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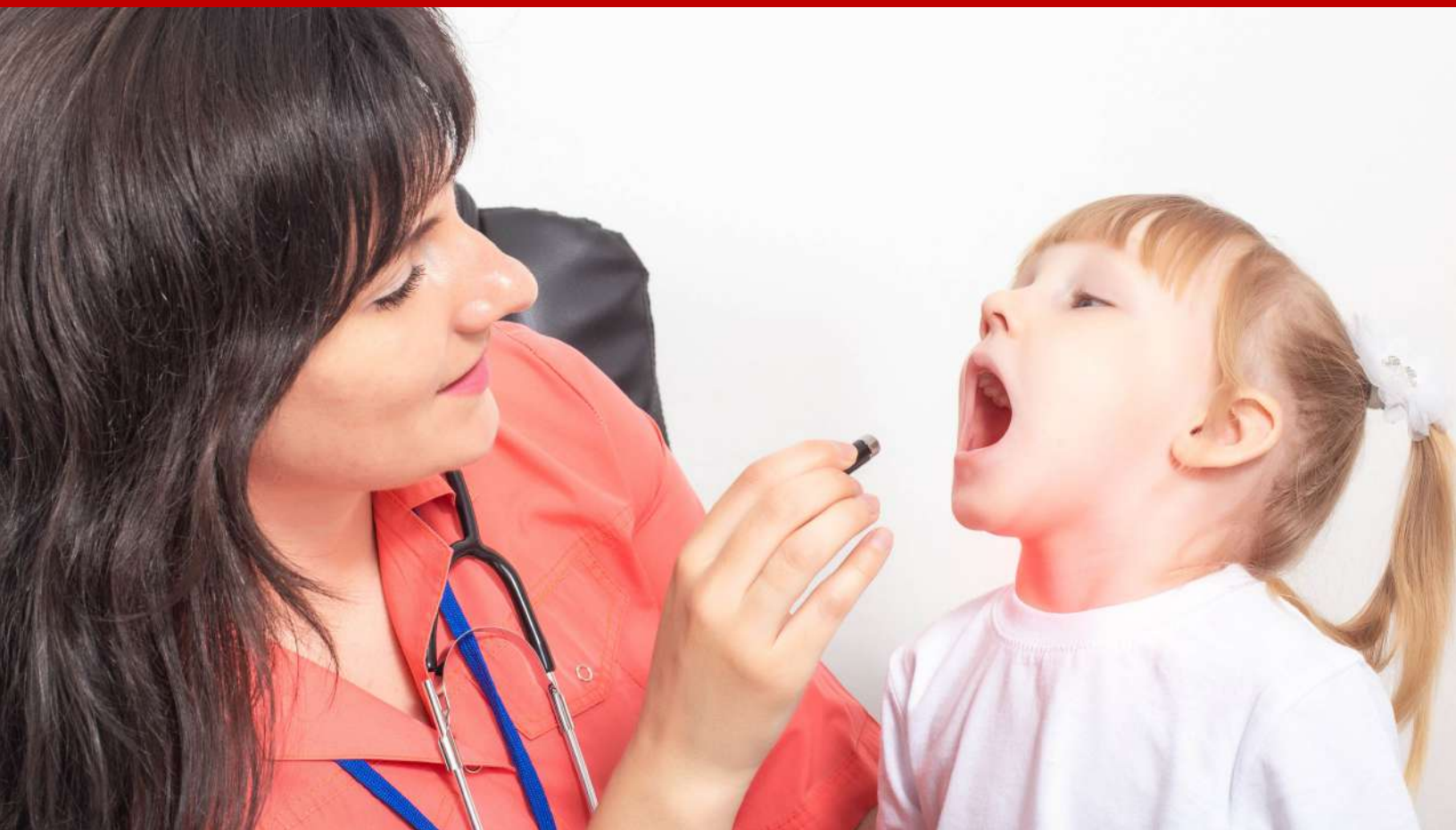
Pediatric Acute Respiratory Infection



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Introduction

Acute respiratory infections can impact a child's health, overall well-being, and quality of life, as well as lead to death. The question is, what types of infections may be characterized as respiratory infections, and how can health care professionals effectively treat specific respiratory infections? This course will answer that very question, while providing insight into methods that may be used to prevent respiratory infections among pediatric patient populations.

Section 1: Respiratory Infections

The parents of a 10-year-old child present to a health care facility. The parents report that their child is suffering from a runny nose, post-nasal drip, a sore throat, and a cough. Upon hearing the child's symptoms, a health care professional begins to consider a respiratory infection. The question that remains is, what types of infections may be characterized as respiratory infections, and how can health care professionals effectively treat specific respiratory infections? This section of the course will answer the previous question, while providing insight into acute respiratory infections. The information found within this section of the course was derived from materials provided by the Centers for Disease Control and Prevention (CDC) unless, otherwise, specified (Centers for Disease Control and Prevention [CDC], 2017).

What is an acute respiratory infection?

An acute respiratory infection may refer to any infectious disease of the upper or lower respiratory tract; an infection that may interfere with normal breathing.

Health care professionals should note the following: the upper respiratory tract consists of the airways from the nostrils to the vocal cords in the larynx, including the paranasal sinuses and the middle ear; the lower respiratory tract covers the continuation of the airways from the trachea and bronchi to the bronchioles and the alveoli (note: the paranasal sinuses may refer to the air-filled spaces that surround the nasal cavity; alveoli may refer to tiny air sacs found in the lungs).

What are the risk factors associated with acute respiratory infections?

The risk factors associated with acute respiratory infections for pediatric patients include the following: age, sex, birth weight, immunization status, nutritional status, breastfeeding, passive smoking, co-infection with human immunodeficiency virus (HIV),

poor hand hygiene, child care/school attendance, and exposure to individuals suffering from a respiratory infection (note: passive smoking may refer to the involuntary inhaling of smoke from other individual's tobacco products [e.g., cigarettes, cigars, and pipes]; hand hygiene may refer to the process of cleaning hands in order to prevent contamination and/or infections).

What are the signs/symptoms of an acute respiratory infection?

The signs/symptoms of an acute respiratory infection include the following:

- Nasal congestion
- Chest congestion
- Difficulty breathing
- Cough
- Runny nose
- Sore throat
- Fever
- Fatigue
- Body aches

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What are the leading causes of acute respiratory infections?

The leading causes of acute respiratory infections include viruses and bacteria.

Health care professionals should note the following: a virus may refer to an infectious agent that can replicate inside the living cells of an organism; bacteria may refer to a living organism that often consists of one biological cell; one of the main differences between a virus and bacteria is that a virus requires a host (e.g., living organism) for long-term survival.

What types of infections may be characterized as a respiratory infection?

Common Cold

One of the first types of infections that may come to mind when considering acute respiratory infections is the common cold. Specific information regarding the common cold may be found below.

- The term common cold may refer to a viral infection of the upper respiratory tract.
- At least 200 viruses can cause the common cold.
- Sore throat and runny nose are usually the first signs/symptoms of the common cold. Additional signs/symptoms of the common cold may include the following: sneezing, coughing, fatigue, body aches, headache, and low-grade fever (note: the term low-grade fever may refer to a body temperature that falls between 99.5°F [37.5°C] and 100.3°F [38.3°C]).
- Most individuals recover from the common cold within, approximately, 7 - 10 days. However, children should seek health care if they meet one or more of the following conditions: symptoms that last more than 10 days; symptoms that are severe or unusual (e.g., a fever 100°F or higher); the child is younger than three months of age and has a fever or is lethargic.
- Individuals suffering from the common cold may present with the following: sneezing, cough, a low-grade fever, a fever 100°F or higher, and body aches/ headache.
- The diagnostic process for the common cold may include a physical exam.
- *Health care professionals should note the following treatment recommendations for the common cold:* the treatment and management of the common cold should focus on symptomatic relief; antibiotics should not be prescribed for the common cold; there is potential for harm and no proven benefit from over-the-counter cough and cold medications in children younger than six; over-the-counter cough and cold medications are among the top 20 substances leading to death in children younger than five.

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Acute Sinusitis

Another type of infection that may initially come to mind when considering acute respiratory infections is sinusitis, also referred to as a sinus infection. Specific information regarding sinusitis may be found below.

