

Respiratory Syncytial Virus

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Purpose and Objectives

The purpose of this course is to provide participants with basic information regarding respiratory syncytial virus (RSV).

After successful completion of this course, you will be able to:

1. Define how RSV is spread
2. Identify symptoms of RSV
3. Describe how RSV testing is obtained
4. Identify the most effective measure to prevent transmission of RSV

Respiratory Syncytial Virus

Introduction

Every year and especially in winter, there is an influx of pediatric patients to doctor's offices, clinics and emergency departments. The culprit is often Respiratory syncytial virus, commonly known as RSV.

RSV is a seasonal Ribonucleic acid (RNA) virus that occurs in temperate climates. It is the most common respiratory virus found in infants and young children and is thought to virtually infect all infants by the time they reach the age of two years old (CDC, 2014a &c).

Most children that contract this virus will suffer only mild cold like symptoms. Other children, however, may become extremely ill, requiring hospitalization and advanced life support measures.

RSV is the most common cause of bronchiolitis and pneumonia among infants and children under 1 year of age.

Incidence of RSV

Although people of any age can develop a RSV infection, severe infection is most common in the very young and the elderly (CDC, 2014a). RSV may cause mild, cold-like symptoms in adults and healthy older children, but can cause bronchiolitis and pneumonia in children less than one year of age.

According to the CDC (2014a&c), most children will have had an RSV infection by their second birthday. When infants and children are exposed to RSV for the first time:

- 25% to 40% of them have signs or symptoms of bronchiolitis or pneumonia
- 0.5% to 2% will require hospitalization
 - Most children hospitalized for RSV infections are 6 months of age or younger (CDC, 2014a).

In temperate climates, RSV infections generally occur during fall, winter, and early spring.

People of any age can become re-infected with RSV, but subsequent infections are generally less severe than the initial infection. However, older adults and adults with weakened immunity are at high risk for developing severe RSV disease if re-infected (CDC, 2014a).

Transmission of RSV

RSV is easily spread by physical contact.

RSV is transmitted **directly** via large droplets during close contact with people that are infected, or **indirectly** via RSV-contaminated hands and surfaces. Sneezing, coughing, and handling contaminated materials increase the possibility of infection. In individuals that are infected and symptomatic, RSV is present in large numbers in the respiratory secretions (CDC, 2014b).

The portal of entry for RSV is usually via the nasal mucosa or conjunctiva of the eyes. RSV-contaminated hands deposit the virus onto the eyes or nose. Hands can become contaminated by either handling the respiratory secretions of infected persons or by contact with contaminated objects or surfaces (CDC, 2014b).

Daycare settings and play areas provide a multitude of sources to facilitate transmission of infection. The surfaces of toys, high chairs, and infant seats may be contaminated with RSV (CDC, 2014b).

Most individuals infected with RSV are contagious for 3 to 8 days.

Infants and individuals with weakened immune systems can be contagious for up to 4 weeks.

According to the CDC (2014b), the virus can live up to five hours on countertops and for several hours on used tissues.

Pathophysiology of RSV

Once an individual is infected with the Respiratory Syncytial Virus, viral replication begins in the nasal epithelium and then progresses downward through the bronchiolar epithelium (Dawson-Caswell & Munice, 2011).

At first, the viral infection is usually limited to the respiratory tract. Viral replication results in edema, increased mucus production and eventual bronchiolar epithelial necrosis (Dawson-Caswell & Munice, 2011).

As the infection progresses, viscous mucous secretions increase in quantity and the loss of ciliated epithelium makes clearance of these secretions difficult. The end result is small airway obstruction, dense mucous plugging of the narrowed airways, which produces wheezing, coughing, air trapping, and increased airway resistance (Dawson-Caswell & Munice, 2011).



This electron micrograph reveals the morphologic traits of the respiratory syncytial virus (RSV). The virus is variable in shape and size (average diameter of between 120-300nm).

RSV & High Risk Groups

RSV has the potential to cause serious respiratory complications in high-risk groups.

High risk groups include:

- premature infants
- children younger than 2 years of age with underlying conditions such as congenital heart or chronic lung disease
- children with compromised immune systems due to a medical condition or medical treatment
- adults with compromised immune systems
- adults 65 years and older (CDC, 2014a)

Among the elderly or among those with compromised cardiac, pulmonary, or immune systems, RSV can be a precursor that could lead to further medical complications (Branche & Falsey, 2015).

Outbreaks of RSV

Respiratory syncytial virus is actually a very common virus. In temperate climates, RSV infections usually occur during annual community outbreaks that often last approximately four to six months during the late fall, winter, or early spring (CDC, 2014c).

