteremia.
- Delirium (which is considered a medical emergency).
- Empyema.
- Endocarditis.
- Hypoxemia.
- Lung abscess.
- Pericarditis.
- Persistent hypotension and shock, especially in elderly patients with gram-negative bacterial disease.
- Pleural effusion.
- Respiratory failure.
- Septic shock.
- Superinfections such as meningitis and pericarditis.

**Clinical manifestations**

Signs and symptoms of pneumococcal pneumonia include [24, 39]:

- Abrupt onset of severe, shaking chills.
- Sustained temperature of 102 to 104 degrees Fahrenheit.
- Tachypnea.
- Crackles (rales).
- Cough.
- Production of sputum.
- Pleuritic chest pain exacerbated by coughing.
- Dyspnea.
- Tachycardia.
- Use of accessory muscles of respiration and nasal flaring.

**Diagnosis**

Diagnosis is made by a thorough history and physical examination and the following diagnostic tests [24, 39].

- Chest x-ray: Shows infiltrate and the location and extent of the disease.
- Sputum evaluation: Gram stain and culture and sensitivity of sputum are performed to identify the causative pathogen.
- Blood cultures: Obtained to detect and identify bacterial and other pathogens.
- White blood cell count (WBC): Elevated in the presence of infection.
- Immunologic testing: Such tests detect microbial antigens in serum, sputum, and urine.

**Pneumonia alert!** If pleural effusions are present, they should be tapped and the fluid analyzed for evidence of infection in the pleural space [24].

**Treatment and nursing considerations**

Treatment depends on the causative agents. In the case of pneumococcal pneumonia, penicillin G (or erythromycin if patients are allergic to penicillin) is administered for seven to 10 days. Antibiotic therapy is begun as soon as possible after appropriate cultures are taken. It is not necessary to wait for results as long as cultures are obtained prior to administering the medication [24, 39].

**Pneumonia alert!** Pathogen resistance to penicillin is becoming much more common. Treatment with agents such as vancomycin or levofloxacin should also be considered [24].

Additional interventions include oxygen therapy, frequent coughing and deep breathing, frequent position changes, and as much mobility as possible [24, 39].

**Prevention**

Nurses should encourage all patients, especially those who have limited mobility, to perform deep breathing and coughing exercises frequently. Early ambulation is encouraged post-operatively. For patients who spend a lot of time in bed, position changes and range of motion exercises should be encouraged [24, 39].

Vaccination to prevent pneumococcal pneumonia should be encouraged. The vaccine (pneumococcal polysaccharide vaccine) is recommended for [80]:

- People aged 19 to 64 who smoke.
- All people over the age of 65.
- People two years of age and older with a high-risk infection, such as those who have chronic disease, are alcoholics, are nursing home residents, have sickle cell disease, who have had their spleens removed or who have poorly functioning spleens, have compromised immune systems, who are receiving immunosuppressant therapy, and who live in any institution where other people have long-term health problems.

One dose of the vaccine has shown to be effective for most people. A second dose may be needed if someone [80]:

- Has had the first dose of the vaccine before the age of 65.
- Has a compromised immune system.
- Has chronic kidney failure or nephritic syndrome.
- Has sickle cell disease.
- Has had his/her spleen removed.

**Pneumonia alert!** The pneumococcal polysaccharide vaccine is not used in children less than two years of age. The pneumococcal conjugate vaccine is routinely given to younger children to protect them from Streptococcus pneumonia [80].

### Rabies

Nicholas and his family were enjoying a family vacation at their favorite camp grounds. One afternoon, as they hiked a familiar wooded trail, they came upon a raccoon. The animal is unsteady on its feet, growling, and drooling profusely. Alarmed, Nicholas steps between the raccoon and his young daughter. The animal charges Nicholas and bites him on the leg, after which the raccoon runs rapidly into the woods. Nicholas and his family drive to the nearest hospital emergency department immediately after informing camp ground authorities of the incident. The raccoon cannot be located, and hospital personnel believe that based on the behavior of the animal, it is advisable to initiate treatment with rabies vaccine.