- Sinusitis may refer to inflammation of the sinuses.
- Sinus infections occur when fluid builds up in the air-filled pockets in the face (sinuses), which allows germs to grow.
- Viruses cause most sinus infections, however, bacteria may also cause some sinus infections.
- Risk factors for sinus infections include the following: a previous cold, seasonal allergies, exposure to secondhand smoke, structural problems within the sinuses (e.g., growths on the lining of the nose or sinuses), and a weakened immune system.
- The signs/symptoms of a sinus infection may include the following: runny nose, stuffy nose, facial pain or pressure, headache, post-nasal drip, sore throat, cough, and bad breath.
- Children should seek health care if they meet one or more of the following conditions: severe symptoms (e.g., severe headache or facial pain); symptoms that get worse after initially improving; symptoms lasting more than 10 days without improvement; fever longer than three to four days; the child is younger than three months old and has a fever of 100.4 °F (38 °C) or higher.
- Individuals suffering from a sinus infection may present with the following: runny nose, stuffy nose, facial pain, a low-grade fever, and/or a fever 100°F or higher.
- The diagnostic process for a sinus infection may include a physical exam.
- *Health care professionals should note the following treatment recommendations for acute sinusitis:* watchful waiting for up to three days may be offered for children with acute bacterial sinusitis with persistent symptoms; antibiotic therapy should be prescribed for children with acute bacterial sinusitis with severe or worsening disease; amoxicillin or amoxicillin/clavulanate remain first-line therapy; in children who are vomiting or who cannot tolerate oral

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medication, a single dose of ceftriaxone can be used and then can be switched to oral antibiotics if improving.

Acute Otitis Media

Additionally, acute otitis media may come to mind when considering acute respiratory infections. Specific information regarding acute otitis media may be found below.

- Otitis media may refer to an infection of the middle ear.
- Children are more likely than adults to get ear infections.
- Otitis media may be caused by viruses or the following bacteria: Streptococcus pneumoniae and Haemophilus influenzae.
- The signs/symptoms of otitis media in pediatric patients may include the following: ear pain, fever, fussiness, irritability, rubbing or tugging at an ear, and difficulty sleeping.
- Children should seek health care if they meet one or more of the following conditions: symptoms of a middle ear infection that last for more than 2 - 3 days; worsening signs/symptoms; pus, discharge, or fluid coming from the ear; hearing loss; if the child is younger than three months old and has a fever greater than 100.4 ℉ (38 ℃).
- Individuals suffering from otitis media may present to a health care facility with complaints of ear pain, a fever, and they may be repeatedly touching or rubbing their ears.
- The diagnostic process for otitis media may include a physical exam. Diagnosis of otitis media typically requires one of the following to be present: moderate or severe bulging of tympanic membrane (TM) or new onset otorrhea not due to otitis externa; mild bulging of the TM and recent (<48h) onset of otalgia with holding, tugging, rubbing of the ear in a nonverbal child or intense erythema of the TM (note: the term otalgia may refer to ear pain; erythema may refer to redness of the skin).
- *Health care professionals should note the following:* acute otitis media should not be diagnosed in children without middle ear effusion (based on pneumatic otoscopy and/or tympanometry); effusion may refer to fluid buildup in the space behind the eardrum.

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- *Health care professionals should note the following treatment recommendations for acute otitis media:* mild cases with unilateral symptoms in children 6 - 23 months of age or unilateral or bilateral symptoms in children >2 years may be appropriate for watchful waiting based on shared decision-making; amoxicillin remains first line therapy for children who have not received amoxicillin within the past 30 days; amoxicillin/clavulanate is recommended if amoxicillin has been taken within the past 30 days, if concurrent purulent conjunctivitis is present, or if the child has a history of recurrent acute otitis media unresponsive to amoxicillin; for children with a non-type I hypersensitivity to penicillin: cefdinir, cefuroxime, cefpodoxime, or ceftriaxone may be appropriate choices; prophylactic antibiotics are not recommended to reduce the frequency of recurrent acute otitis media.

Pharyngitis

Pharyngitis is often simply referred to as a "sore throat," and may be common among children. Specific information regarding pharyngitis may be found below.

- Pharyngitis may refer to inflammation of the pharynx.
- Pharyngitis is common among children five through 15 years of age.
- The signs/symptoms of pharyngitis may include the following: sore throat, dry throat, throat pain, difficulty swallowing, swollen lymph nodes, fever, runny nose, cough, chills, body aches, headache, fatigue, malaise, muscle aches, loss of appetite, and rash.
- Viruses and bacteria can lead to acute pharyngitis.
- *Streptococcus pyogenes*, which are also called group A *Streptococcus* or group A strep, can cause acute pharyngitis, also referred to as strep throat.
- Group A strep pharyngitis is an infection of the oropharynx caused by *S. pyogenes*. *S. pyogenes* are gram-positive cocci that grow in chains.
- Group A strep pharyngitis is most commonly spread through direct person-to-person transmission (note: transmission typically occurs through saliva or nasal secretions from an infected person).
- Individuals suffering from pharyngitis typically present with complaints of a sudden-onset of sore throat, fever, and odynophagia (note: odynophagia may refer to painful swallowing).

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- Upon presentation, health care professionals should confirm group A strep pharyngitis in children older than three years of age to appropriately guide treatment decisions. Health care professionals should note the following: providing antibiotics to children with confirmed group A strep pharyngitis can reduce their risk of developing sequela (acute rheumatic fever); testing for group A strep pharyngitis is not routinely indicated for children younger than three years of age.
- The diagnostic process for pharyngitis may include the following: a physical exam, throat culture, and/or blood tests.
- *Health care professionals should note the following treatment recommendations for pharyngitis:* amoxicillin and penicillin V remain first-line therapy; for children with a non-type I hypersensitivity to penicillin, cephalexin, cefadroxil, clindamycin, clarithromycin, or azithromycin are recommended; for children with an immediate type I hypersensitivity to penicillin, clindamycin, clarithyomycin, or azithroymycin are recommended; recommended treatment course for all oral beta lactams is 10 days.

Bronchiolitis

Bronchiolitis is the most common lower respiratory tract infection in infants. Specific information regarding bronchiolitis may be found below. The information found below was derived from materials provided by the CDC unless, otherwise, specified (CDC, 2020).

- Bronchiolitis may refer to inflammation of the bronchioles.
- Bronchiolitis is typically caused by the respiratory syncytial virus (RSV).
- Viral bronchiolitis affects children up to two years old. However, it generally occurs in infants three to nine months of age.
- Almost all children become infected with RSV by the time they are two years old.
- Risk factors for RSV infection include the following: preterm birth; very young infants, especially those six months and younger; children younger than two years old with chronic lung disease or congenital heart disease; children with suppressed immune systems; children who have neuromuscular disorders, including those who have difficulty swallowing or clearing mucus secretions

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(note: the term preterm birth may refer to the birth of a live baby that is born before 37 weeks of pregnancy have been completed).

- Transmission of RSV may occur when: an infected individual coughs or sneezes; virus droplets from a cough or sneeze enters the eyes, nose, or mouth; an individual touches a surface that has the virus on it (e.g., table; countertop) and then touches the face, mouth, and/or nose; direct contact with the virus.
- Individuals infected with RSV are usually contagious for three to eight days. However, some infants, and individuals with weakened immune systems, can continue to spread the virus even after they stop showing symptoms, for as long as four weeks.
- RSV can survive for many hours on hard surfaces such as tables and crib rails. It typically lives on soft surfaces such as tissues and hands for shorter amounts of time.
- Children are often exposed to and infected with RSV outside the home (e.g., in school or child-care centers).
- Infants who get an RSV infection almost always show symptoms.
- Early symptoms of RSV may include: runny nose, decrease in appetite, and cough, which may progress to wheezing (note: fever may not always occur with RSV infections).
- In very young infants (e.g., less than six months old), the only symptoms of a RSV infection that may be present include the following: irritability, decreased activity, decreased appetite, and apnea (note: apnea may refer to pauses while breathing).
- Infants/children should seek health care if they meet one or more of the following conditions: difficulty breathing, not drinking enough fluids, and/or experiencing worsening symptoms.
- Individuals suffering from bronchiolitis may present to a health care facility with complaints of a runny nose, coughing, wheezing, irritability, decreased appetite, and may be having difficulty breathing.

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- The diagnostic process for bronchiolitis may include a physical exam, chest x-ray, and/or laboratory testing (note: a chest x-ray may help identify inflammation in the chest).

- *Health care professionals should note the following:* several types of laboratory tests are available for confirming RSV infection; RSV-related tests may be performed on upper and lower respiratory specimens. Health care professionals should also note the following tests that may be used to confirm the presence of a RSV infection: real-time reverse transcriptase-polymerase chain reaction (rRT-PCR), which is more sensitive than culture and antigen testing; antigen testing; viral culture.

- *Health care professionals should note the following treatment recommendations for bronchiolitis:* usually patients worsen between three to five days, followed by improvement; antibiotics are not helpful and should not be used; nasal suctioning is the mainstay of therapy; there is no evidence to support routine suctioning of the lower pharynx or larynx.

Acute Bronchitis

Bronchitis is often referred to as a chest cold. Specific information regarding bronchitis may be found below.

- Bronchitis may refer to inflammation of the mucous membrane in the bronchial tubes (note: the bronchial tubes carry air to and from the lungs).

- Acute bronchitis occurs when the airways of the lungs swell and produce mucus in the lungs.

- Acute bronchitis is usually caused by a virus and often occurs after an upper respiratory infection. Bacteria may also lead to acute bronchitis.

