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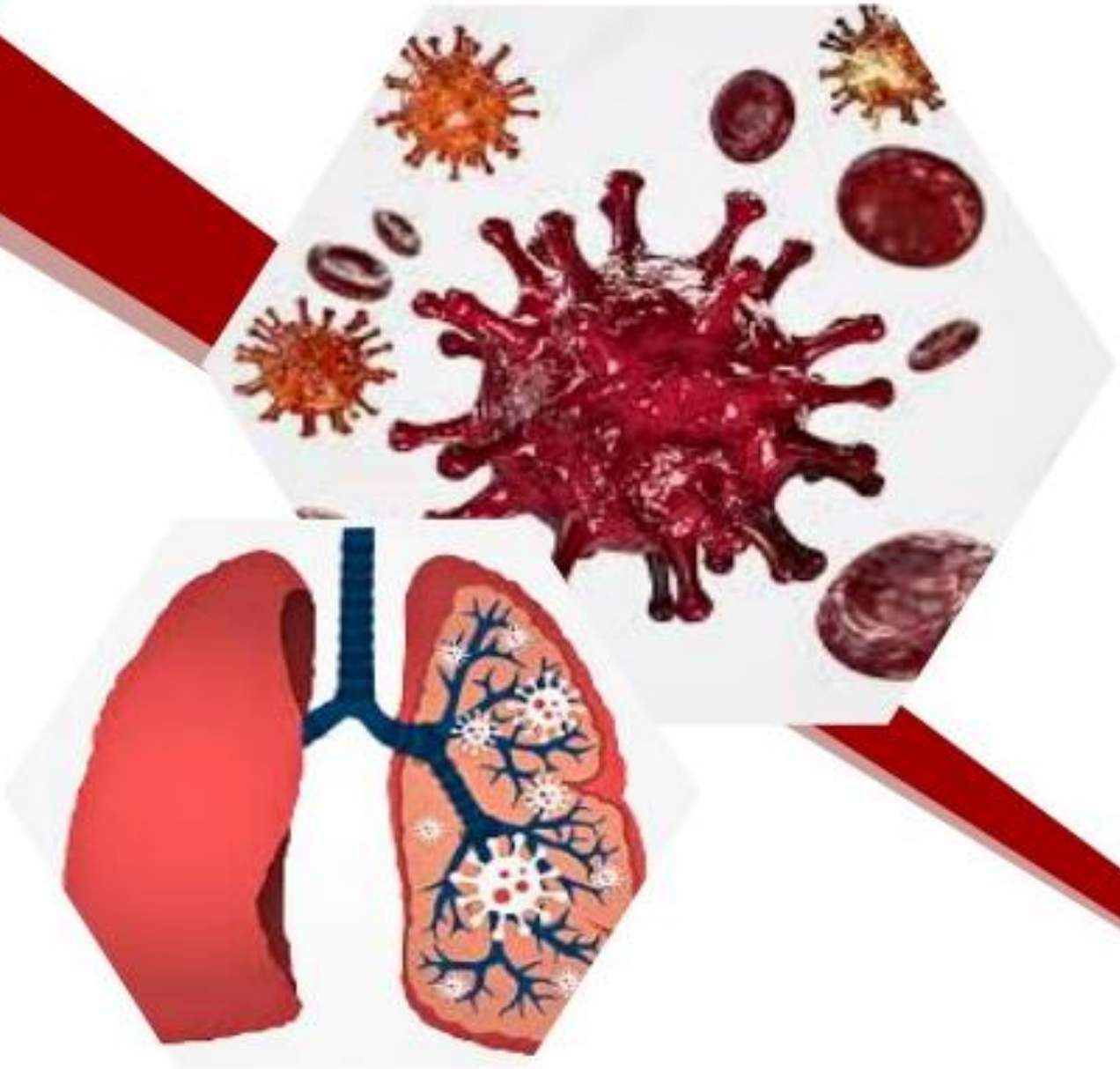
MICROBIOLOGY



Writer:

Corrector:

Doctor:

Rhinovirus

Part of Picornaviruses, which include enteroviruses and rhinoviruses.

