

Viral Respiratory Tract Infections (B)

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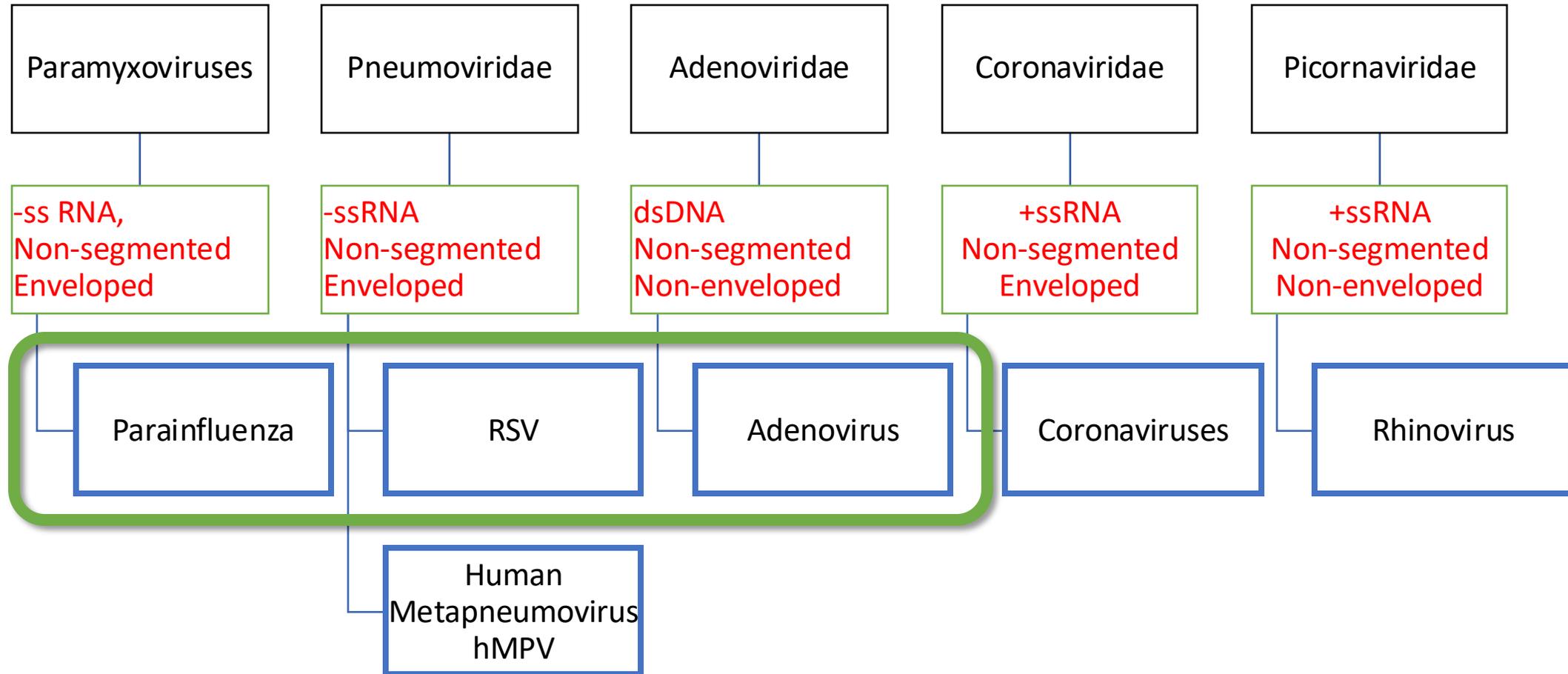
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Paramyxoviruses and other respiratory viruses



Paramyxoviruses

- Family: Paramyxoviridae
- -ss RNA enveloped viruses.
- Have RNA dependent RNA polymerase.
- Includes Parainfluenza, mumps, measles, and Newcastle disease virus (NDV)
- Parainfluenza viruses are distributed within two genera, *Respiroviruses* and *Rubularviruses*
 - *Respiroviruses* → Parainfluenza viruses types 1, 3
 - *Rubularviruses* → Parainfluenza viruses types 2, 4a, 4b



Parainfluenza viruses

- Heat Labile, but survive on surfaces for several hours
- Highly infectious
- Susceptible to destruction by soap and water, disinfectants.
- Four serotypes 1-4
- Reinfections occur throughout life
- Many remain asymptomatic but infective
- Viral shedding lasts for about 1 week after infection
- Prolonged viral shedding in immunocompromised



Parainfluenza viruses

- Hemagglutinin → binds to the sialic acid sugar on the surface of epithelial cells

After binding

- The Fusion (F protein) facilitates the fusion of the virus to fuse with the epithelial cell membrane and release the nucleocapsid into the cytoplasm

After transcription and translation and assembly

- The virus leaves the cell by using Neuraminidase → cleaves the sialic acid sugar



Parainfluenza viruses - Clinically

- Transmitted via respiratory secretions leading to a wide spectrum from asymptomatic, common cold to severe Lower resp. Tract infections (LRTI).
- 1. common cold: sore throat, hoarseness, cough and sometimes mild fever.
- 2. Croup (acute laryngotracheobronchitis):
 - Age: typically <6 years of age including infants
 - Involvement of the larynx, subglottic area and trachea
 - Clinical features: fever, cough, hoarseness, inspiratory stridor
 - May cause cyanosis and respiratory distress mandating tracheostomy.