- The signs/symptoms of acute bronchitis may include the following: coughing with or without mucus, soreness in the chest, fatigue, mild headache, mild body aches, and sore throat.

- The first sign/symptom of acute bronchitis is typically a cough. The cough will likely be dry at first, and then become productive. A productive cough is the most common symptom of acute bronchitis and can last from 10 days to three weeks (note: the term productive cough may refer to a cough that produces phlegm or mucus).

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- Symptoms of acute bronchitis typically last for less than three weeks.
- Infants/children should seek health care if they meet one or more of the following conditions: have symptoms lasting more than three weeks; exhibit a cough with bloody mucus; exhibit shortness of breath or trouble breathing; the child is younger than three months old and has a fever of 100.4 °F (38 °C) or higher (note: individuals experiencing repeated episodes of bronchitis may also require health care).
- Individuals suffering from bronchitis may present to a health care facility with complaints of a cough, mucus production, shortness of breath, trouble breathing, a fever, and/or repeated episodes of bronchitis.
- The diagnostic process for bronchitis may include a physical exam.
- *Health care professionals should note the following treatment recommendations for acute bronchitis:* acute bronchitis typically gets better on its own without antibiotics; children should receive rest and fluids; additional supportive care may be required for specific patients.

Pneumonia

Pneumonia is a potentially serious infection in children that may lead to hospitalization and/or prolonged hospitalization. Specific information regarding pneumonia may be found below. The information found below was derived from materials provided by the CDC (CDC, 2020).

- Pneumonia may refer to an infection of the lungs.
- A pneumonia infection typically leads to alveoli inflammation (note: alveoli may refer to tiny air sacs found in the lungs).
- Viruses, bacteria, and fungi may lead to pneumonia.
- In the U. S., common causes of viral pneumonia include RSV and severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).
- A common cause of bacterial pneumonia is *Streptococcus pneumoniae* (pneumococcus).
- Community-acquired pneumonia may refer to pneumonia that develops in the community (e.g., not in a hospital or other health care facility).

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- Health care-associated pneumonia may refer to pneumonia that develops during or following a stay in a health care setting (e.g., hospitals, long-term care facilities, and dialysis centers).
- Ventilator-associated pneumonia may refer to pneumonia that develops in an individual after he or she is on a ventilator (note: the term ventilator may refer to a machine that supports breathing).
- The signs/symptoms of pneumonia may include the following: cough, mucus production, chest pain, shortness of breath, fever, chills, fatigue, loss of appetite, nausea, vomiting, and headaches (note: infants may not appear to have signs/ symptoms of pneumonia, however, they may vomit, lack energy, or have trouble drinking or eating).
- Children should seek health care if they have a fever of 100.4 °F (38 °C) or higher.
- Individuals suffering from pneumonia may present to a health care facility with complaints of a cough, mucus production, shortness of breath, trouble breathing, fast breathing, wheezing, and a fever.
- The diagnostic process for pneumonia may include a physical exam, chest x-ray, and/or blood cultures.
- *Health care professionals should note the following treatment recommendations for community-acquired pneumonia:* amoxicillin for up to 10 days should be administered to patients that do not have a hypersensitivity to penicillin; azithromycin should be administered to patients that have a hypersensitivity to penicillin; cefuroxime and erythromycin should be reserved for severe pneumonia/critically ill patients.

Influenza

Due to a variety of contributing factors, influenza, otherwise referred to as the flu, is becoming a growing health concern for children. Specific information regarding influenza may be found below. The information found below was derived from materials provided by the CDC (CDC, 2021).

- Influenza may refer to a contagious respiratory illness caused by influenza viruses that infect the nose, throat, and lungs.

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- There are two main types of influenza viruses, types A and B. The influenza A and B viruses that routinely spread in people (human influenza viruses) are responsible for seasonal flu epidemics each year.
- Influenza A viruses can be broken down into sub-types depending on the genes that make up the surface proteins. Over the course of a influenza season, different types (A & B) and subtypes (flu A) of flu circulate and cause illness.
- Children younger than five years old, especially those younger than two, are at higher risk of developing serious flu-related complications (e.g., hospitalization).
- Research indicates that influenza viruses spread mainly by droplets made when individuals suffering from the flu cough, sneeze, and/or talk (note: individuals with influenza can transmit influenza viruses to others up to, approximately, six feet away). These droplets can land in the mouths or noses of individuals who are nearby or possibly be inhaled into the lungs. An individual may also become infected with a flu virus by touching a surface or object that has flu virus on it and then touching his or her own mouth, nose, or eyes.
- Individuals suffering from the flu are most contagious in the first three to four days after their illness begins. Most healthy adults may be able to infect others beginning one day before symptoms develop and up to five to seven days after becoming "sick." Children and some people with weakened immune systems may pass the virus to others seven or more days after becoming "sick."
- Symptoms of the flu can begin about two days after the virus enters the body.
- The signs/symptoms of the flu may include the following: fever, chills, cough, sore throat, runny nose, stuffy nose, muscle or body aches, headaches, fatigue, vomiting, and diarrhea.
- Children should seek health care if they meet one or more of the following conditions: fast breathing or trouble breathing; bluish lips or face; ribs pulling in with each breath; chest pain; severe muscle pain (child refuses to walk); dehydration (no urine for eight hours, dry mouth, no tears when crying); the child is not alert or interacting when awake; seizures; worsening of chronic medical conditions; fever or cough that improve but then return or worsen; fever above 104°F; in children less than 12 weeks, any fever.

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- Individuals suffering from the flu may present to a health care facility with complaints of a fever, chills, chest discomfort, trouble breathing, bluish lips or face, severe muscle pain, and dehydration.
- The diagnostic process for the flu may include a physical exam, a rapid influenza diagnostic test (RIDT), and a rapid molecular assay.
- RIDTs work by detecting the parts of the virus (antigens) that stimulate an immune response. RIDTs can provide results within approximately 10 - 15 minutes, however, they may not be as accurate as other flu tests. Therefore, an individual could have the flu, even though a RIDT result is negative.
- Rapid molecular assays detect genetic material of the flu virus. Rapid molecular assays produce results in 15 - 20 minutes and are more accurate than RIDTs.
- *Health care professionals should note that patients may confuse the flu for a cold*. The differences between the flu and a cold include the following: symptom onset is abrupt with the flu and more gradual with a cold; fever typically lasts for three to four days; chills are common with the flu and not as common with a cold; body aches are common and may be severe; chest discomfort can be severe; headaches are common with the flu and less common with a cold.
- *Health care professionals should note the following treatment recommendations for influenza:* the CDC and the American Academy of Pediatrics (AAP) recommend antiviral drugs to treat confirmed or suspected flu in children with severe, complicated, or progressive illness, or who are hospitalized with confirmed or suspected flu, as early as possible; prompt initiation of antiviral treatment is also recommended for children who are at high risk of serious flu complications and who have confirmed or suspected flu of any severity; children at high risk for flu-related complications include children younger than five years old (especially those younger than two years) and children of any age with certain chronic health conditions like asthma, diabetes, or heart or lung disease.
- The four CDC recommended flu antiviral drugs approved by the U.S. Food and Drug Administration (FDA) include the following: oseltamivir, zanamivir, peramivir, and baloxavir. Specific information on the aforementioned antiviral drugs may be found below. The information found below was derived from materials provided by the CDC (CDC, 2020).

- **Oseltamivir** - oseltamivir is available as a generic version or under the trade name Tamiflu. Oseltamivir is approved for treatment of the flu in children two weeks old or older.
- **Zanamivir** - zanamivir is approved for treatment of flu in children seven years and older. It is not recommended for use in children with underlying respiratory disease, including those with asthma and other chronic lung diseases.
- **Peramivir** - peramivir is given intravenously and recommended for use in children two years and older.
- **Baloxavir** - baloxavir is a pill that is given as a single dose by mouth and is approved for early outpatient treatment of children with the flu who are aged 12 years and older.

Coronavirus disease 2019 (COVID-19)

Finally, due to the current pandemic, COVID-19 should come to mind when considering respiratory infections. Specific information regarding COVID-19 may be found below. The information found below was derived from materials provided by the CDC (CDC, 2021).

- Coronavirus disease 2019 (COVID-19) may refer to a respiratory illness that can spread from person to person that is caused by a virus known as the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).
- SARS-CoV-2, the virus that causes COVID-19, is an enveloped virus, meaning that its genetic material is packed inside an outer layer (envelope) of proteins and lipids. The envelope contains structures (e.g., spike proteins) for attaching to human cells during infection.
- Research indicates that COVID-19 is transmitted or spread through person-to-person contact (note: the term person-to-person contact may refer to the transmission of a communicable disease/illness from a host to a healthy person by way of body fluids [e.g., respiratory droplets, blood]).
- It may also be possible for an individual to obtain COVID-19 by touching a surface or an object that has become contaminated with the COVID-19 virus and then touching his or her face, mouth, nose, and/or eye.