Not unlike other infectious outbreaks, the severity and timing of RSV outbreaks in a community vary from year to year.

Test Yourself 1

Most outbreaks of RSV last one to three months.

- a. True
- b. False

Clinical Presentation

Infants and children infected with RSV usually show symptoms within **4 to 6 days of infection**, and most will recover in 1 to 2 weeks (CDC, 2015). However, even after recovery, very young infants and children with weakened immune systems can continue to spread the virus for 4 weeks (CDC, 2014b).

Clinical signs and symptoms may include:

- Nasal congestion
- Nasal flaring
- Cough
- Tachypnea
- Difficulty breathing

Minor symptoms such as nasal congestion, mild fever, and cold like complaints are usually easily managed at home.

Children or adults with symptoms such as nasal flaring, tachypnea, labored breathing, severe wheezing, uncontrolled fever, and cyanosis should seek medical care and may require hospitalization.

Test Yourself 2

Symptoms of RSV usually appear within how many days after exposure?

- a. 1-2
- b. 2-4
- c. 4-6
- d. 6-8

Respiratory Syncytial Virus

Diagnosis

The standard method for diagnosing RSV is to obtain a culture of respiratory secretions. Once RSV is confirmed by laboratory testing, a definitive diagnosis can be made.

The sample can be obtained by a nasal washing collected from the patient's nares.

A nasal wash is obtained by using a plastic bulb catheter that is designed to go no further than the tip of the nostril. Prior to aspiration, a small amount (1-1.5 ml) of normal saline is instilled in one nostril. The contents are then aspirated using the bulb catheter and gentle mechanical suction and placed in a specimen container, and labelled appropriately

Diagnosis can be made by virus isolation, detection of viral antigens, detection of viral RNA, demonstration of a rise in serum antibodies, or a combination of these approaches (CDC, 2015).

Most clinical laboratories use antigen detection assays to diagnose RSV infection (CDC, 2015).

More info

Several different types of laboratory tests are commercially available for diagnosis of RSV infection. Rapid diagnostic assays performed on respiratory specimens are available commercially. Most clinical laboratories currently utilize antigen detection tests. Compared with culture, the sensitivity of antigen detection tests generally ranges from 80% to 90%. Antigen detection tests and culture are generally reliable in young children but less useful in older children and adults (CDC, 2015).

Sensitivity of virus isolation from respiratory secretions in cell culture varies among laboratories. Experienced laboratorians should be consulted for optimal results(CDC, 2015).

RT-PCR assays are now commercially available. The sensitivity of these assays is equal to or exceeds the sensitivity of virus isolation and antigen detections methods. Highly sensitive RT-PCR assays should be considered particularly when testing adults, because they may have low viral loads in their respiratory specimens (CDC,2015).

Treatment

For children with mild RSV, no specific treatment is necessary other than the management of symptoms. Antipyretics such as acetaminophen can worsen asthma in some children, so caution should be employed when administering acetaminophen (McBride, 2011).

Most children will recover from an RSV illness in eight to 1-2 weeks (CDC, 2014a).

Since antibiotics are not effective for viral diseases, antibiotic therapy is not indicated for RSV (AAP, 2014).

RSV Can Cause Dehydration

RSV can cause dehydration due to decreased intake. Congestion in children can challenge a parent's ability to ensure adequate intake. The potential for dehydration is of special concern. Children and other individuals in high risk groups that have had decreased intake due to symptoms related to RSV or other disease processes may require intravenous therapy (IV) to prevent further complications (AAP, 2014).

Signs of dehydration that may require fluid replacement include:

- Decrease in urination.
- Sunken eyes and / or sunken fontanel(s) in newborns.
- No tears when crying.
- Extreme thirst.
- Unusual drowsiness or altered level of consciousness.
- Dry, sticky mouth.

Teaching parents and caregivers to observe for signs of dehydration is very important in the prevention of further complications. If there is more than one child or high risk individual in the home, it is also important to teach parents and caregivers that there may be an individualized response to the infection and that each person could exhibit slightly different symptoms or more acute symptoms.

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Virazole (Ribavirin)

Ribavirin is the only Federal and Drug Administration (FDA) approved antiviral treatment. Ribavirin interferes with RNA metabolism required for viral replication. Only severe RSV lower respiratory tract infections should be treated with Virazole (ribavirin). It can be administered intravenously, orally or by aerosolization (Turner, Kopp, Paul, Landgrave, Hayes & Thompson, 2014).