Parainfluenza viruses - Clinically

- 3. Bronchiolitis: Common in young children.
- 4. Pneumonia: Common in young children and immunocompromised.
- **Diagnosis:**
 - Direct detection of the virus antigen (Serology) or RNA by PCR.
 - Culture: less used.
- **Treatment:** supportive.



→ Croup

- Infection of the Larynx (Laryngitis), Trachea (Tracheitis) and bronchi (bronchitis):
- Almost all cases are caused by viruses esp. Parainfluenza viruses (most common).
 - Other pathogens: respiratory syncytial virus (RSV), adenovirus, influenza virus, COVID-19
 - In rare cases: *Staphylococcus aureus*.
- Children have smaller airways and nonexpandable rings of trachea, so edema is more likely to cause narrowing of the lumen.
- Typically, mild upper R.T symptoms such as nasal discharge and dry cough are present days before signs of airway obstruction followed by sudden onset of barking cough and difficult respiration.
- **Treatment:**
 - It is a self-limited infection resolve after 5 to 7 days. No specific antiviral drug.
 - Corticosteroids and inhaled aerosolized epinephrine can be used.

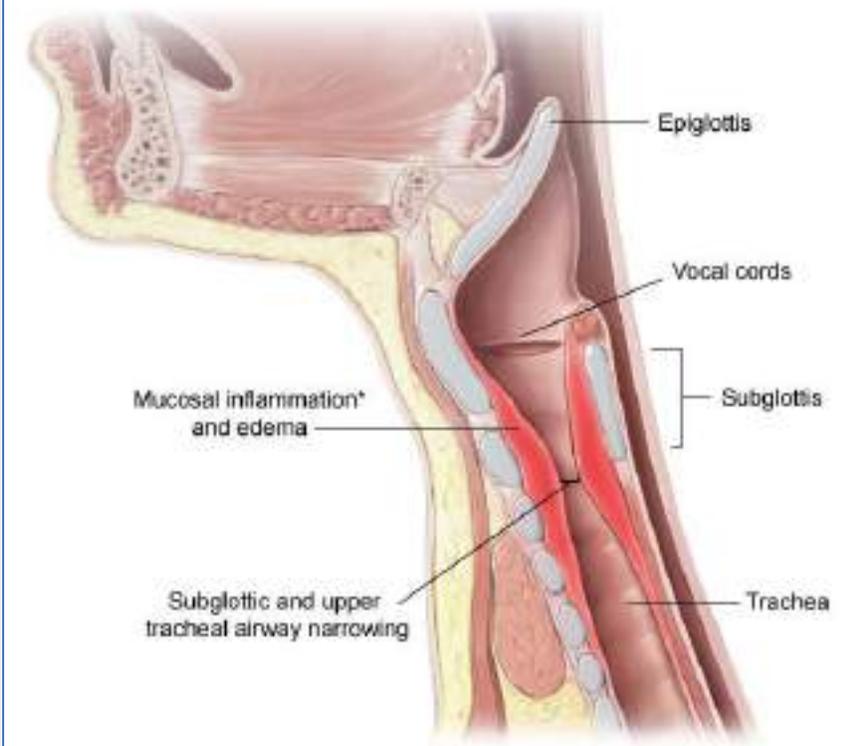


→ Croup

Croup



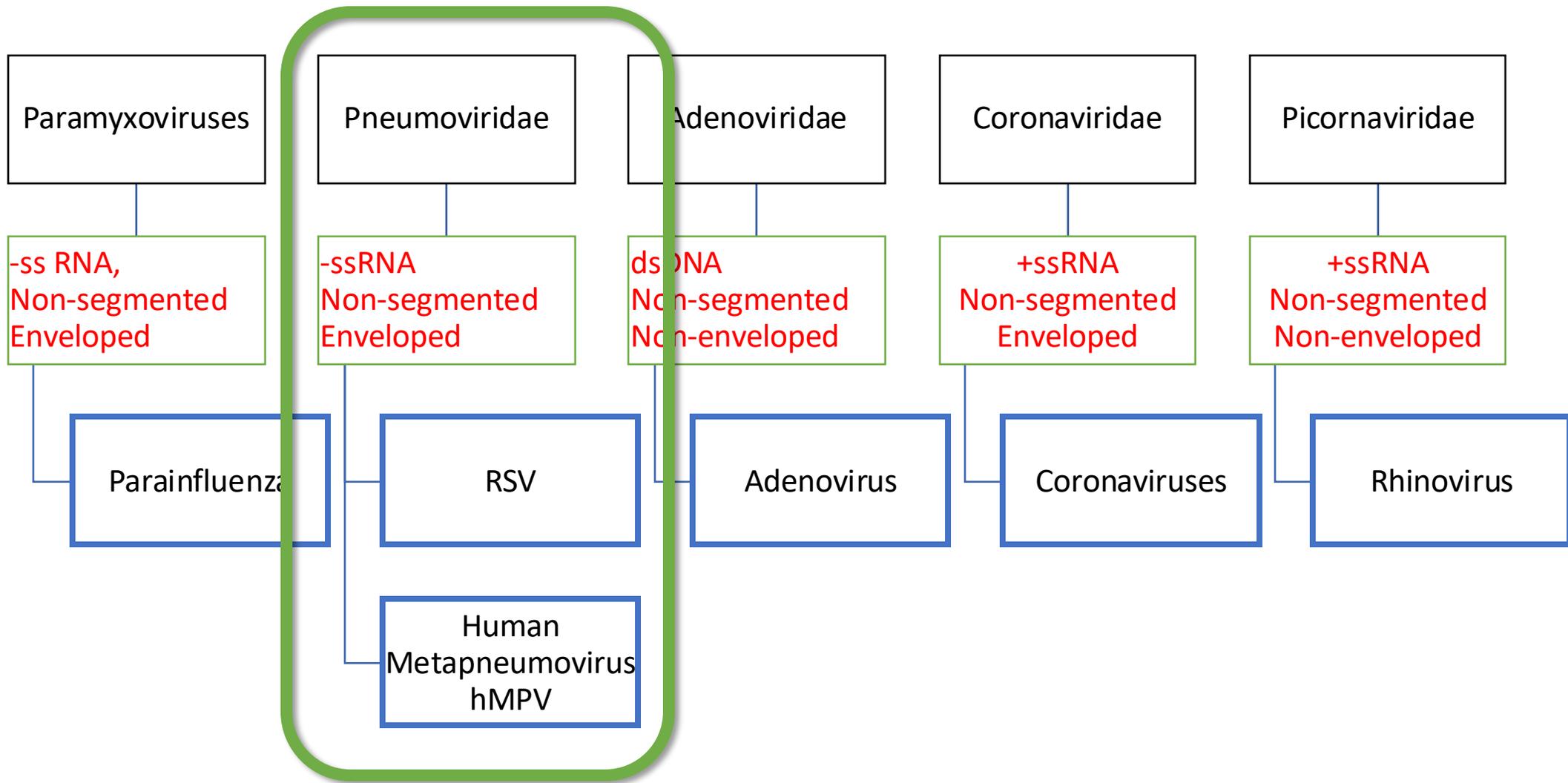
Croup (laryngotracheitis)