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- Research indicates that SARS-CoV-2 can survive on a variety of porous (e.g., paper; fabric) and non-porous surfaces (e.g., glass; plastics; metals). On porous surfaces, studies report an inability to detect viable virus within minutes to hours; on non-porous surfaces, viable virus can be detected for days to weeks. The apparent, relatively faster inactivation of SARS-CoV-2 on porous compared with non-porous surfaces might be attributable to capillary action within pores and faster aerosol droplet evaporation.

- The incubation period for COVID-19 is thought to extend to 14 days, with a median time of 4 - 5 days from exposure to symptoms onset.

- COVID-19 variants currently exist within the U.S. The Delta variant is one of the most predominate COVID-19 variants in the U.S. Health care professionals should note the following: the Delta variant causes more infections and spreads faster than early forms of SARS-CoV-2; the Delta variant is highly contagious, more than two times as contagious as previous variants; recent data suggests the Delta variant might cause more severe illness than previous variants in unvaccinated individuals; the greatest risk of transmission is among unvaccinated individuals who are much more likely to get infected, and therefore transmit the virus.

- The potential symptoms of COVID-19 include the following: fever, chills, cough, shortness of breath, aches and pain, fatigue, headaches, nasal congestion, runny nose, sore throat, new loss of taste or smell, nausea, vomiting, and diarrhea (note: COVID-19 can range from mild symptoms to severe illness).

- Children should seek health care if they meet one or more of the following conditions: trouble breathing; persistent pain or pressure in the chest; new or worsening confusion; inability to wake or stay awake; pale, gray, or blue-colored skin, lips, or nail beds, depending on skin tone; if the child is younger than three months old and has a fever greater than 100.4 °F (38 °C).

- Individuals potentially suffering from COVID-19 may present to a health care facility in a variety of different states including the following: the potential exposure state; the mild symptom state; the severe illness state; and the critical illness state.

- Individuals in the potential exposure state may present to a health care facility with reports that they were exposed to the COVID-19 virus. Typically, individuals presenting in the potential exposure state will not exhibit symptoms of COVID-19 or appear to be "sick." Health care professionals should follow their health care

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organization's policies and procedures regarding COVID-19 when caring for patients in the potential exposure state.

- Individuals potentially suffering from COVID-19 may present to a health care facility in the mild symptom state. Individuals in the mild symptom state may not appear to be "sick," or they may appear to be "mildly sick" (i.e., individuals in the mild symptom state may appear to have a cold). Individuals in the mild symptom state may present with reports of the following symptoms: fever, chills, cough, shortness of breath, aches and pain, fatigue, headaches, nasal congestion, runny nose, sore throat, new loss of taste or smell, nausea, vomiting, and diarrhea. Individuals presenting in the mild symptom state, once diagnosed with COVID-19, may require health care. If a health care professional is administering care to an individual in the mild symptom state, with confirmed COVID-19, he or she should follow his or her health care organization's policies and procedures regarding COVID-19 or related diseases. Health care professionals should note that individuals in the mild symptom state may transmit the COVID-19 virus to healthy individuals, including health care professionals, through person-to-person contact.

- Individuals potentially suffering from COVID-19 may present to a health care facility in the severe illness state. Individuals presenting in the severe illness state will appear to be "sick," and should exhibit symptoms of COVID-19. Additionally, individuals presenting in the severe illness state may suffer from the following: trouble breathing; persistent pain or pressure in the chest; new or worsening confusion; inability to wake or stay awake; pale, gray, or blue-colored skin, lips, or nail beds, depending on skin tone; fever greater than 100.4 °F (38 °C). Individuals presenting in the severe illness state may also be suffering from some of the complications of COVID-19, which include pneumonia in both lungs. Individuals in the severe illness state may require immediate health care, and should be triaged accordingly. Health care professionals should follow their specific health care organization's policies and procedures regarding COVID-19 when administering health care to patients in the severe illness state. Health care professionals should note that individuals in the severe illness state may transmit the COVID-19 virus to healthy individuals, including health care professionals, through person-to-person contact.

- Individuals potentially suffering from COVID-19 may present to a health care facility in the critical illness state. Individuals presenting in the critical illness state

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will appear to be "sick," and should exhibit symptoms of COVID-19. Additionally, individuals presenting in the severe illness state may suffer from respiratory failure, shock, and/or multi-organ system dysfunction. Individuals in the critical illness state may require immediate health care, and should be triaged accordingly. Health care professionals should follow their specific health care organization's policies and procedures regarding COVID-19 when administering health care to patients in the critical illness state. Health care professionals should note that individuals in the severe illness state may transmit the COVID-19 virus to healthy individuals, including health care professionals, through person-to-person contact.

- The diagnostic process for COVID-19 may include a physical exam, SARS-CoV-2 viral tests (e.g., a nucleic acid amplification test [NAAT] or antigen tests), and possibly a serology test.

- Viral tests, including NAATs and antigen tests, are used as diagnostic tests to detect infection with SARS-CoV-2.

- *Health care professionals should note the following:* NAATs are high-sensitivity, high-specificity tests for diagnosing SARS-CoV-2 infection; NAATs are point-of-care tests with results available in about 15 - 45 minutes; NAATs can be performed on upper respiratory specimens, such as nasopharyngeal, nasal mid-turbinate, anterior nasal, or saliva; NAATs detect one or more viral ribonucleic acid (RNA) genes and indicate a current infection or a recent infection but, due to prolonged viral RNA detection, are not always direct evidence for the presence of virus capable of replicating or being transmitted to others.

- *Health care professionals should note the following:* antigen tests are immunoassays that detect the presence of a specific viral antigen; antigen tests generally have similar specificity, but are less sensitive than most NAATs; antigen tests can be performed on nasopharyngeal or anterior nasal specimens; due to the performance characteristics of antigen tests, it may be necessary for health care professionals to confirm some antigen test results (e.g., a negative test in individuals with symptoms or a positive test in individuals without symptoms).

- *Health care professionals should note the following:* antibody (or serology) tests are used to detect previous infection with SARS-CoV-2 and can aid in the diagnosis of Multisystem Inflammatory Syndrome in Children (MIS-C); the CDC does not recommend using antibody testing to diagnose current infection;

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depending on the time when someone was infected and the timing of the test, the test might not detect antibodies in someone with a current infection.

- Once diagnosed, pediatric patients suffering from COVID-19, may require treatment. COVID-19 treatment recommendations for children may be found below. The information found below was derived from materials provided by the National Institutes of Health (NIH) (National Institutes of Health [NIH], 2021).
- SARS-CoV-2 infection is generally milder in children than in adults, and a substantial proportion of children with the disease have asymptomatic infection.
- Most children with SARS-CoV-2 infection will not require any specific therapy.
- Children who have a history of medical complexity (e.g., due to neurologic impairment, developmental delays, or genetic syndromes including trisomy 21), obesity, chronic cardiopulmonary disease, or who are immunocompromised, as well as older teenagers may be at increased risk for severe disease.
- Most children with mild or moderate disease can be managed with supportive care alone.
- Remdesivir is recommended for hospitalized children aged ≥12 years with COVID-19 who have risk factors for severe disease and have an emergent or increasing need for supplemental oxygen; and hospitalized children aged ≥16 years with COVID-19 who have an emergent or increasing need for supplemental oxygen regardless of whether they have risks factors for severe disease.
- In consultation with a pediatric infectious disease specialist, remdesivir can be considered for hospitalized children of all ages with COVID-19 who have an emergent or increasing need for supplemental oxygen.
- The COVID-19 Treatment Guidelines Panel (the Panel) recommends using dexamethasone for hospitalized children with COVID-19 who require high-flow oxygen, noninvasive ventilation, invasive mechanical ventilation, or extracorporeal membrane oxygenation.
- Based on adult studies, bamlanivimab plus etesevimab or casirivimab plus imdevimab may be considered on a case-by-case basis for nonhospitalized children who meet Emergency Use Authorization (EUA) criteria for high-risk of severe disease, especially those who meet more than one criterion or are aged ≥16 years.

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What are the complications associated with respiratory infections?