Although not a disease for which vaccine is routinely administered, rabies vaccine is the only treatment option for a disease that is serious, and usually fatal [39].

**Etiology and incidence**

Rabies, also known as hydrophobia, is an acute CNS infection caused by a virus that is transmitted via the saliva of an infected animal, particularly wild animals. Treatment swiftly administered after exposure may prevent fatal CNS infection [24, 39].

**Rabies alert!** If symptoms of rabies develop, rabies is almost always fatal [24].

Rabies virus is usually transmitted by direct contact with virus-laden saliva of a rabid animal into a bite or a scratch. It may also be transmitted via transplanted corneas and, possibly from other transplanted organs that have been harvested from patients who have died from undiagnosed rabies [39].

The virus replicates in the striated muscle cells at the site of entry and spreads up the nerve to the CNS where it replicates in the brain. It eventually travels through the nerves into other tissues, including the salivary glands of the infected patient [24].

**Rabies alert!** Rabies symptoms appear earlier if the bite occurs on the head or on the face. If the patient is bitten on the face, the risk of developing rabies is about 60 percent, on the upper extremities, 15 to 40 percent, and on the lower extremities, about 10 percent [24].

Rabies is found on all continents with the exception of Antarctica. More than 95 percent of human deaths due to rabies occur in Asia and Africa. Rabies in poor, vulnerable populations may go undiagnosed and/or unreported. It occurs most often in remote rural communities where dog vaccination programs have not been implemented [81]. According to the World Health Organization (WHO), the following points are important to the understanding of rabies as it exists in the world [81]:
- More than 60,000 people die from rabies annually. These deaths occur mostly in Asia and Africa.
- 40 percent of people bitten by suspected rabid animals are children under the age of 15 years.
- The sources of the majority of human rabies deaths are dog bites.
- Cleansing the wound/bite and receiving immunization within a few hours after contact with a suspect rabid animal can prevent the onset of rabies and death.
- About 29 million people throughout the world receive a post-exposure rabies vaccine to prevent the disease every year. These measures cost about 2.1 billion U.S. dollars annually.

In the U.S., the vaccination of dogs has significantly reduced the transmission of the rabies virus to humans. In the U.S. wild animals such as raccoons, skunks, foxes, and bats account for 70 percent of rabies cases [24].

**Clinical manifestations**

The incubation period of rabies virus is about one to three months but varies from as little as less than one week to more than one year [81]. If the bite is on the head, the incubation period is shorter because of the proximity of the bite to the brain [39].

Initial symptoms include fever; malaise; fatigue; headache; a sense of apprehension and anxiety; and pain or unusual sensations of tingling, pricking, or burning at the site of the bite [39, 81]. These initial symptoms last about two to six days [39].

As the disease advances and the virus spreads through the CNS, progressive, fatal inflammation of the CNS develops. At this point, two clinical forms of the disease can occur [81].
- **Furious rabies:** Patients exhibit hyperactivity, excited behavior, and hydrophobia. Death occurs within a few days due to cardiopulmonary arrest.
- **Paralytic rabies:** Paralytic rabies is responsible for about 30 percent of the total number of human cases of rabies. This form produces less dramatic signs and symptoms, and the course is usually longer than the furious form. Paralysis of the muscles occurs gradually, beginning at the site of the wound. Coma develops slowly and eventually leads to death.

**Rabies alert!** The paralytic form of rabies is often misdiagnosed. This contributes to under-reporting of the disease and the lack of accurate statistics pertaining to prevalence and incidence [81].

About 50 percent of all patients are affected by hydrophobia (extreme fear of water) [24]. Patients affected by hydrophobia exhibit [24, 39]:
- Forceful, painful pharyngeal muscle spasms that cause fluids to be expelled from the mouth, leading to dehydration.
- Patients have trouble swallowing, causing frothy saliva to drool from the moth.
- Ultimately, even the mention of water or fluids triggers uncontrollable pharyngeal muscle spasms and uncontrollable, excessive salivation.