*Most commonly due to parainfluenza virus infection

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Croup is a viral infection caused by the **parainfluenza virus** most commonly seen in children age 6 months to 3 years. The virus spreads from the nasopharyngeal mucosa to the larynx and trachea, causing inflammation and **edema of the proximal trachea** (ie, **subglottis**). Narrowing at this area creates a partial airway obstruction, which results in **inspiratory stridor**, hoarseness, and a **barking cough**. X-ray may reveal subglottic narrowing (ie, **steep sign**).



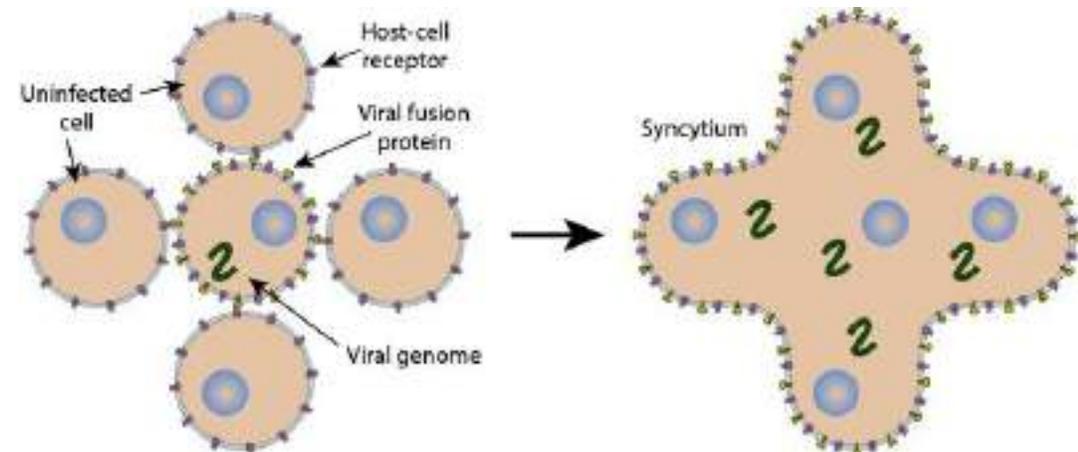
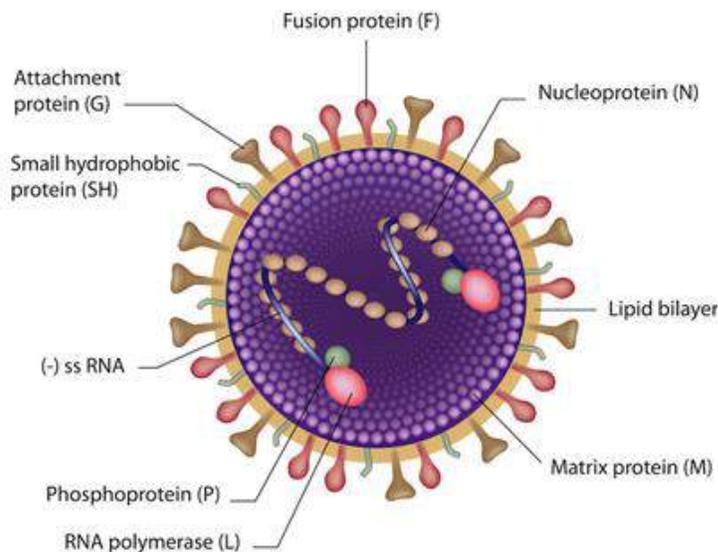
Respiratory syncytial virus (RSV)

- **Family: Pneumoviridae** (Previously, Pneumoviridae was part of the Paramyxovirus family, but in 2016, Pneumoviridae was reclassified as a separate family.)
- Enveloped virus.
- Envelope Glycoproteins: F and G proteins.
- Two antigenic subgroups 'A' and 'B' based on variations in G protein
- Entry through mucosa of nose and eyes.
- Cell to cell spread within respiratory tract, Syncytium formation with multinucleated giant cells.