- **Empyema** - empyema may refer to a collection of pus between the lung and the membrane that surrounds it, which typically results from a bacterial infection. Health care professionals should note the following symptoms of empyema: fever, cough, shortness of breath, and chest pain.
- **Lung abscess** - a lung abscess may refer to a pus-filled cavity within the lung that may be surrounded with inflamed tissue. Health care professionals should note the following symptoms of a lung abscess: fatigue, loss of appetite, night sweats, fever, weight loss, and a cough that brings up sputum (note: sputum may refer to a mixture of saliva and mucus).
- **Orbital cellulitis** - orbital cellulitis may refer to an infection of the fat and muscles around the eye. orbital cellulitis is typically associated with sinusitis. Health care professionals should note the following symptoms of orbital cellulitis: pain, swelling, red eye, fever, a bulging eye, and impaired vision.
- **Mastoiditis** - mastoiditis may refer to a bacterial infection that affects the mastoid bone behind the ear. Mastoiditis is often associated with otitis media. Health care professionals should note the following symptoms of mastoiditis: fever, pain, ear redness, and discharge from the ear.
- **Sepsis** - sepsis may refer to the body's extreme and toxic response to an infection. Sepsis can be life-threatening. Health care professionals should note the following signs/symptoms of sepsis: fever, difficulty breathing, low blood pressure, fast heart rate, and mental confusion.
- **Septic shock** - septic shock may refer to a condition characterized by hypotension, altered mental state, and organ dysfunction. Septic shock can be life-threatening. Health care professionals should note the following signs/symptoms of septic shock: dangerously low blood pressure; difficulty breathing; pale and cool arms, and legs; chills; decreased urine output; mental confusion and disorientation.
- **Multisystem inflammatory syndrome in children (MIS-C)** - multisystem inflammatory syndrome in children (MIS-C) is associated with COVID-19. Specific information regarding MIS-C may be found below. The information found below was derived from materials provided by the CDC (CDC, 2021).

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- Multisystem inflammatory syndrome in children (MIS-C) may refer to a condition characterized by inflammation of different body parts, such as: the heart, lungs, kidneys, brain, skin, eyes, and gastrointestinal organs.
- MIS-C can be life-threatening.
- The signs/symptoms of MIS-C include the following: stomach pain, diarrhea, vomiting, bloodshot eyes, skin rash, and low blood pressure (note: children may experience dizziness as a result of low blood pressure).
- Children potentially suffering from MIS-C should seek health care if they meet one or more of the following conditions: trouble breathing; persistent pain or pressure in the chest; new or worsening confusion; inability to wake or stay awake; pale, gray, or blue-colored skin, lips, or nail beds, depending on skin tone.
- Individuals potentially suffering from MIS-C may present to a health care facility with a persistent fever, abdominal pain, vomiting, diarrhea, skin rash, mucocutaneous lesions and, in severe cases, with hypotension and shock. Individuals typically suffering from MIS-C will have elevated laboratory markers of inflammation (e.g., CRP, ferritin), and in a majority of patients laboratory markers of damage to the heart (e.g., troponin; B-type natriuretic peptide [BNP] or proBNP). Some patients suffering from MIS-C may develop myocarditis, cardiac dysfunction, and acute kidney injury. Health care professionals should note the following: not all children suffering from MIS-C will have the same signs and symptoms; MIS-C may begin weeks after a child is infected with SARS-CoV-2.
- The diagnostic process for MIS-C may include a physical exam, blood tests, chest x-ray, heart ultrasound (e.g., echocardiogram), and an abdominal ultrasound.
- The treatment for MIS-C typically primarily consists of supportive care and directed care against the underlying inflammatory process. Health care professionals should note the following MIS-C supportive measures: fluid resuscitation; inotropic support; respiratory support; and extracorporeal membranous oxygenation (ECMO). Health care professionals should also note the following: anti-inflammatory measures for MIS-C typically include the frequent use of IVIG and steroids; aspirin may be used due to concerns for coronary artery involvement, and antibiotics may be used to treat

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potential sepsis while awaiting bacterial cultures; thrombotic prophylaxis is often used given the hypercoagulable state typically associated with MIS-C.

Section 1 Summary

An acute respiratory infection may refer to any infectious disease of the upper or lower respiratory tract; an infection that may interfere with normal breathing. The signs/ symptoms of an acute respiratory infection include the following: nasal congestion, chest congestion, difficulty breathing, cough, runny nose, sore throat, fever, fatigue, and body aches. The leading causes of acute respiratory infections include viruses and bacteria. The following types of infections may be characterized as a respiratory infection: the common cold, acute sinusitis, acute otitis media, pharyngitis, bronchiolitis, acute bronchitis, pneumonia, influenza, and COVID-19. The complications associated with respiratory infections include the following: empyema, lung abscess, orbital cellulitis, mastoiditis, sepsis, septic shock, and MIS-C. Finally, health care professionals should work to effectively identify patients potentially suffering from respiratory infections to help prevent any delay in treatment that could potentially lead to improved outcomes related to illness and mortality.

Section 1 Key Concepts

- The upper respiratory tract consists of the airways from the nostrils to the vocal cords in the larynx, including the paranasal sinuses and the middle ear; the lower respiratory tract covers the continuation of the airways from the trachea and bronchi to the bronchioles and the alveoli.
- The risk factors associated with acute respiratory infections for pediatric patients include the following: age, sex, birth weight, immunization status, nutritional status, breastfeeding, passive smoking, co-infection with human immunodeficiency virus (HIV), poor hand hygiene, child care/school attendance, and exposure to individuals suffering from a respiratory infection.
- The signs/symptoms of an acute respiratory infection include the following: nasal congestion, chest congestion, difficulty breathing, cough, runny nose, sore throat, fever, fatigue, and body aches.
- The leading causes of acute respiratory infections include viruses and bacteria.

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- The following types of infections may be characterized as a respiratory infection: the common cold, acute sinusitis, acute otitis media, pharyngitis, bronchiolitis, acute bronchitis, pneumonia, influenza, and COVID-19.
- The complications associated with respiratory infections include the following: empyema, lung abscess, orbital cellulitis, mastoiditis, sepsis, septic shock, and MIS-C.

Section 1 Key Terms

Acute respiratory infection - any infectious disease of the upper or lower respiratory tract; an infection that may interfere with normal breathing

Paranasal sinuses - the air-filled spaces that surround the nasal cavity

Alveoli - tiny air sacs found in the lungs

Passive smoking - the involuntary inhaling of smoke from other individual's tobacco products

Hand hygiene - the process of cleaning hands in order to prevent contamination and/or infections

Virus - an infectious agent that can replicate inside the living cells of an organism

Bacteria - a living organism that often consists of one biological cell

Common cold - a viral infection of the upper respiratory tract

Sinusitis - inflammation of the sinuses

Otitis media - an infection of the middle ear

Otalgia - ear pain

Erythema - redness of the skin

Effusion - fluid buildup in the space behind the eardrum

Pharyngitis - inflammation of the pharynx

Odynophagia - painful swallowing

Bronchiolitis - inflammation of the bronchioles

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Preterm birth - the birth of a live baby that is born before 37 weeks of pregnancy have been completed

Apnea - pauses while breathing

Bronchitis - inflammation of the mucous membrane in the bronchial tubes

Productive cough - a cough that produces phlegm or mucus

Pneumonia - an infection of the lungs

Community-acquired pneumonia - pneumonia that develops in the community

Health care-associated pneumonia - pneumonia that develops during or following a stay in a health care setting

Ventilator-associated pneumonia - pneumonia that develops in an individual after he or she in on a ventilator

Ventilator - a machine that supports breathing

Influenza - a contagious respiratory illness caused by influenza viruses that infect the nose, throat, and lungs

Coronavirus disease 2019 (COVID-19) - a respiratory illness that can spread from person to person that is caused by a virus known as the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)

Person-to-person contact - the transmission of a communicable disease/illness from a host to a healthy person by way of body fluids

Empyema - a collection of pus between the lung and the membrane that surrounds it, which typically results from a bacterial infection

Lung abscess - a pus-filled cavity within the lung that may be surrounded with inflamed tissue

Sputum - a mixture of saliva and mucus

Orbital cellulitis - an infection of the fat and muscles around the eye

Mastoiditis - a bacterial infection that affects the mastoid bone behind the ear

Sepsis - the body's extreme and toxic response to an infection

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Septic shock - a condition characterized by hypotension, altered mental state, and organ dysfunction

Multisystem inflammatory syndrome in children (MIS-C) - a condition characterized by inflammation of different body parts, such as: the heart, lungs, kidneys, brain, skin, eyes, and gastrointestinal organs

Section 1 Personal Reflection Question

How can health care professionals effectively identify individuals potentially suffering from a respiratory infection?

Section 2: Prevention

Respiratory infections can devastate a child's health, overall well-being, and quality of life, as well as lead to death. Fortunately, respiratory infections can be prevented. This section of the course will review methods that may be used to prevent respiratory infections in pediatric patients. The information found within this section of the course was derived from materials provided by the CDC unless, otherwise, specified (Centers for Disease Control and Prevention [CDC], 2021).

Hand Hygiene

Hand hygiene can be one of the most effective methods to prevent respiratory infections. Specific information regarding hand hygiene may be found below.