**Diagnosis**

Diagnosis is confirmed when the virus is isolated from the patient’s saliva or throat as well as examination of his/her blood by direct fluorescent antibody (DFA) [24]. Specific FA staining of brain tissue or of frozen skin secretions taken from the back of the neck also confirm diagnosis [39].

The animal responsible for the bite should be confined and observed by a veterinarian for 10 days. If the animal appears to be rabid, it should be killed and its brain tissue tested for DFA and Negri bodies, which are oval or round masses that confirm diagnosis [24].
Treatment and nursing considerations

**Rabies alert!** Because rabies is fatal unless treatment is administered promptly, all people who have sustained unprovoked animal bites should be treated as though rabies is suspected [24].

Treatment focuses on wound care and immunization [24, 39].

Initial first aid for animal bites includes the following actions [24, 39, 81].
- Immediately wash the bite vigorously and thoroughly with soap and water for at least 10 minutes to remove the animal’s saliva from the bite.
- Flush the wound with a viricidal agent.
- After flushing the wound with a viricidal agent, rinse the wound with clear water.
- Apply a sterile dressing.
- Avoid suturing the wound if at all possible.
- Avoid immediately stopping bleeding (if possible) since bleeding can help to cleanse the wound.

**Rabies alert!** Ask patients if they did anything to provoke the animal. If they did, it is unlikely that the animal is rabid [24].

Rabies vaccination guidelines are as follows [24, 82].
- A patient who has not been immunized before must receive both passive and active immunization.
- Passive immunization is provided with rabies immune globulin (RIG). Active immunization is provided with human diploid cell vaccine (HDCV).
- If patients have received HDCV before and has an adequate rabies antibody titer, they do not need RIG, merely and HDCV booster.
- The U.S. brand names for rabies vaccines are Imovax Rabies and Rabavert [82]. If patients have received the rabies vaccine in the past and are exposed to rabies, they will need to receive two doses on two different days within a one-month period. If patients have never received the vaccine and have been exposed to rabies they will need to receive a total of five doses on five different days within a one-month period [82].

**Rabies alert!** It is essential that patients receive all doses of the vaccine within the identified time frame in order to prevent the disease [24, 82].

Common side effects of the rabies vaccine may go away as the patient’s body adjusts to the vaccine. These side effects should be reported to the patient’s healthcare professional and their severity discussed. Such common side effects include [82]:
- Chills.
- Fever.
- Dizziness.
- General discomfort or feeling ill.
- Headache.
- Itching, pain, redness, or swelling at the injection site.
- Muscle and joint aches and pains.
- Nausea.

Some side effects are less common, but require immediate medical attention. These include [82]:
- Chest tightness.
- Confusion.
- Coughing.
- Difficulty moving.
- Hives or rash.
- Irritability.
- Joint inflammation.
- Loss of strength.
- Lymphadenopathy in the neck, underarm, or groin.
- Muscle pain, stiffness, or weakness.
- Paralysis or severe weakness in the legs.
- Rash.
- Respiratory distress.
- Seizures.
- Stiffness of the extremities or neck.
- Swelling of the eyelids, area around the eyes, face, lips, or tongue.
- Tachycardia.
- Trouble swallowing.
- Unusual fatigue.
- Vomiting.

**Rabies alert!** Rabies vaccine injection site is the deltoid muscle. Injection sites should be rotated. When administering RIG, half of it should be infiltrated into and around the bite wound. The remaining half is injected intramuscularly [24].

**Rabies alert!** Healthcare professionals should stress disease prevention with patients. They should also emphasize the need for household pets to receive necessary immunizations and warn patients to avoid touching wild animals. They should also promote the prophylactic administration of rabies vaccine to those at high risk such as forest rangers, camp ground personnel, farm workers, and veterinarians [24].

If rabies does develop, it is almost always fatal. The patient should be kept as comfortable as possible in a dark, quiet room. Use meticulous standard precautions when handling body fluids. Healthcare personnel should be careful to avoid being bitten by the patient during “furious” episodes. Provide emotional support and appropriate mental health counseling to patients and families as they deal with this probably fatal disease [24, 39].