Respiratory syncytial virus (RSV)

- G protein (mutates often) → Attachment
 - Glycoprotein G allows the virus to attach to respiratory epithelial cells; its ability to frequently mutate helps the virus evade the host immunity and permits reinfections throughout an individual's life.
- F protein (typically conserved) → Induces syncytia formation → giant cell with multiple nuclei
 - The RSV vaccine targets the RSV fusion (F) protein, as it rarely mutates.



Respiratory syncytial virus (RSV)

- The incubation period is 2–8 days.
- Transmitted via direct contact with respiratory droplets and indirect contact with contaminated surfaces
 - RSV can survive on the hands for ≥ 30 minutes and on contaminated surfaces for several hours.
- Viral shedding typically lasts 3–8 days.
 - RSV viral shedding can be prolonged (≥ 3 weeks) in infants and immunocompromised individuals.



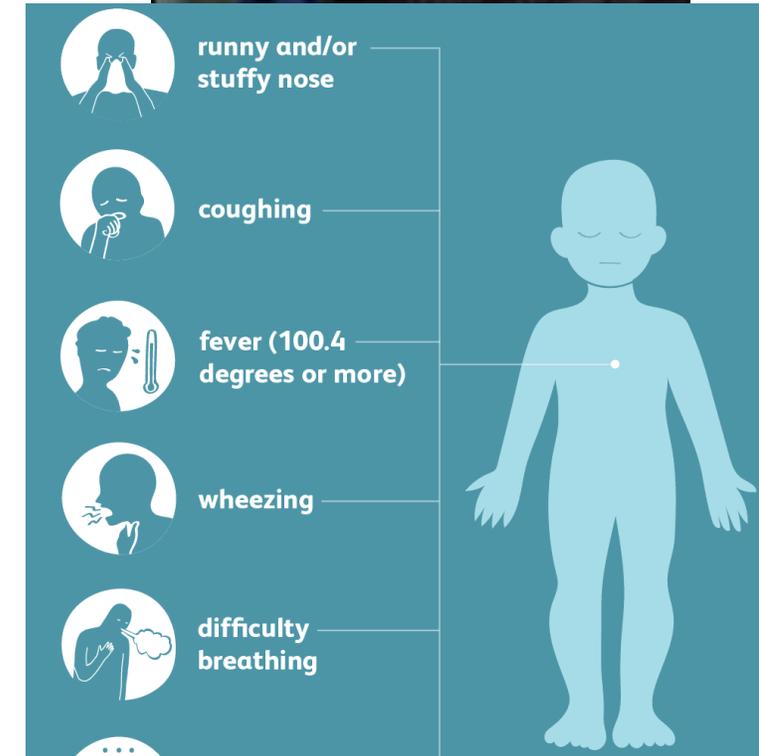
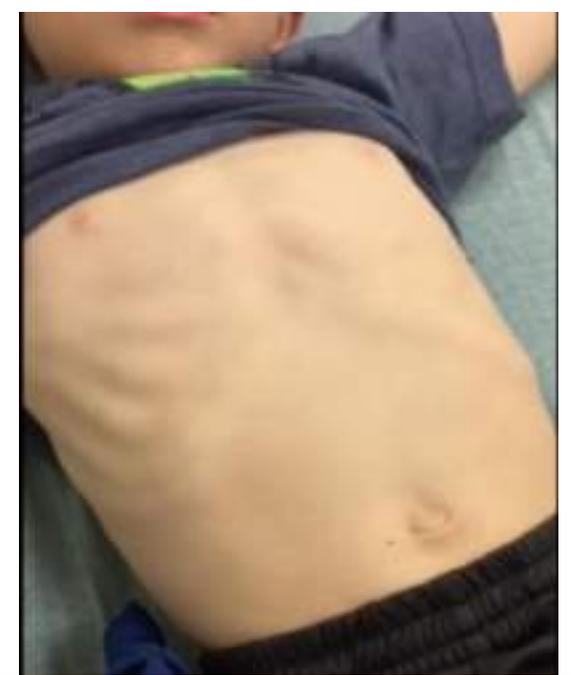
Respiratory syncytial virus (RSV) - Clinical features

1. URTI:

- Fever, Rhinitis, Pharyngitis, Otitis media, Croup.