Human rhinovirus has three species (A, B & C) based on sequence analyses.

Nonenveloped, Icosahedral, +Sense single-strand RNA virus.

Includes more than 100 antigenic types (serotypes).

Divided into major and minor receptor groups.

Major group uses ICAM-1 as a receptor, and minor group binds LDLR family.

Causes upper respiratory tract infections, common cold syndrome.

Responsible for about half of asthma exacerbations.

Most grow better at 33°C, similar to human nasopharynx temperature.

Pathogenesis - Virus Entry and Replication:

Rhinoviruses enter through the upper respiratory tract.

High titers of the virus in nasal secretions associated with maximal illness.

Viral titers decrease over time, but illness persists, detectable for up to 3 weeks.

Direct correlation between virus amount in secretions and illness severity.

Pathogenesis - Limited Replication Site:

Replication primarily occurs in the surface epithelium of nasal mucosa.

Histopathologic changes confined to submucosa and surface epithelium.

Involves edema and mild cellular infiltration.

Nasal secretions increase in quantity and protein concentration.

Pathogenesis - Lower Respiratory Tract Impact:

Rhinoviruses rarely cause lower respiratory tract disease in healthy individuals.

Commonly associated with acute asthma exacerbations.

Pathogenesis - Cold Myth and Experimental Evidence:

Chilling, including wet clothes, does not directly cause a cold or increase rhinovirus susceptibility.

Chilliness is an early symptom, but not the direct cause.

Clinical Findings - Incubation Period and Duration:

Incubation period: 2 to 4 days.

Acute illness typically persists for 7 days.

Nonproductive cough may linger for 2–3 weeks.

Average adult experiences one or two cold attacks each year.

Clinical Findings - Symptoms in Adults:

Common symptoms: sneezing, nasal obstruction, nasal discharge, sore throat.

Additional symptoms: headache, mild cough, malaise, chilly sensation.

Generally little or no fever.

Nasal and nasopharyngeal mucosa exhibit redness and swelling.

Diagnosis Challenges:

No distinctive clinical findings for distinguishing rhinovirus-induced colds from other viruses.

Secondary bacterial infections may lead to conditions like acute otitis media, sinusitis, bronchitis, or pneumonitis, especially in children.

Coronavirus

Family: Coronaviridae
Virus: Coronavirus
Characteristics: Enveloped, +ss RNA, helical capsid
Transmission: Direct contact & aerosols
Diseases: Common cold, SARS, COVID-19, MERS
Diagnosis: RT-PCR
Treatment: Supportive
Prevention: Avoid contact

Coronavirus - Genera and Human Infections:

Six genera in Coronaviridae (Alphacoronavirus, Betacoronavirus, Gammacoronavirus, Deltacoronavirus, Bafinivirus, Torovirus).

Six coronaviruses infect humans (e.g., 229E, NL63, OC43, HKU1, SARS-CoV1, SARS-CoV2, MERS-CoV).

Alpha coronaviruses (229E, NL63) and beta coronaviruses (OC43, HKU1, SARS-CoV1, SARS-CoV2, MERS-CoV).

Coronaviruses 229E, NL63, OC43, HKU1 cause upper respiratory tract infections.

SARS-CoV2 receptor is ACE2 receptors, causing COVID-19 disease.

Pathogenesis of Coronaviruses - Specificity and In Vivo Infections:

Tropism for epithelial cells in respiratory or gastrointestinal tract.

Animal coronaviruses infect respiratory or gastrointestinal epithelial cells.

In vivo infections can be disseminated or localized.

Human coronavirus infections typically remain limited to the upper respiratory tract.

SARS-CoV Outbreak (2003):

2003 outbreak resulted in severe respiratory illness, including pneumonia and respiratory failure.

Virus detected not only in respiratory tract but also in organs like kidney, liver, small intestine, and stool.

Likely origin in bats, amplified in palm civets, transmitted to humans in live animal markets.

Chinese horseshoe bats serve as natural reservoirs of SARS-like coronaviruses.