Ribavirin may reduce the duration of mechanical ventilation and may reduce days of hospitalization, and decrease the long-term incidence of recurrent wheezing following RSV disease. Yet, ribavirin is rarely used today as there are controversial studies regarding the efficacy and high cost of this drug (Turner, Kopp, Paul, Landgrave, Hayes & Thompson, 2014).

The primary observed serious adverse side effect of ribavirin is hemolytic anemia, but other possible side effects include rash, conjunctivitis from contact with the mist, headache and confusion. Ribavirin may also worsen RSV infection and make complications more severe (Turner, Kopp, Paul, Landgrave, Hayes & Thompson, 2014).

Respiratory Syncytial Virus

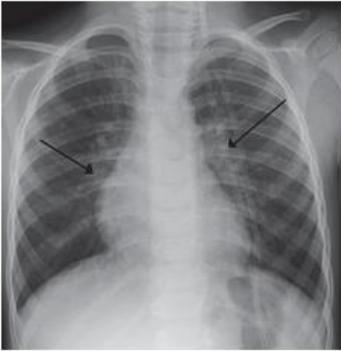
Additional Treatments

Additional treatment for RSV infection will be individualized according to symptoms.

A chest X-ray may show pneumonia or bronchiolitis however should be only reserved for a child or high risk individuals with suspicion of airway complications (AAP, 2014 & Bradely et al, 2011).

If the individual appears dehydrated, IV fluids will most likely be administered.

Medications for wheezing or labored respiration may also be required to improve patient status.



An x ray of a child with RSV showing the typical bilateral perihilar fullness of bronchiolitis.

Heilman, J (2011). Permission granted under the GNU Free Documentation License. Retrieved from: <http://en.wikipedia.org/wiki/Bronchiolitis>

Complications: Bronchiolitis

Bronchiolitis is inflammation of the bronchioles that usually occurs in children less than two years of age and presents with coughing, wheezing, and shortness of breath. This inflammation is usually caused by RSV (AAP, 2014).

The management of bronchiolitis is usually focused on the symptoms instead of the infection itself (supportive therapies) since the infection is usually self-limiting and complications usually arise from the symptoms themselves. AAP (2014)

Guidelines for treatment of bronchiolitis include:

- In children with a diagnosis of bronchiolitis clinicians **should**:
 - Administer nasogastric or intravenous fluids for infants or children who cannot maintain hydration orally.

- In children with a diagnosis of bronchiolitis clinicians **should not**:
 - administer albuterol
 - administer epinephrine
 - administer nebulized hypertonic saline in the emergency department
 - however, may administer nebulized hypertonic saline to infants and children hospitalized for bronchiolitis
 - administer systemic corticosteroids
 - administer antibacterial medications unless, there is a bacterial infection, or a strong suspicion of one
 - use chest physiotherapy
 - use frequent chest x-rays

Clinicians may choose to not administer supplemental oxygen if oxyhemoglobin saturations exceeds 90% in infants and children with a diagnosis of bronchiolitis

Complications: Pneumonia

Pneumonia may also succeed respiratory viral infections, particularly influenza virus and RSV (Zhou, Haber, Ray, Farley, Panozzo & Klugman, 2012). In children younger than 2 years of age, RSV is the most common cause of pneumonia (Bradley, et al., 2011) .

- Management of viral pneumonia is supportive and acute care may involve the following:
- Oxygen, if the patient is dyspneic
- Beta-agonists, if bronchospasm is present
- Fluids, if dehydration is present
- Respiratory isolation
- Antibiotics, if infiltrate is seen on the chest radiograph
- Mechanical ventilation if respiratory failure is present or impending (Mosenifar, 2015)

All viral pneumonia patients must receive supportive care with oxygen, rest, antipyretics, analgesics, nutrition, and close observation (Mosenifar, 2015).

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Prophylaxis

Synagis® (Palivizumab) is a monoclonal antibody that helps prevent serious lower respiratory tract disease caused by RSV in children at high risk for RSV disease.

The United States Food and Drug Administration (FDA) approved Synagis® (Palivizumab) to protect high risk infants against the worst effects of RSV.

Safety and efficacy were established in children with bronchopulmonary dysplasia (BPD), infants with a history of premature birth (≤ 35 weeks gestational age), and children with hemodynamically significant congenital heart disease (CHD) (MedImmune, 2015).

This antibody is manufactured using human and mouse antibody genes and can be produced consistently on a large scale for mass availability. Thimerosal and other mercury-containing salts are not used in the production of Synagis® (Palivizumab) (MedImmune, 2015).