2. LRTI: Bronchiolitis, Pneumonia.

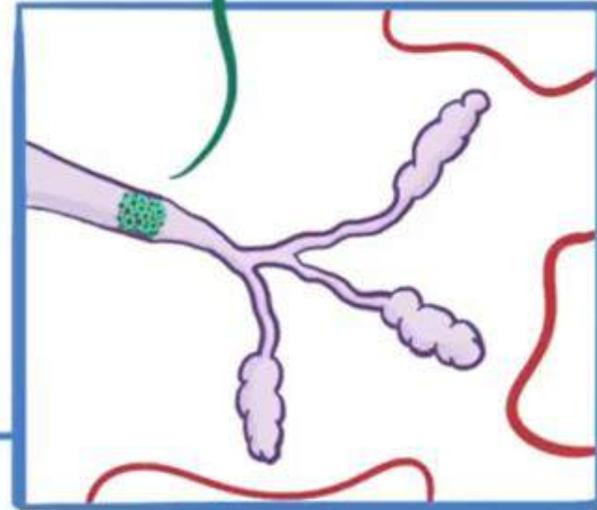
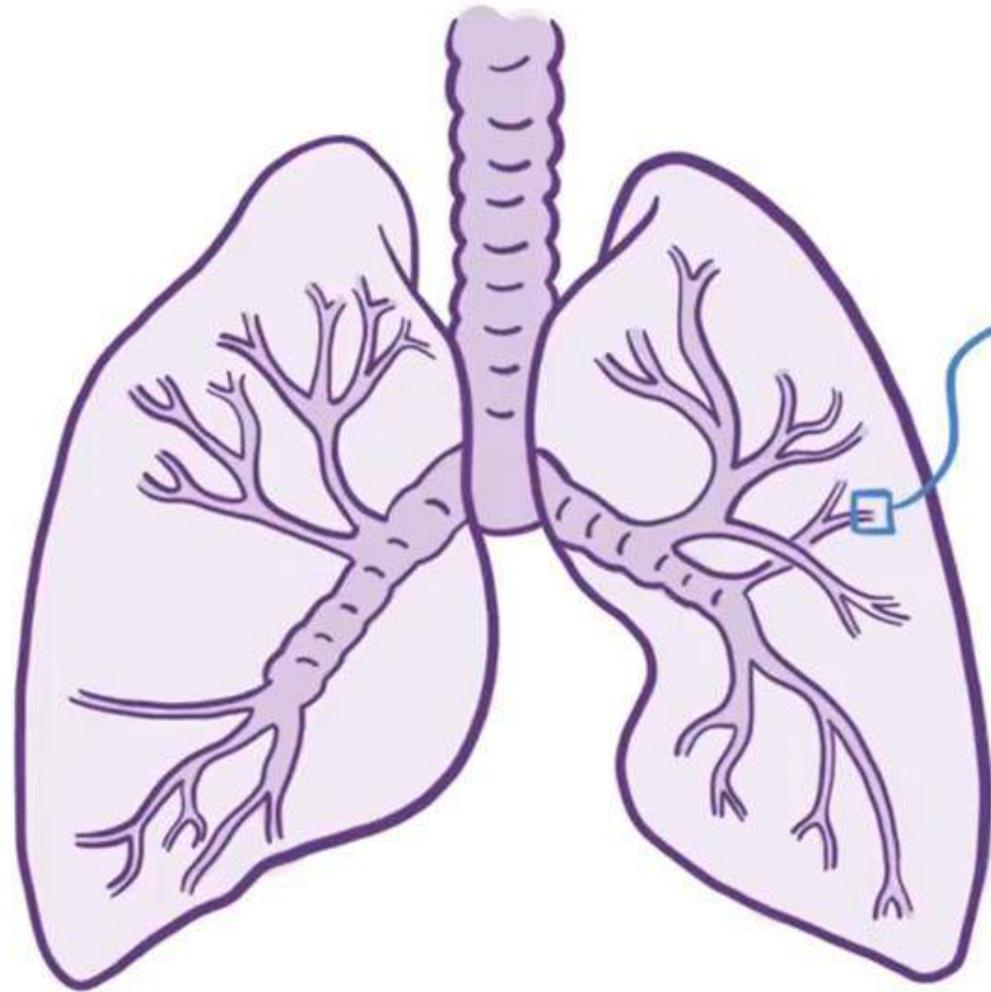
- Common in infants and in those with lung or heart diseases.
- Cough, Poor feeding, lethargy, Hypoxemia
- Respiratory Distress (tachypnea, retractions)
- Apnea, wheezes.



Respiratory syncytial virus (RSV) – Dx

- Viral isolation/Culture
- Antigen detection - >90 % sensitivity and specificity
 - ELISA
 - RIA, IF
- PCR.
- CXR: Lung hyperinflation.

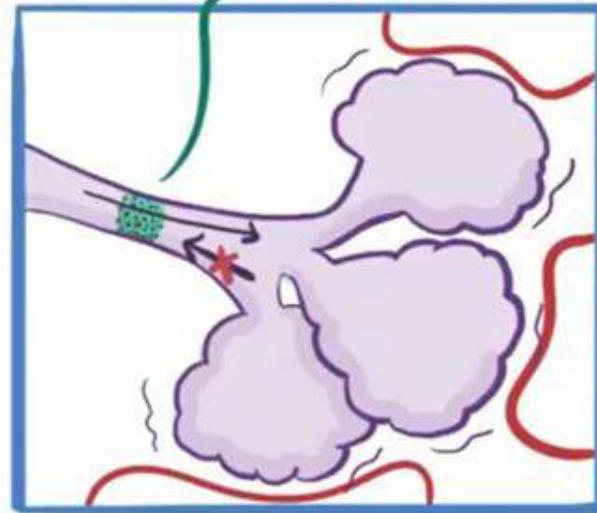




MUCUS PLUG
TRAPS AIR

AIR DIFFUSES INTO
BLOODSTREAM

AIRWAYS COLLAPSE
(ATELECTASIS)