**Rabies alert!** Transmission of rabies from person to person is rare. To date, there is no report/documentation of the disease being transmitted from patient to healthcare worker [24].

**Anthrax**

February 19, 2014 CNN Justice online: “The FBI announced that it has concluded its investigation into the 2001 anthrax mailings, saying Friday that a biodefense researcher carried out the attacks alone. The anthrax letters killed five people and sickened 17 shortly after the September 11, 2001, terrorist attacks. The letters, filled with bacterial spores, were sent to Senate Democratic leaders and news organizations. By 2007, investigators conclusively determined that a single spore-batch created and maintained by Dr. Bruce E. Ivins at the United States Army Medical Research Institute of Infectious Diseases was the parent material for the letter spores, said a report released Friday by the FBI. Evidence developed from that investigation established that Dr. Ivins, alone, mailed the anthrax letters. Ivins, 62, committed suicide in July 2008 as federal agents were closing in on him, police said [83]. ”

Like rabies, immunization for the prevention of anthrax is not routinely administered. But the use of anthrax as a terrorist weapon makes it important for healthcare workers to become familiar with its clinical manifestations and available vaccine.

Anthrax is an acute bacterial infection caused by the bacteria Bacillus anthracis, which exists as spores in soil. These spores can live for years. It is most often found in animals that graze, such as sheep, goats, cattle, and horses. The disease can also affect humans who come into contact with infected animals or their fur, bones, hair,
wool [24]. Anthrax is also used as a bioterrorism agent, as in the 2001 case when letters containing anthrax spores were mailed to various people, including members of Congress and news organizations in the U.S.

There are three forms of anthrax [24, 84]:

- Cutaneous or skin anthrax: This form of anthrax is usually transmitted when someone with a break in their skin comes into direct contact with anthrax spores. Resulting skin infection causes a small, elevated, itchy lesion that looks like the bite of an insect. In one to two days, this lesion becomes a vesicle. Eventually, the lesion becomes a small, painless ulcer with a black, necrotic center. In addition to the lesion, patients may develop headaches, muscle aches, fever, vomiting, and enlarged lymph nodes in surrounding areas. Without treatment, the mortality rate is 20 percent. With treatment, the mortality rate is less than 1 percent. Cutaneous anthrax is the most common form of the disease. Prompt treatment is essential.

- Inhalation anthrax: Inhalation anthrax is the most serious form of the disease. It is also the rarest form. People contract inhalation anthrax by breathing in a large number of anthrax spores that have been suspended in the air. Initial signs and symptoms resemble those of the common cold, such as malaise, fever, headache, chills, and myalgia. The disease can progress to cause severe respiratory distress and shock. Sadly, even with treatment, inhalation anthrax is usually fatal. **Anthrax alert! Anthrax has not been known to spread from person to person [24]**.

**Diagnosis**

Diagnosis is made by culturing blood, skin lesions, or sputum of the patient. The presence of Bacillus anthracis confirms the diagnosis of anthrax. Specific antibodies to the bacterium may also be detected [24].

**Treatment and nursing considerations**

It is imperative that treatment be initiated as soon as exposure to anthrax is suspected. Antibiotic therapy with agents such as penicillin, ciprofloxacin, and doxycycline are the drugs most often used. The patient’s response to antibiotic therapy is monitored, and supportive measures such as monitoring vital signs, intake and output, cardiac and respiratory status are performed [24, 39].

Emotional support is also critical since this is a frightening, often fatal, disease.

**Vaccine**

Anthrax vaccine consists of an attenuated strain of the bacterium. This vaccine is not available for routine administration to the general public and is, as of this writing, administered only to U.S. military personnel and, under certain circumstances, to other people who have been exposed to anthrax [24, 85].