- Hand hygiene is most effective when dirt, soil, microorganisms, and other contaminants are removed from the hands.
- Patients should be counseled on effective hand hygiene.
- Individuals may use a variety of different products to carry out effective hand hygiene. The following products are typically available to health care professionals and may be used to carry out effective hand hygiene: detergents, plain soap, antimicrobial (medicated) soap, antiseptic agents, and alcohol-based handrubs.
- The major indications for hand hygiene, for all individuals, can be broken down into the following key moments:
    - Before, during, and after preparing food

    - Before and after eating food
    - Before and after caring for someone at home who is sick with vomiting or diarrhea
    - Before and after treating a cut or wound
    - After using the toilet
    - After changing diapers or cleaning up a child who has used the toilet
    - After blowing the nose, coughing, or sneezing
    - After touching an animal, animal feed, or animal waste
    - After handling pet food or pet treats
    - After touching garbage
- Health care professionals should engage in hand hygiene if exposure to potential spore-forming pathogens is strongly suspected or proved (note: handwashing with soap and water is the preferred means).
- Health care professionals should engage in hand hygiene before handling an invasive device for patient care.
- Health care professionals should engage in hand hygiene after contact with body fluids or secretions, mucous membranes, non-intact skin, or wound dressings.
- Health care professionals should engage in hand hygiene if moving from a contaminated body site to another body site during the care of the same patient.
- Health care professionals should engage in hand hygiene after contact with inanimate surfaces and objects (e.g., medical equipment) in the immediate vicinity of a patient.
- Health care professionals should engage in hand hygiene after removing sterile or non-sterile gloves.
- Health care professionals should engage in hand hygiene before handling medications or vaccines (note: hand hygiene in the previous case may include the use of an alcohol-based handrub or handwashing with either plain or antimicrobial soap and water).

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- Health care professionals should wash their hands with soap and water when they are visibly dirty or visibly soiled with blood or other body fluids or after using the toilet.
- Individuals should follow the steps in the following procedure when washing their hands with soap and water to optimize hand hygiene results. The duration of the entire handwashing procedure should last between 40 - 60 seconds.

  Hand Hygiene Procedure with Soap and Water

  1) Individuals should wet their hands with water.

  2) Individuals should apply enough soap to cover all hand surfaces.

  3) Individuals should rub their hands palm to palm.

  4) Individuals should rub the right palm over the left dorsum with interlaced fingers and vice versa.

  5) Individuals should rub their hands palm to palm with fingers interlaced.

  6) Individuals should rub the backs of fingers to opposing palms with fingers interlocked.

  7) Individuals should engage in rotational rubbing of the left thumb clasped in the right palm and vice versa.

  8) Individuals should engage in rotational rubbing, backwards and forwards with clasped fingers of the right hand in the left palm and vice versa.

  9) Individuals should then rinse their hands with water.

  10) Individuals should then dry their hands thoroughly with a single use towel.

  11) Finally, individuals should use a towel to turn off the faucet.
- Health care professionals and other individuals should use an alcohol-based handrub when their hands are not visibly soiled to reduce bacterial counts.
- Individuals should follow the steps in the following procedure when using an alcohol-based formulation to optimize hand hygiene results. The duration of the entire procedure should last between 20 - 30 seconds. When using an alcohol-based formulation, health care professionals should note the following: alcohol-based handrubs with optimal antimicrobial efficacy usually contain 75% to 85%

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ethanol, isopropanol, or n-propanol, or a combination of the aforementioned products.

Hand Hygiene Procedure with an Alcohol-Based Formulation

1) Individuals should first apply a palmful of alcohol-based product in a cupped hand, making sure to cover all surfaces.

2) Individuals should then rub their hands palm to palm.

3) Individuals should rub the right palm over the left dorsum with interlaced fingers and vice versa.

4) Individuals should rub their hands palm to palm with fingers interlaced.

5) Individuals should rub the backs of their fingers to opposing palms with fingers interlocked.

6) Individuals should engage in the rotational rubbing of the left thumb clasped in the right palm and vice versa.

7) Individuals should engage in rotational rubbing, backwards and forwards with clasped fingers of the right hand in the left palm and vice versa.

8) Finally, individuals should note that their hands are "safe" once they are dry.

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Personal Protective Equipment (PPE)

In addition to hand hygiene, individuals should don personal protective equipment (PPE), when appropriate, to help prevent respiratory infections. Specific information regarding personal protective equipment (PPE) may be found below.

- Personal protective equipment (PPE) may refer to equipment designed to protect, shield, and minimize exposure to hazards that may cause serious injury, illness, and/or disease.
- Patients should be counseled on PPE to help prevent respiratory infections. Health care professionals should note that PPE is especially relevant to preventing the transmission of the virus that causes COVID-19.
- Health care professionals should note that PPE can include a variety of different types of equipment such as: face masks, respirators, gowns, and gloves.

- Face masks may be the most relevant piece of PPE to help prevent respiratory infections.
- To help prevent the transmission of the virus that causes COVID-19, individuals aged two or older, should wear a mask in indoor public places.
- Health care professionals should wear medical procedure masks, otherwise referred to as surgical masks or disposable face masks, when treating of caring for patients (note: medical procedure masks may refer to single-use masks that are not made of cloth and are not designed to be washed or laundered).
- To effectively don a medical procedure mask, health care professionals should engage in hand hygiene before touching a mask; health care professionals should ensure the mask completely covers his or her mouth and nose A health care professional should also ensure a mask fits snugly to the face and below the chin. Health care professionals should note that, often, masks can be secured to the head and neck via separate ties.
- To effectively remove a medical procedure mask, health care professionals should untie the bottom ties, if applicable, followed by the upper ties. The mask should then be pulled off and discarded in the appropriate waste container. A health care professional should not touch a contaminated mask. Health care professionals should wash their hands or use an alcohol-based hand sanitizer after removing a mask or other types of PPE.
- Respirators may also be used to prevent the spread of COVID-19 and other respiratory infections.
- A respirator may refer to a personal protective device that is worn on the face or head and covers at least the nose and mouth.
- A respirator is used to reduce the wearer's risk of inhaling hazardous airborne particles (including infectious agents), gases, or vapors.
- A N95 respirator may refer to a particulate-filtering, face piece respirator that filters at least 95% of airborne particles.
- Health care professionals should note that N95 respirators reduce the wearer's exposure to airborne particles.

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- Health care professionals should note that N95 respirators are capable of filtering out all types of particles, including bacteria and viruses.
- A "fit test" may be required to determine the appropriate size respirator needed for each individual health care professional; health care professionals may also require training regarding how and when to use a respirator.
- Hand hygiene should be performed before donning a respirator.
- When donning a respirator, a health care professional should make sure the respirator completely covers his or her mouth and nose; health care professionals should also ensure the respirator fits snug to the face and below the chin; additionally, a health care professional should be sure the respirator is properly sealed.
- Health care professionals should note that achieving an adequate seal to the face is essential when wearing a N95 respirator.
- Health care professionals should note that when properly fitted and worn, minimal leakage should occur around edges of the respirator when the user inhales.
- To effectively remove a respirator, a health care professional should untie the bottom ties, if applicable, followed by the upper ties; the respirator should then be pulled off and discarded in the appropriate waste container; a health care professional should not touch a contaminated respirator. Health care professionals should engage in hand hygiene after removing respirators; health care professionals should wash their hands or use an alcohol-based hand sanitizer after removing all PPE.
- *Health care professionals should note the following:* a surgical N95 respirator (also referred as a medical respirator) is recommended only for use by health care professionals who need protection from both airborne and fluid hazards (e.g., splashes, sprays).

Cleaning and Disinfecting

Cleaning and disinfecting the home environment can help prevent respiratory infections. Specific information regarding cleaning and disinfecting may be found below.

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- Patients should be counseled on cleaning and disinfecting the home environment to help prevent respiratory infections. Health care professionals should note that cleaning and disinfecting the home environment is especially relevant to preventing the transmission of the virus that causes COVID-19.
- Cleaning with a household cleaner that contains soap or detergent reduces the amount of germs on surfaces and decreases the risk of infection from surfaces.
- Individuals should clean high-touch surfaces regularly (e.g., daily) and after visitors entered the home.
- Individuals should focus on high-touch surfaces, such as: doorknobs, tables, handles, light switches, and countertops.
- Individuals should clean other surfaces in the home when they are visibly dirty or as needed.
- Individuals should clean surfaces using a product suitable for each surface, following instructions on the product label.
- Individuals should disinfect the home when someone is sick.
- Individuals should always follow the directions on a disinfectant label.
- Individuals should check a disinfectant label to find out what PPE is recommended/necessary to use the product safely (e.g., gloves, glasses, or goggles).
- Individuals should clean visibly dirty surfaces with household cleaners containing soap or detergent before disinfecting if the disinfectant product does not have a cleaning agent.
- Individuals should ensure adequate ventilation while using any disinfectant by keeping doors and windows open and using fans to help improve air flow.

Adequate Nutrition

Adequate nutrition can help booster the immune system, which in turn can help prevent respiratory infections. Therefore, patients should receive nutrition counseling to help prevent respiratory infections. Specific nutrition recommendations may be found below. The information found below was derived from materials provided by the U.S.

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Department of Health and Human Services (U.S. Department of Health and Human Services, 2020).