Conditions in rural southern China promote emergence of new viral strains.

MERS-CoV Outbreak (2012):

2012 outbreak characterized by pneumonia and respiratory failure.

Most fatalities in patients with medical comorbidities.

MERS-CoV likely originated in bats, widespread in camels.

Initial human infections likely through contact with bats or camels, with subsequent person-to-person transmission.

SARS-CoV-2 and COVID-19:

SARS-CoV-2 is a novel single-stranded RNA ($\oplus$ ssRNA) coronavirus responsible for the COVID-19 pandemic.

Clinical presentation varies, with some individuals being asymptomatic.

Common symptoms include fever, dry cough, shortness of breath, fatigue, anosmia, and dysgeusia.

Complications:

Complications include acute respiratory distress syndrome (ARDS), thrombotic complications, shock, organ failure, and death.

Risk factors for severe illness or death include increasing age, obesity, diabetes, hypertension, chronic kidney disease, and severe cardiopulmonary illness.

Diagnosis:

Diagnosed by nucleic acid amplification test (NAAT), commonly RT-PCR.

Tests detecting viral antigen are less sensitive but rapid and accessible.
Transmission:

Spreads through respiratory droplets and aerosols.

Host cell entry occurs through attachment of viral spike protein to ACE2 receptor on cell membranes.

Immunity and Vaccination:

Anti-spike protein antibodies confer immunity.

Vaccination induces humoral and cellular immunity, reducing virus transmission, severe disease, hospitalization, and death.

Therapeutic Approaches:

Supplemental oxygen and supportive care are mainstays for hospitalized patients.

Dexamethasone, remdesivir, and IL-6 pathway inhibitors may benefit severely ill patients.

Adenovirus

Family	*Adenoviridae*
Common name	Adenovirus
Virus	Adenovirus
Characteristics	Double-stranded deoxyribonucleic acid (DNA) genome; icosahedral capsid, no envelope; approximately 50 human serotypes
Transmission	Respiratory, fecal-oral, and direct contact (eye)
Site of latency	Replication in oropharynx
Disease	Pharyngitis, pharyngoconjunctival fever, keratoconjunctivitis, pneumonia, hemorrhagic cystitis, disseminated disease, and gastroenteritis in children
Diagnosis	Cell culture (HEp-2 and other continuous human epithelial lines), enzyme immunoassay (EIA) for gastroenteritis serotypes 40-41
Treatment	Supportive
Prevention	Vaccine (adenovirus serotypes 4 and 7) for military recruits

Adenovirus Respiratory Diseases:

Typical symptoms include cough, nasal congestion, fever, and sore throat.

Most prevalent in infants and children.

Group C viruses, especially types 1, 2, and 5, associated with respiratory diseases in infants and children.

Infections with types 3, 4, and 7 more frequent in adolescents and adults.

Pneumonia and Adenoviruses:

Adenoviruses, particularly types 3, 7, and 21, implicated in 10–20% of childhood pneumonias.

Adenoviral pneumonia, especially in very young, associated with a mortality rate of up to 10%.

Military Recruit Respiratory Syndrome:

Adenoviruses are causative agents.

Characterized by fever, sore throat, nasal congestion, cough, and malaise, with potential progression to pneumonia.

Epidemics often occur among young military recruits, especially under conditions of fatigue, stress, and crowding.

Adenovirus Types in Military Recruit Syndrome:

Types 4 and 7 primarily responsible.

Occasionally, type 3 may also contribute to the syndrome.

Parainfluenza

Family	*Paramyxoviridae*
Common name	Paramyxoviruses
Characteristics	Single-stranded, ribonucleic acid (RNA) genome; helical capsid with envelope; no segmented genome (e.g., orthomyxoviruses)
Virus	Parainfluenza virus
Transmission	Contact with respiratory secretions
Disease	Adults: upper respiratory disease, rarely pneumonia Children: respiratory including croup, bronchiolitis, and pneumonia
Detection	Cell culture (PMK), shell vial culture, and FA stain
Epidemiology	Four serotypes, disease occurs year-round
Treatment	Supportive
Prevention	Avoid contact with virus.