The only licensed anthrax vaccine is Anthrax Vaccine Adsorbed (AVA) or BioThraxTM and is indicated for active immunization for the prevention of anthrax caused by Bacillus anthracis in people 18 to 65 years of age at high risk of exposure (e.g. people who work with potentially infected animals, researches who study the bacterium, or military personnel). The vaccine has been approved for use since 1970. Next-generation vaccines are currently under development by a variety of manufacturers [85].

BioThraxTM has been purchased by the U.S. federal government. It is stored in the Strategic National Stockpile (SNS) for use as part of a post-exposure prophylaxis regimen with licensed antibiotics in the event of a terrorist attack with anthrax. The military also has an active vaccination program for military personnel going to specific locations around the world [85].

Questions still exist about the spread of anthrax via the mail, since this was the mode of transport in the 2001 domestic terrorist attacks. The World Health Organization offers the following advice about suspicious letters or parcels [84].

- Typical characteristics of letters or parcels that should incite suspicion include having a powdery substance on the outside, are

- Gastrointestinal (GI) anthrax: GI anthrax is acquired from eating the meat of an infected animal. Patients develop symptoms similar to food poisoning such as nausea, vomiting, and fever. However, these symptoms progress to abdominal pain, vomiting blood, and severe diarrhea. People should seek medical evaluation and treatment swiftly. Even with treatment, death occurs in 25 to 60 percent of cases.

**Anthrax alert!**
Summary

Thanks to long-term research, immunizations are now available for many diseases that were once significant causes of serious complications and even death. Research continues in the area of immunization so that current vaccines may be made even more safe and effective, and that new vaccines may be developed to limit or prevent the occurrence of diseases for which there are currently no means of prevention.

Some members of the public, including some healthcare professionals, have concerns about the number of vaccines administered, the timetable for administration, and the safety and effectiveness of immunization programs. Nurses should be aware of these concerns and be prepared to address them when interacting with patients and families. Nurses should also be aware of their own concerns regarding vaccines and vaccine-preventable diseases. These concerns should not interfere with objective patient education and counseling.

It is important that healthcare professionals be aware of potential vaccine side effects. Even though the vast majority of vaccines cause minimal, mild side effects, there remains the potential for serious adverse occurrences, such as anaphylactic reactions. When assisting with vaccine administration, nurses should meticulously help patients and families identify potential risk factors for such reactions, including allergies to vaccine components.

Nurses and other healthcare professionals should also be aware of the laws that govern vaccine administration. For example, what laws are in place regarding vaccination status prior to children being enrolled in school? Are there exemptions to these laws? Laws vary from state to state in the U.S., so nurses must be aware of the laws governing immunizations in their particular geographic location. Nurses must be able to help clarify these laws for patients and families and comprehend what type of exemptions may apply (e.g. medical, religious, and/or philosophical).

Nurses must also be aware of the consequences of refusal to receive vaccinations. For example, parents of unvaccinated children may be held legally liable (in some states) if their children transmit a vaccine-preventable disease to another child.

Patients and families must also be aware of the effects of acquiring vaccine-preventable diseases. Some diseases, such as rubella, are mild and self-limiting; however, even these diseases can have serious consequences. Recall that a pregnant female exposed to rubella may give birth to a baby with serious birth defects as a consequence of such exposure. Additionally, all diseases have the potential to cause complications, some of which can be life-altering.

Adults often forget that they, too, need to receive vaccinations. Vaccines to prevent influenza, pneumonia, and shingles are available. However, many adults refuse such vaccines, which generally increase the potential for severe outbreaks and epidemics. Adults are often also unaware of the need for periodic booster immunizations to ensure that they remain protected.

Members of healthcare professions must also be aware that more and more healthcare organizations are mandating that their employees receive influenza vaccine on a yearly basis. This trend may expand to include vaccination for other diseases as well, and nurses must be prepared for such mandates.

Nurses must also recognize how disease-causing pathogens can be used as bioterrorist weapons. For example, the fact that specimens of the smallpox virus are still maintained for research purposes has triggered concerns that such specimens may be used as weapons of terror in the U.S. and other countries.