MUCUS PLUG acts as
a ONE-WAY VALVE

OVERINFLATION

Respiratory syncytial virus (RSV) –Tx

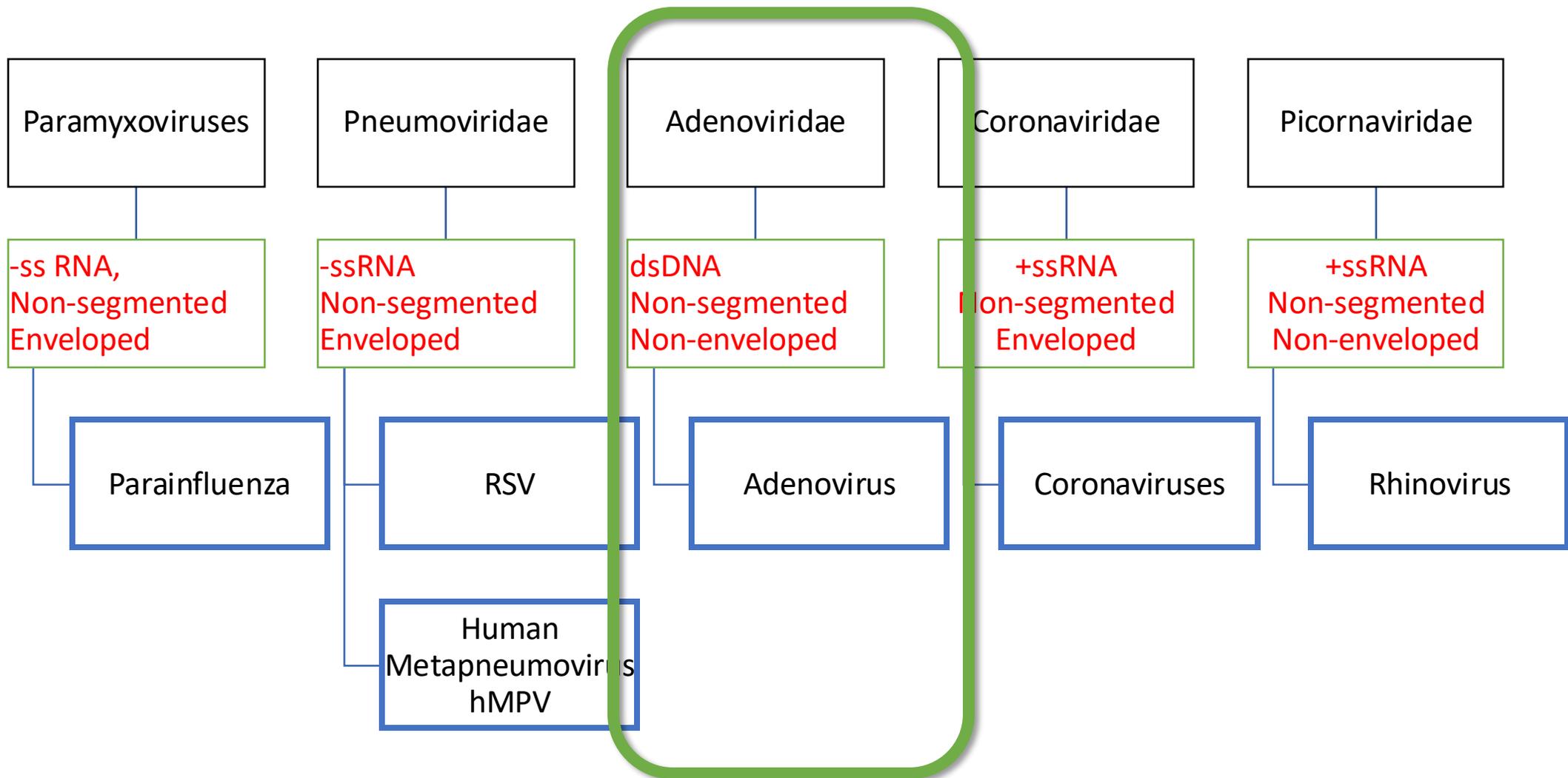
1. Supportive (Antipyretics, fluid intake, nasal suctioning)
2. Antiviral Agents
 - Ribavirin, a synthetic guanosine analogue (inhibits the RNA-dependent RNA polymerase), given as an aerosol, approved for premature and immunocompromised infants.
3. Vaccine
 - RSV vaccine → a bivalent vaccine based on the prefusion form of the RSV fusion (F) protein
4. RSV prophylaxis (Two RSV monoclonal antibodies are now available)
 - Nirsevimab (preferred) → long-acting RSV monoclonal antibody
 - Palivizumab → short-acting RSV monoclonal antibody



Human metapneumovirus

- Human metapneumovirus was first identified in the Netherlands in 2001
- Single-stranded RNA
- Belongs to the Pneumoviridae family
- Transmitted through close contact with an infected person or a contaminated surface
- Infections are most common during late winter and early spring and are known to cause pneumonia and bronchitis.
- Diagnosis: RT-PCR.
- Treatment: No specific antiviral yet.





Adenovirus/Structure & characteristics

- Non-enveloped ds DNA virus.
- Infects mucoepithelial cells of respiratory, GI and GU tracts
- Enter via epithelium, replicate and spread to lymphoid tissue.
- Viremia occurs with secondary involvement of viscera.