Human parainfluenza viruses have five serotypes: Types 1 and 3 (genus Respirovirus), Types 2, 4a, and 4b (genus Rubulavirus).

Parainfluenza Viruses Overview:

Common pathogens causing respiratory illnesses in all ages.

Particularly significant for severe respiratory tract disease in infants and young children.

Reinfections with parainfluenza viruses are common.

Pathogenesis - Host Tropism and Replication:

Replication primarily limited to respiratory epithelia.

Viremia uncommon, often involving nose and throat, leading to "common cold" syndrome.

Infection extent varies, with types 1 and 2 leading to croup (laryngotracheobronchitis).

Potential for Lower Respiratory Involvement:

Deeper spread to lower trachea and bronchi, causing pneumonia or bronchiolitis, more common with type 3.

Viral shedding lasts about 1 week; type 3 may be excreted for up to 4 weeks.

IgE Antibodies and Inflammation:

Production of virus-specific IgE antibodies during primary infections linked to disease severity.

Mechanism may involve inflammatory mediators altering airway function.

Clinical Findings of Parainfluenza Viruses - Primary Infections in Young Children:

Manifest as rhinitis, pharyngitis, fever, and some bronchitis.

Severe illness may occur, ranging from laryngotracheitis and croup to bronchiolitis and pneumonia.

Severe illness associated with type 3 more prevalent in infants under 6 months.

Croup or laryngotracheobronchitis more likely in children aged 6 months to 18 months.

Over half of initial infections result in febrile illness, with 2–3% progressing to croup.

Parainfluenza virus type 4 typically does not cause serious disease, even during the first infection.

Common Complication:

Most common complication of parainfluenza virus infection is otitis media.

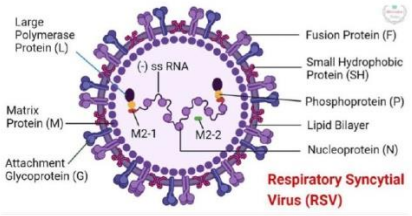
Susceptibility in Immunocompromised Individuals:

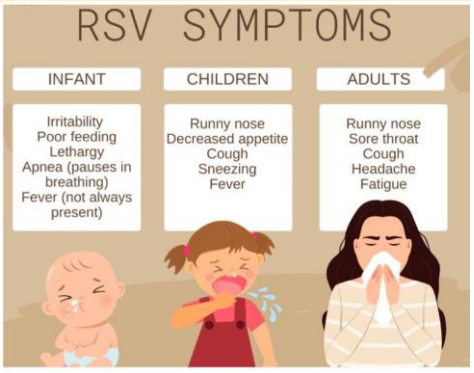
Immunocompromised individuals, especially children and adults, are susceptible to severe parainfluenza virus infections.

Mortality rates after parainfluenza infection in bone marrow transplant recipients range from 10% to 20%.

Respiratory Syncytial Virus

Family	*Paramyxoviridae*
Common name	Paramyxoviruses
Characteristics	Single-stranded, ribonucleic acid (RNA) genome; helical capsid with envelope; no segmented genome (e.g., orthomyxoviruses)
Virus	Respiratory syncytial virus (RSV)
Transmission	Person-to-person by hand and respiratory contact
Disease	Primarily in infants and children. Infants: bronchiolitis, pneumonia, and croup Children: upper respiratory disease
Detection	Cell culture (HEp-2), EIA, and FA stain
Epidemiology	Disease occurs annually late fall through early spring; nosocomial transmission can occur readily.
Treatment	Supportive; treat severe disease in compromised infants with ribavirin.
Prevention	Avoid contact with virus; immune globulin for infants with underlying lung disease; prevent nosocomial transmission with isolation and cohorting.





Leading cause of lower respiratory tract illness in infants and young children.

Particularly responsible for bronchiolitis and pneumonia in those under 1 year.

Accounts for approximately 25% of pediatric hospitalizations due to respiratory disease.