Diseases that are considered eradicated (e.g. smallpox) or under control have the potential to experience resurgence and cause dangerous epidemics if causative pathogens fall into the hands of those who would use them as weapons.

Finally, all healthcare professionals must be aware of steps to take to prevent vaccine-preventable diseases in addition to immunization. Basic infection control initiatives (e.g. frequent hand-washing) can go a long way to prevent the contraction and spread of disease. They must also be able, in the event that these diseases are contracted, to teach family members and other caregivers and close contacts, how to avoid becoming ill themselves.

Another aspect of prevention is to discourage the unnecessary use of antibiotics. Many people believe that taking antibiotics is a good way to prevent disease. They must be taught that prophylactic antibiotic therapy is useful only under specific circumstances outlined by qualified healthcare providers. The over-use of antibiotics has contributed to the ever-growing problem of antibiotic-resistant pathogens. It is a matter of concern to all who work in healthcare. Researchers are constantly looking for ways to develop new antibiotics to combat resistant pathogens. But patient education about the dangers of indiscriminate use of antibiotics is essential as part of the fight against drug resistant pathogens.

Vaccine-preventable diseases have decreased drastically thanks to effective, vigorous immunization programs. However, there has been an increase in the number of cases of such diseases due, in large part, to people not receiving recommended immunizations. This increase can have drastic consequences as in the case of recent deadly outbreaks of meningitis on college campuses or severe complications of influenza and pneumonia, or as seen in current outbreaks of measles (the most serious of childhood diseases) in unvaccinated populations. Healthcare professionals must help patients and families consider whether the potential side effects of vaccination outweigh the benefits of immunization. With appropriate immunization programs, it is hoped that more and more vaccine-preventable diseases can be eradicated.
VACCINE-PREVENTABLE DISEASES: DEALING WITH THE THREAT OF POTENTIAL DISEASE OUTBREAKS

Self Evaluation Exercises
Select the best answer for each question and check your answers at the bottom of the page.

You do not need to submit this self-evaluation exercise with your participant sheet.

1. Some parents expressed worries that too many vaccines administered at one time could overwhelm their children’s immune system or that the components of the vaccines could cause long-term adverse effects.
   - True
   - False

2. Serious shingles vaccine related side effects are common.
   - True
   - False

3. The CDC says that adults previously vaccinated against polio who plan to travel to countries where there is a risk of polio have no need for booster doses of inactivated polio virus vaccine.
   - True
   - False

4. The incidence of whooping cough is believed to be increasing because the pertussis vaccine immunity received when vaccinated as a child has decreased leaving most teenagers and adults susceptible to the disease during an outbreak.
   - True
   - False

5. Rabies causes patients to have difficulty opening their mouths, and they develop a facial spasm that resembles a bizarre, distorted grin.
   - True
   - False

6. Live attenuated influenza vaccine is now available as a nasal spray approved for healthy persons two to 49 years of age who are not pregnant.
   - True
   - False

7. Diagnosis of measles is generally made by the evaluation of presenting clinical manifestations, particularly the appearance of the characteristic Koplik’s spots.
   - True
   - False

8. Adults who do not need to receive the MMR vaccine if the patient is a male born before 1957.
   - True
   - False

9. Children with varicella expose unimmunized adult contacts to the risk of severe, possibly fatal, disease.
   - True
   - False

10. HBV is the main cause of cirrhosis and liver cancer throughout the world.
    - True
    - False

11. When testing for meningeal irritation with Brudzinski’s sign the patient is placed in the prone position and the head is extended upward.
    - True
    - False

12. Treatment measures to management bacterial meningitis include the administration of mannitol to treat cerebral edema.
    - True
    - False

13. Lactating mothers with rotavirus should continue to breast feed their babies without restriction.
    - True
    - False

14. In pneumonia, Pathogen resistance to penicillin is becoming much more common, so treatment with agents such as vancomycin or levofloxacin should also be considered.
    - True
    - False

15. Inhalation anthrax is the most serious form of the disease.
    - True
    - False

Answers:

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