Although Synagis® (Palivizumab) is administered as a vaccine **it is NOT technically a vaccine**. It works by slowly increasing antibody levels to the RSV virus. An infant may still get RSV even if receiving treatment.

Synagis® (Palivizumab) is commonly administered in five monthly doses, during the RSV season, which generally lasts from November through March in most locations in the United States (MedImmune, 2015).

To Administer Synagis® (Palivizumab)

DO NOT DILUTE

DO NOT SHAKE OR VIGOROUSLY AGITATE THE VIAL

1. **Using aseptic techniques, attach a sterile needle to a sterile syringe.**
2. **Remove the flip top from the Synagis® (Palivizumab) vial and wipe the rubber stopper with a disinfectant.**
3. **Insert the needle into the vial and withdraw into the syringe the appropriate volume of solution.**

The dose per month =
patient weight (kg) X 15 mg/kg / 100 mg per mL of Synagis® (Palivizumab)

Injection volumes over 1 mL should be given in divided doses.

4. **Administer intramuscularly into the anterolateral aspect of the thigh.**

The gluteal muscles should not be used routinely as an injection site because of the risk of damage to the sciatic nerve (MedImmune, 2015).

To view Prescribing Information for Synagis® (Palivizumab), including Patient Information:
<http://www.azpicentral.com/synagis/synagis.pdf>

Candidates for Synagis ® (palivizumab) Prophylaxis

According to AAP (2014) guidelines for RSV prophylaxis, the following are candidates for Synagis ® (palivizumab) prophylaxis:

- Infants younger than 24 months who have hemodynamically significant congenital heart disease (cyanotic or acyanotic lesions) or who have chronic lung disease and are off oxygen or pulmonary medications for less than 6 months at the start of the RSV season
- Premature infants born at 28 weeks' gestational age or less who are younger than 1 chronological year of age at the start of the RSV season; once treatment is initiated, it should continue throughout the season and not stop at age 1 year
- Premature infants born at 29-32 weeks' gestational age who are younger than 6 months' chronological age at the start of the RSV season; once treatment is initiated, it should continue throughout the season and not stop at age 6 months
- Infants born at 32-35 weeks' gestational age who are younger than 3 months' chronological age at the start of, or during, the RSV season and who either attend child care or have one or more siblings or other children younger than 5 years living permanently in the same household; prophylaxis should be provided only until age 3 months

Nursing Alerts – Common Side Effects

Common Side Effects include:

- Diarrhea
- Fever
- Cough
- Earache
- Runny nose
- Pain/redness at the injection site

Rarely, patients may have an anaphylactic reaction or other acute hypersensitivity reactions including urticaria, pruritus, angioedema, dyspnea, respiratory failure, cyanosis, hypotonia, hypotension and unresponsiveness.

If anaphylaxis or other significant hypersensitivity reaction occurs, administer appropriate medications (e.g., epinephrine) and provide supportive care as required.

If a mild hypersensitivity reaction occurs, clinical judgment should be used regarding cautious re-administration of Synagis® (Palivizumab) (RX List, 2014).

Synagis® (palivizumab) is approved for use in high risk infants under two years of age that have lung problems related to chronic bronchopulmonary dysplasia (BPD) or prematurity.

Respiratory Syncytial Virus

Test Yourself 3

Synagis ® (Palivizumab) is a vaccine to prevent an infant from contracting RSV.

- a. True
- b. False

Correct. Although Synagis® (Palivizumab) is administered as a vaccine; it is not one, though it works by slowly increasing antibody levels to the RSV virus. An infant may still get RSV even if receiving treatment.

Prevention

One beneficial factor that helps control and prevent RSV is the viruses instability in the environment. **RSV usually only survives for a few hours on environmental surfaces** and it is usually easily inactivated with soap and water and disinfectants (CDC, 2014b).

Instructing healthcare workers, parents, family members, and friends to follow simple guidelines for frequent and thorough hand washing can help prevent the spread of RSV infection.

Individuals should be instructed to wash their hands especially before touching any individuals or after any contact with any other children or adults that have symptoms of a cough, runny nose, or appear ill (CDC, 2014b).

Individuals should be reminded not to share items such as cups, glasses, and utensils with persons who have any symptoms of RSV illness.