- Follow a healthy dietary pattern at every life stage. A healthy dietary pattern may refer to a diet that consists of nutrient-dense forms of foods and beverages across all food groups, in recommended amounts, and within calorie limits.
- For about the first six months of life, individuals should exclusively feed infants human milk. Individuals should continue to feed infants human milk through at least the first year of life, and longer if desired. Individuals should feed infants iron-fortified infant formula during the first year of life when human milk is unavailable. Individuals should provide infants with supplemental vitamin D beginning soon after birth.
- At about six months, individuals should introduce infants to nutrient-dense complementary foods. Individuals should introduce infants to potentially allergenic foods along with other complementary foods. Individuals should encourage infants and toddlers to consume a variety of foods from all food groups. Individuals should include foods rich in iron and zinc, particularly for infants fed human milk.
- From 12 months through older adulthood, individuals should follow a healthy dietary pattern across the lifespan to meet nutrient needs, help achieve a healthy body weight, and reduce the risk of chronic disease.
- At every life stage, meeting food group recommendations, even with nutrient-dense choices, requires most of an individual's daily calorie needs and sodium limits. A healthy dietary pattern doesn't have much room for extra added sugars, saturated fat, or sodium. A small amount of added sugars, saturated fat, or sodium can be added to nutrient-dense foods and beverages to help meet food group recommendations, but foods and beverages high in these components should be limited. Therefore, individuals should consider the recommendations found below.
    - **Added sugars** - less than 10 percent of calories per day starting at age two; avoid foods and beverages with added sugars for those younger than age two.
    - **Saturated fat** - less than 10 percent of calories per day starting at age two.

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- **Sodium** - less than 2,300 milligrams per day, and even less for children younger than age 14.

Vaccination

Finally, vaccination can help prevent some respiratory infections. Specific information regarding vaccination may be found below. The information found below was derived from materials provided by the CDC and the World Health Organization (WHO) unless, otherwise, specified (CDC, 2021; World Health Organization [WHO], 2021).

What is vaccination?

- Vaccination may refer to the act of introducing a vaccine into the body to produce immunity to a specific disease.
- *Health care professionals should note the following:* the terms immunization and vaccination are often used interchangeably; immunization may refer to the process by which an individual becomes protected against a specific disease through vaccination.
- *Health care professionals should note that vaccines can be used to prevent the following respiratory infections:* influenza, pneumonia, and coronavirus disease 2019 (COVID-19).

What is a vaccine?

A vaccine may refer to a product that stimulates an individual's immune system to produce immunity to a specific infection/disease, protecting the person from that disease (note: immunity may refer to protection from an infectious disease; if an individual is immune to a specific disease, he or she may be exposed to the disease without becoming infected).

How does a vaccine work?

Vaccines work (i.e., provide protection against infectious agents) by introducing an infectious agent into the human body via injection, oral administration, or nasal administration (note: the term infectious agent may refer to an organism that is capable of producing an infection or infectious disease; infectious agents include: bacteria, fungi, viruses, and parasites). Once an infectious agent, such as a virus, is introduced into the human body, via a vaccine, the human body's immune system responds, and, ultimately, builds protection against the infectious agent and related infection. In other words,

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vaccines work by giving the human body's immune system the tools and ability necessary to prevent infection from infectious agents, such as a virus.

How does the human body's immune system respond, and, ultimately, build protection, against an infectious agent and related infection?

Once a vaccine is administered to an individual, the human body's immune system responds, and, ultimately, builds protection against the infectious agent and related infection by the following three steps:

1. The immune system recognizes the invading infectious agent.
2. The immune system produces antibodies (note: antibodies may refer to proteins produced naturally by the immune system to fight infection and disease).
3. Once antibodies are produced, the immune system develops a "strategy" and "memory" on how to prevent infection from the related infectious agent. If the infectious agent is introduced to the human body and its immune system after vaccination, the human body's immune system uses its previously developed "strategy" and "memory" to eliminate the infectious agent and prevent infection.

The human body's immune system has a form of "recall." Once the immune system "learns" a "strategy" to eliminate an infectious agent and prevent a related infection it commits the "strategy" to "memory" and "recalls" the "strategy" any time the infectious agent is introduced to the human body to provide protection against the infectious agent for years, decades, or a lifetime.

What are the main components of a vaccine?

The main components of a vaccine include: the antigen, adjuvants, antibiotics, preservatives, and stabilizers. Specific information on the aforementioned components of a vaccine may be found below.

- **Antigen** - the antigen component of a vaccine may refer to an infectious agent of foreign substance that induces an immune response, such as the production of antibodies, once in the body; the component of the vaccine that helps provide protection against infectious agents and related infections.
- **Adjuvant** - an adjuvant may refer to a substance that increases and/or modulates the body's immune response to a vaccine; a substance that boosts the immune response to a vaccine; a substance that helps increase the overall effectiveness of

a vaccine. Health care professionals should note the following: aluminum and aluminum derivatives are examples of adjuvants.

- **Antibiotics** - some vaccines may contain antibiotics. Health care professionals should note the following: antibiotics may be used in some vaccines to counter the risk of dangerous bacterial infections.
- **Preservatives** - preservatives are included in vaccines to prevent potentially dangerous bacteria or fungal contamination. Health care professionals should note that thimerosal is an example of a preservative that may be found in some vaccines.
- **Stabilizers** - stabilizers are included in vaccines to protect the stability of a vaccine during transportation and storage. Health care professionals should note that gelatin is an example of a preservative that may be found in some vaccines.

What are the two main types of vaccines?

The two main types of vaccines include inactivated vaccines and live-attenuated vaccines. Specific information regarding the aforementioned types of vaccines may be found below. The information found below was derived from materials provided by the U.S. Department of Health and Human Services (U.S. Department of Health and Human Services, 2021).

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- **Inactivated vaccines** - inactivated vaccines include the dead version of the infectious agent that causes a specific infection or disease. Inactivated vaccines may require several doses over time (e.g., booster shots) in order for an individual to obtain ongoing immunity against a specific infection or disease. Health care professionals should note the following: inactivated vaccines may require yearly administration.
- **Live-attenuated vaccines** - live-attenuated vaccines use a weakened or attenuated form of an infectious agent that causes a specific infection or disease. Live-attenuated vaccines are similar to the natural infection they help prevent - therefore, they create a strong and long-lasting immune response (note: one or two doses of live-attenuated vaccines may provide an individual with a lifetime of protection against an infectious agent and the infection or disease it causes). Health care professionals should note the following: live-attenuated vaccines should be used with caution in individuals with weakened immune systems; often live-attenuated vaccines must be kept cool or cold.

Can a vaccine cause an infection?

Vaccines do not cause infections once they are administered to an individual because they, typically, only contain dead or weekend infectious agents.

How are vaccines developed and tested?

Vaccines are typically developed by drug companies and tested via a rigorous process that often involves animal testing and human clinical trials. The human clinical trial process usually involves the following three key phases: phase I, phase II, and phase III. Specific information on the three phases involved in the human clinical trial process may be found below.

- **Phase I** - phase I clinical trials often involve a small number of volunteers who receive the vaccine being tested in order to assess and determine vaccine safety and dose. Phase I clinical trials are also conducted to confirm the vaccine's ability to generate an immune response to an infectious agent.
- **Phase II** - in phase II clinical trials, the vaccine is usually administered to hundreds of volunteers, who are closely monitored for any side effects, to further assess the vaccine's ability to generate an immune response. Health care professionals should note the following: often in phase II clinical trials, data is collected on disease outcomes; often participants included in a phase II clinical trial have the same characteristics (e.g., age and sex) as the individuals for whom the vaccine is intended; in phase II clinical trials some participants receive the vaccine and others do not in order to allow for comparisons to be made and conclusions drawn about the vaccine being tested.
- **Phase III** - in phase III clinical trials, the vaccine is usually administered to thousands of volunteers. Health care professionals should note the following: in phase III clinical trials, data is collected on disease outcomes; in phase III clinical trials some participants receive the vaccine and others do not in order to allow for comparisons to be made and conclusions drawn about the vaccine being tested; data from both groups is carefully compared to see if the vaccine is safe and effective against the disease it is designed to protect against.

Once the three phases involved in the human clinical trial process are complete, government agencies (e.g., the United States Food and Drug Administration [FDA]) often require additional steps to be completed before a vaccine may be introduced to the

general population (note: the aforementioned additional steps may include reviews of efficacy, safety, and manufacturing for regulatory and public health policy approval).

Once a vaccine is introduced to the general population, close monitoring of the vaccine may continue to further determine its effectiveness, and to detect any unexpected adverse effects. Health care professionals should note any new or updated vaccine related information to optimize patient care.

Why should an individual get vaccinated?

- Individuals should obtain vaccines to protect themselves and others from infectious agents and resulting infections/diseases.
- Health care professionals should note that vaccines can protect individuals and communities from life-threatening infections/diseases.

Which vaccines may be used to help prevent respiratory infections and the transmission of respiratory infections?