Adenovirus/Structure & characteristics

- Stable in the environment and in GI tract.
- Relatively resistant to disinfection (nonenveloped)
- Persists for long time in adenoids, tonsils & kidneys (latent?). Also, viral shedding in faeces may persist for years.
- Sub-grouped into 7 species (A-G) based on DNA sequence, with at least 88 distinct types identified to date.
- Certain serotypes are associated with certain infections e.g types 1-4, 7, 14 and 21 are associated with respiratory infections, types 40 & 41 associated with Gut infection, types 8, 19 and 37 associated with epidemic keratoconjunctivitis



Adenovirus/Epidemiology & clinically

- Many infections are sub-clinical.
 - Adenovirus infections are endemic in many parts of the world however, outbreaks are also common in Military recruits, swimming pool users, hospitals, residential institutions and nursing homes i.e crowded areas.
1. IP: ~ 2-14 Days.
 2. Mode of transmission:
 - Aerosols droplets
 - Fecal-oral route
 - direct inoculation of the conjunctiva.



Adenovirus/Clinically

- Respiratory.
- Eye (conjunctivitis, keratoconjunctivitis).
- Genitourinary (hemorrhagic cystitis).
- Gastrointestinal (gastroenteritis and non bloody diarrhea especially in young children, bowel intussusception (currant jelly stools)).
- Others: Myocarditis, Pericarditis, Meningitis/Encephalitis, Hepatitis and Rash.



Adenovirus respiratory infections

1. Subclinical.

2. Mild upper respiratory tract infections (URTI):

- Fever, runny nose wheezy chest and cough.
- Pharyngitis, tonsillitis and conjunctivitis.
- Majority are due to types 1-7.
- Usually mild but may progress to a serious Lower respiratory tract infections.

3. Lower resp. Tract infections (LRTI):

- Fever, shortness of breath (SOB), cough and wheezing.
- Can be fatal particularly in children.
- Pneumonia occurs in a small percentage of patients



Adenovirus respiratory infections Diagnosis

- Electron microscope
- Virus antigen detection in nasopharyngeal aspirates or stool using ELISA.
- Culture
- Serology: detection of 4-fold increase in the antibodies.
- PCR: Sensitive, single or part of a multiplex PCR for most respiratory viruses.



Adenovirus respiratory infections

Treatment:

- Infections are usually not life threatening in immunocompetent and no treatment required apart from symptomatic treatment.
- No antiviral available or licensed.

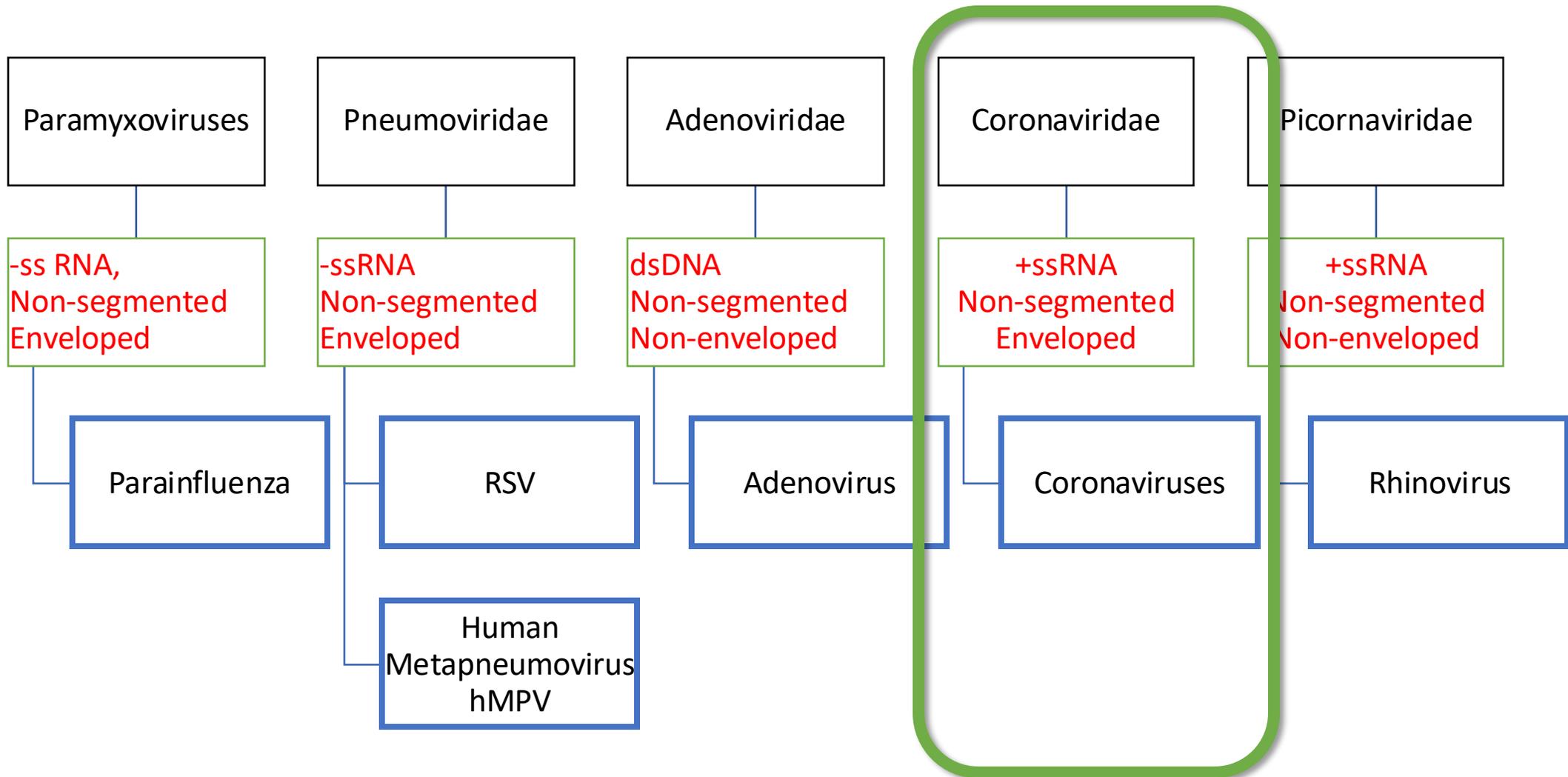
Prevention:

- Vaccine is not usually necessary as most infections are not serious, Nevertheless;

A vaccine is available for military people and not the civilians.