Follow These Prevention Instructions

The following instructions are especially helpful in preventing the spread of RSV to infants:

- Insist that others wash their hands with warm water and soap before touching the infant or child.
- Wash your hands or use an alcohol based sanitizer whenever you have touched anything in a common area.
- Have others avoid contact with the infant/child if they have a cold or fever. If necessary, it may be helpful to wear a mask.
- Be aware that kissing the infant/child can spread RSV infection.
- Try to keep young children away from the infant. RSV is very common among young children and is easily spread from child to child.
- Advise parents not to smoke inside their house, car, or anywhere near the baby. Exposure to tobacco smoke increases the risk of RSV.

Inform parents with high-risk young infants that they should avoid crowds during outbreaks of RSV. Moderate to large outbreaks are often reported in the local news and newspapers to provide parents with an opportunity to avoid exposure (CDC, 2014b).

Parents and caregivers may benefit from a reminder that even a trip to a crowded shopping mall or library can potentially expose their child or loved one to RSV (CDC, 2014b).

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Test Yourself 4

RSV is stable in the environment and can thrive for up to 72 hours.

- a. True
- b. False

Correct. RSV usually only survives for a few hours on environmental surfaces and it is usually easily inactivated with soap and water and disinfectants.

Healthcare Professionals

Healthcare professionals have numerous opportunities to contaminate their hands during routine care and unless they wash their hands, RSV and other diseases will be transmitted by indirect contact to other patients.

Caregivers are also putting themselves and their families at risk by not performing frequent and effective hand washing. The CDC states that different combinations of control measures, ranging from the simple to the complex, have been effective in varying degrees in preventing and controlling nosocomial RSV infection.

Successful programs have shared two common elements:

1. Implementation of contact-isolation precautions
2. Compliance

According to the CDC, in theory, strict compliance with hand washing recommendations could prevent most nosocomial RSV infections; however studies have shown that compliance among healthcare workers has been poor. Because of this, other preventive measures are usually necessary to prevent RSV infection. The use of gowns and gloves has also shown a decreased incidence of hospital acquired RSV infection (CDC, 2015).

Healthcare professionals must change gloves and gowns after contact with infected patients or contaminated surfaces in order for them to be effective. The use of eye-nose goggles rather than masks has also protected healthcare workers but they are not always available. Additional measures may be indicated to control ongoing nosocomial transmission of RSV or to prevent transmission to patients that are at high risk for serious complications (CDC, 2015).

Transmission can also be decreased by:

- Using private rooms for infected patients
- Grouping infected patients together
- Screening by rapid laboratory diagnostic tests
- Limiting visitors
- Send healthcare workers home if they are sick

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Test Yourself 5

Preventive measures in addition to hand washing are usually necessary to prevent RSV infection because studies have shown that compliance among healthcare workers has been poor.

- a. True
- b. False

Correct. According to the CDC, in theory, strict compliance with hand washing recommendations could prevent most nosocomial RSV infections; however studies have shown that compliance among healthcare workers has been poor. Because of this, other preventive measures are usually necessary to prevent RSV infection.

Commented [KA1]: Added this test question so that course will have the minimum of 5 questions.

Research and Surveillance

According to the CDC, development of an RSV vaccine is a high research priority, but no vaccine is yet available. Administration of medications to treat the symptoms of RSV must suffice at this time.

In an effort to learn more about RSV and identify ways to prevent infection, a lab based system called The National Respiratory and Enteric Virus Surveillance System (NREVSS) monitors temporal and geographic patterns associated with the detection of respiratory syncytial virus (RSV), human parainfluenza viruses (HPIV), respiratory and enteric adenoviruses, and rotavirus.

Information is collected from collaborating university and community hospital laboratories, selected state and county public health laboratories, and commercial laboratories. The participating laboratories report virus detections, isolations and electron microscopy results on a weekly basis. NREVSS is a relatively simple and practical surveillance system that contributes important data to the CDC to prevent and control respiratory and enteric virus diseases.

The National Respiratory and Enteric Virus Surveillance System (NREVSS) is a laboratory-based system that monitors temporal and geographic patterns associated with the detection of respiratory syncytial virus (RSV), human parainfluenza viruses, respiratory and enteric adenoviruses and rotavirus.

To track the prevalence of RSV in the US, visit:
<http://www.cdc.gov/surveillance/nrevss/index.html>

Conclusion

Most children that become infected with RSV will only complain of cold like symptoms.

Other children however, may become seriously ill and require hospitalization with oxygen therapy and even mechanical ventilation.

Healthcare professionals that work with pediatric populations should be observant of the potential for RSV infection and its complications.

An awareness of the most appropriate care and treatment of patients with RSV is desirable. By providing caregivers and parents practical educational information, children with respiratory syncytial virus will be assured quality care.

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