- **Afluria Quadrivalent Influenza Vaccine** - Afluria Quadrivalent is an inactivated influenza vaccine indicated for active immunization against influenza disease caused by influenza A subtype viruses and type B viruses contained in the vaccine. Afluria Quadrivalent is approved for use in individuals six months of age and older. The recommended dose for Afluria Quadrivalent is 0.5 mL. Individuals nine years and older should receive one dose. Afluria Quadrivalent is a suspension for injection supplied in the following three presentations: 0.25 mL pre-filled syringe (single dose); 0.5 mL pre-filled syringe (single dose): 5 mL multi-dose vial (0.25 mL or 0.5 mL). Health care professionals should store Afluria Quadrivalent refrigerated at 2 - 8°C (36 - 46°F) (note: do not freeze). The most common adverse reactions associated with Afluria Quadrivalent include: injection-site pain, myalgia, and headache.
- **FluMist Quadrivalent (Influenza Vaccine Live, Intranasal)** - FluMist is a vaccine indicated for active immunization for the prevention of influenza disease caused by influenza A subtype viruses and type B viruses contained in the vaccine. FluMist Quadrivalent is approved for use in individuals 2 through 49 years of age. FluMist is for intranasal administration. The recommended dose of FluMist is 0.2 mL. Individuals 2 years through 8 years of age may receive one or two doses separated by one month. Individuals 9 years through 49 years of age should receive one dose. Each FluMist 0.2mL dose is a suspension supplied in a single-

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dose pre-filled intranasal sprayer. Health care professionals should store FluMist refrigerated at 2 - 8°C (36 - 46°F) (note: do not freeze). The most common adverse reactions associated with FluMist include runny nose and nasal congestion.

- **Pneumococcal 13-valent Conjugate Vaccine (Prevnar 13)** - Prevnar 13 is a vaccine indicated for the following: active immunization for the prevention of invasive disease caused by *Streptococcus pneumoniae* serotypes 1, 3, 4, 5, 6A, 6B, 7F, 9V, 14, 18C, 19A, 19F and 23F in children six weeks through five years of age (prior to the 6th birthday); active immunization for the prevention of otitis media caused by *S. pneumoniae* serotypes 4, 6B, 9V, 14, 18C, 19F, and 23F; active immunization for the prevention of invasive disease caused by *S. pneumoniae* serotypes 1, 3, 4, 5, 6A, 6B, 7F, 9V, 14, 18C, 19A, 19F and 23F in children six years through 17 years of age (prior to the 18th birthday); active immunization for the prevention of pneumonia and invasive disease caused by *S. pneumoniae* serotypes 1, 3, 4, 5, 6A, 6B, 7F, 9V, 14, 18C, 19A, 19F and 23F in adults 18 years of age and older. Children six weeks through five years should receive a four-dose immunization series consisting of a 0.5 mL intramuscular injection administered at 2, 4, 6, and 12 - 15 months of age. Children six through 17 years of age and adults should receive a single dose. Prevnar 13 is a 0.5 mL suspension for intramuscular injection, supplied in a single-dose prefilled syringe. Health care professionals should store Prevnar 13 refrigerated at 2°C to 8°C (36°F to 46°F) (note: do note freeze; Prevnar 13 is stable at temperatures up to 25°C (77°F) for four days). The most common adverse reactions associated with Prevnar 13 include: injection-site pain, fever, irritability, decreased appetite, fatigue, and sleep problems.

- **Pneumococcal Vaccine, Polyvalent (Pneumovax 23)** - Pneumovax 23 is a vaccine indicated for active immunization for the prevention of pneumococcal disease caused by the 23 serotypes contained in the vaccine (1, 2, 3, 4, 5, 6B, 7F, 8, 9N, 9V, 10A, 11A, 12F, 14, 15B, 17F, 18C, 19F, 19A, 20, 22F, 23F, and 33F) in individuals 50 years of age or older and persons aged ≥ 2 years who are at increased risk for pneumococcal disease. Pneumovax 23 should be administered in a single dose, either by intramuscular injection or subcutaneous injection. Pneumovax 23 is a clear, sterile solution supplied in a (0.5-mL dose) single-dose prefilled syringe. Health care professionals should store Pneumovax 23 at 2 - 8°C (36 - 46°F). The most common adverse reactions associated with Pneumovax 23 include: injection-site pain/soreness/tenderness, injection-site swelling, headache, and fatigue.

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- **Pfizer-BioNTech COVID-19 Vaccine** - the Pfizer-BioNTech COVID-19 vaccine is indicated for individuals 16 years of age and older (note: the CDC now recommends that children between the ages of 5 and 11 years receive the Pfizer-BioNTech pediatric COVID-19 Vaccine). The Pfizer-BioNTech COVID-19 vaccine is provided in a multidose vial, which may include up to six doses per vial. The vaccine must be mixed with diluent before administration (note: after dilution, vials must be stored between 2°C and 25°C and used within six hours of dilution). The recommended dose for the Pfizer-BioNTech COVID-19 vaccine is 0.3 mL. The vaccine should be administered via intramuscular (IM) injection in the deltoid muscle. The vaccine should be administered in a 2-dose series separated by 21 days (note: individuals should not be scheduled to receive the second dose earlier than recommended; second doses administered within a grace period of four days earlier than the recommended date for the second dose are considered valid; both doses are required). The Pfizer-BioNTech COVID-19 vaccine may be stored in one of the following three options: ultra-cold freezer between -80°C and -60°C (-112°F and -76°F) up to the expiration date; thermal shipping container using a controlant temperature monitoring device (TMD) (note: a temperature monitoring device (TMD) may refer to a measurement instrument that is capable of recording temperature over a defined period of time); refrigerator between 2°C and 8°C (36°F and 46°F) for up to 5 days (120 hours). Health care professionals should open the Pfizer-BioNTech COVID-19 vaccine thermal shipping container no more than twice per day for up to three minutes at a time. Vaccination should be offered to individuals regardless of whether they have a history of prior symptomatic or asymptomatic COVID-19 virus infection; vaccination of an individual with a known current COVID-virus infection should be deferred until the individual has recovered from acute illness. The most common adverse reactions associated with the Pfizer-BioNTech COVID-19 vaccine include: injection-site pain, injection-site swelling, injection-site redness, fatigue, headache, muscle pain, chills, joint pain, fever, nausea, malaise, and lymphadenopathy.

Section 2 Summary

Respiratory infections can devastate a child's health, overall well-being, and quality of life, as well as lead to death. Fortunately, respiratory infections can be prevented. The methods that may be used to help prevent respiratory infections include the following: hand hygiene, donning PPE, cleaning and disinfecting the home environment, adequate nutrition, and vaccination. Lastly, health care professionals should counsel patients on

methods to help prevent respiratory infections, as well as work to prevent the spread of respiratory infections while caring for patients in need.

Section 2 Key Concepts

The methods that may be used to help prevent respiratory infections include the following: hand hygiene, donning PPE, cleaning and disinfecting the home environment, adequate nutrition, and vaccination.

Section 2 Key Terms

Personal protective equipment (PPE) - equipment designed to protect, shield, and minimize exposure to hazards that may cause serious injury, illness, and/or disease

Medical procedure masks - single-use masks that are not made of cloth and are not designed to be washed or laundered

Respirator - a personal protective device that is worn on the face or head and covers at least the nose and mouth

N95 respirator - a particulate-filtering, face piece respirator that filters at least 95% of airborne particles

Healthy dietary pattern - a diet that consists of nutrient-dense forms of foods and beverages across all food groups, in recommended amounts, and within calorie limits

Vaccination - the act of introducing a vaccine into the body to produce immunity to a specific disease

Immunization - the process by which an individual becomes protected against a specific disease through vaccination

Vaccine - a product that stimulates an individual's immune system to produce immunity to a specific infection/disease

Immunity - protection from an infectious disease

Infectious agent - an organism that is capable of producing an infection or infectious disease

Antibodies - proteins produced naturally by the immune system to fight infection and disease

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Antigen - an infectious agent of foreign substance that induces an immune response, such as the production of antibodies, once in the body

Adjuvant - a substance that increases and/or modulates the body's immune response to a vaccine; a substance that boosts the immune response to a vaccine; a substance that helps increase the overall effectiveness of a vaccine

Temperature monitoring device (TMD) - a measurement instrument that is capable of recording temperature over a defined period of time

Section 2 Personal Reflection Question

How can health care professionals work to prevent the spread of respiratory infections while caring for patients in need?

Conclusion

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An acute respiratory infection may refer to any infectious disease of the upper or lower respiratory tract; an infection that may interfere with normal breathing. The following types of infections may be characterized as a respiratory infection: the common cold, acute sinusitis, acute otitis media, pharyngitis, bronchiolitis, acute bronchitis, pneumonia, influenza, and COVID-19. Fortunately, respiratory infections can be prevented. The methods that may be used to help prevent respiratory infections include the following: hand hygiene, donning PPE, cleaning and disinfecting the home environment, adequate nutrition, and vaccination. Finally, health care professionals should work to effectively identify patients potentially suffering from respiratory infections to help prevent any delay in treatment that could potentially lead to improved outcomes related to illness and mortality.

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