Pathogenesis - Initial Replication Site:

Replication begins in epithelial cells of the nasopharynx.

May spread to the lower respiratory tract, leading to bronchiolitis and pneumonia.

Viral antigens identified in upper respiratory tract and shedding epithelial cells.

Viremia is rare, occurring infrequently if at all.

Incubation Period and Shedding:

Incubation period is 3–5 days.

Viral shedding can persist for 1–3 weeks in infants and young children, shorter in adults.

Inoculum size is a crucial determinant of successful infection.

Role of Immune System:

Intact immune system crucial for resolving RSV infections.

Patients with impaired cell-mediated immunity may shed the virus for extended periods.

Genetic susceptibility to bronchiolitis linked to innate immunity gene polymorphisms.

Clinical Findings of RSV - Spectrum of Respiratory Illness:

Causes a spectrum of respiratory illnesses, from inapparent infections to pneumonia and bronchiolitis.

Bronchiolitis is a distinct clinical syndrome associated with RSV.
Severity and Hospitalization:

About one-third of primary RSV infections involve the lower respiratory tract severely.

Almost 2% of infected babies require hospitalization, peak occurrence at 2–3 months.

Higher viral loads predict longer hospitalizations.

Rapid Progression and Mortality:

Symptoms may progress rapidly, with low mortality in normal infants (approximately 1% of hospitalized patients).

Preexisting diseases like congenital heart disease may increase mortality rates.

Reinfection and Symptomatic Episodes:

Common in both children and adults.

Symptomatic reinfections usually involve the upper respiratory tract.

RSV in Immunocompromised Patients:

Accounts for about one-third of respiratory infections in bone marrow transplant patients.

Pneumonia develops in approximately half, with reported mortality rates ranging from 20% to 80%.

RSV in Elderly Adults:

Infections in elderly adults may present symptoms similar to influenza, with potential pneumonia development.

Prevalence in long-term care facilities includes infection rates of 5–10%,

pneumonia in 10–20%, and mortality rates of 2–5%.

Long-Term Effects in Children:

Children with RSV bronchiolitis and pneumonia may experience recurrent wheezing for years.

No established causal relationship between RSV infections and long-term abnormalities.

RSV and Otitis Media:

Significant cause of otitis media, with 30–50% of wintertime episodes in infants attributed to RSV infection.

Treatment - Supportive Care:

Primary approach to serious RSV infections involves supportive care.

Measures include removal of secretions and administration of oxygen.

Treatment - Antiviral Medication (Ribavirin):

Ribavirin, an antiviral drug, approved for lower respiratory tract disease caused by RSV, especially in high-risk infants.

Administration in aerosol form over 3–6 days; oral ribavirin not considered effective.

Treatment - Immune Globulin and Monoclonal Antibodies:

Immune globulin with high-titer antibodies against RSV has marginal benefits.

Humanized antiviral monoclonal antibodies (palivizumab) available as a treatment option.

Prevention - Vaccine Development Challenges:

Developing an RSV vaccine has been challenging.

Experimental formalin-inactivated RSV vaccine in the late 1960s resulted in nonneutralizing serum antibodies.

Prevention - Unique Challenges for RSV Vaccine Development:

RSV poses specific challenges, especially for newborns.

Eliciting a protective immune response at this early age is difficult due to maternal antibodies.

Prevention - Maternal Immunization Strategy:

Testing involves maternal immunization with a vaccine.

Goal is to transfer protective levels of virus-specific neutralizing antibodies to infants.

Current Vaccine Status:

RSV vaccine available for pregnant ladies (as of May 2023).

Prevention - Control Measures during Nosocomial Outbreaks:

Similar to control measures for parainfluenza viruses.

Measures include contact isolation, handwashing, and visitor restriction.

Metapneumovirus

Respiratory pathogen initially described in 2001.

Detected using molecular approach on clinical samples from children with respiratory illnesses but negative for known respiratory viruses.

Causes a spectrum of respiratory illnesses, ranging from mild upper to severe lower respiratory tract disease in all age groups.

Generally, symptoms are similar to those caused by RSV.