The vaccine is given orally and it contains 3 serotypes, 4, 7 and 21.

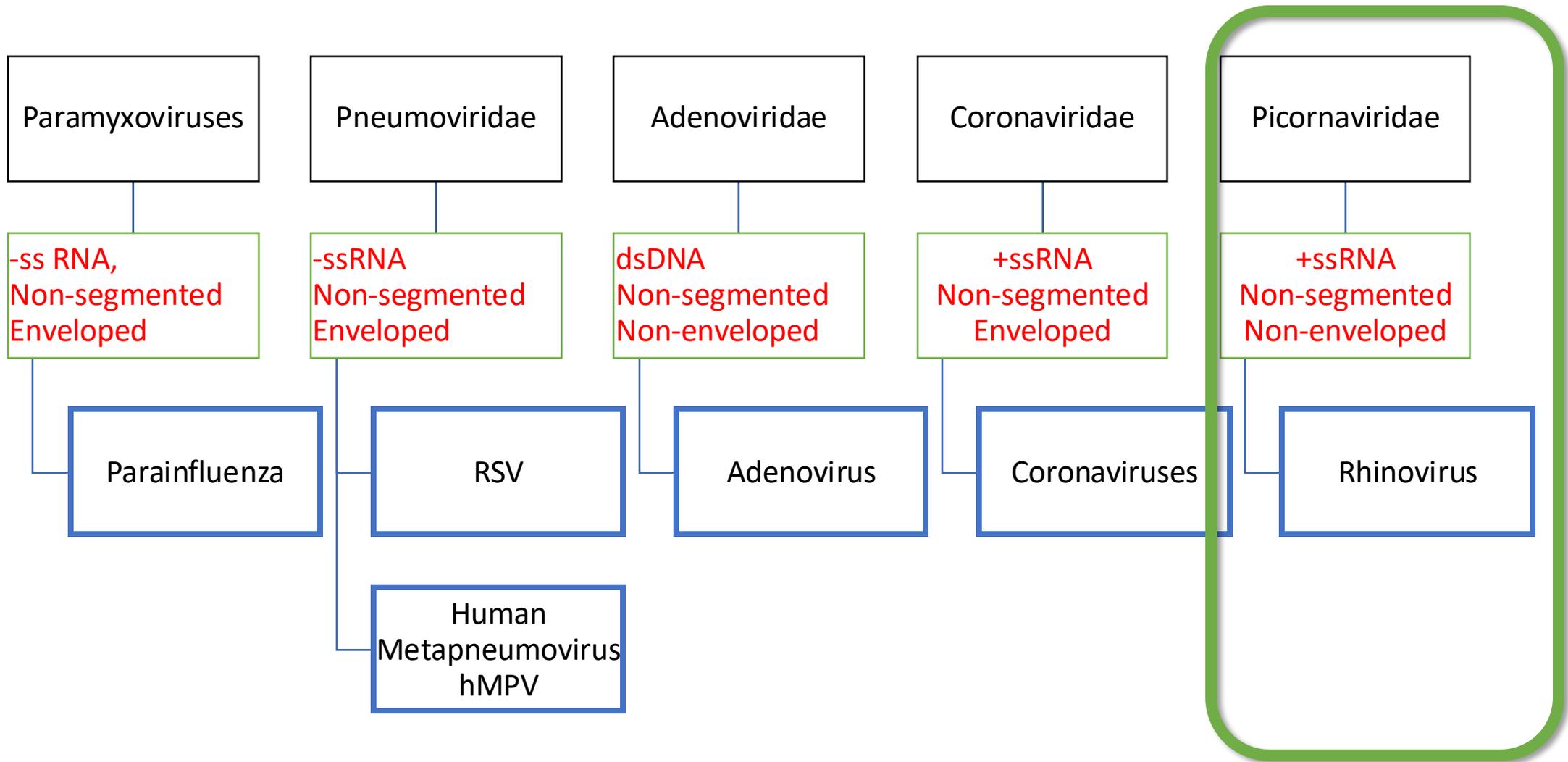




Coronaviruses

- Family: Coronaviridae
- Large, enveloped, positive-sense single-stranded RNA genomes.
- Genus: Betacoronavirus → this genus include
 - SARS-CoV (responsible for the 2002-2003 SARS outbreak) and
 - MERS-CoV (responsible for Middle East Respiratory Syndrome)
 - SARS-CoV-2 (the virus responsible for COVID-19)





Rhinovirus/clinically

- Common in preschool children and adults.
- It causes nearly one third of all common colds
- Found all over the year but more in Winter.
- Signs and symptoms (S & S): 'common cold
- S&S may stay for 1-2 weeks
- Complications as sinusitis and otitis media



Rhinovirus/clinically - Diagnosis, treatment and prevention.

- Diagnosis: not usually attempted but can be carried out by culture or PCR (single or Multiplex).
- No specific treatment.
- No specific vaccine: many serotypes.

