

# Microbiology lecture 5

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## I. Fundamental Concepts and Definitions *first*

• **Emerging Viruses:** Newly recognized viruses or those newly introduced into the human population, representing the first successful contact between humans and the virus

• **Re-emerging Viruses:** Known viruses that show a renewed clinical impact, such as increased incidence, severity, or geographic spread, often due to evolution or failed control measures.

• **Why Respiratory Viruses are Feared:**

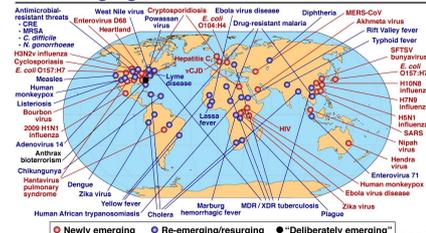
• The respiratory system offers a large surface area with constant exposure to inhaled air.

• They have direct access to the environment.

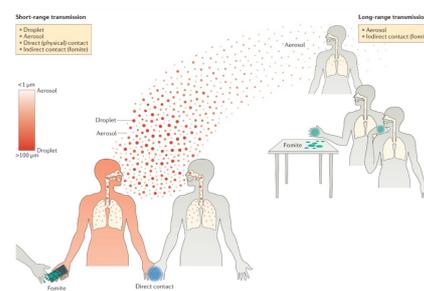
• Transmission is efficient via aerosols (long-range) and droplets (short-range), especially in poorly ventilated spaces.

• Involvement of the lower airway typically results in higher clinical severity. ☆☆☆

### Global Examples of Emerging and Re-Emerging Infectious Diseases



### Emerging and re-emerging respiratory viruses are feared



## II. Shared Features of Emerging and re-emerging Respiratory Viruses

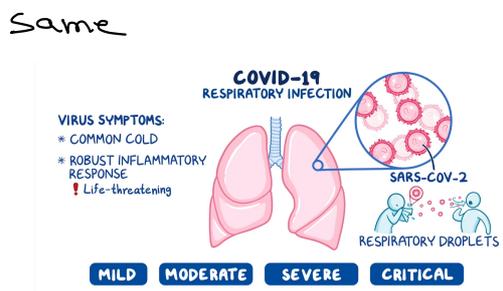
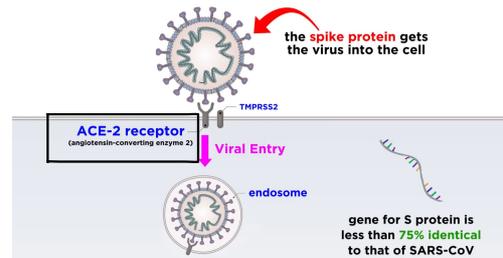
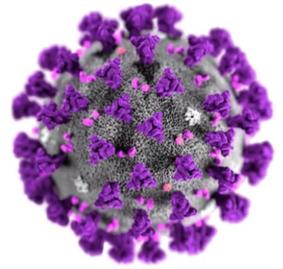
• **Zoonotic Origin:** Most begin with a zoonotic spillover from animal reservoirs such as birds, bats, and rodents.

• **The species barrier**—comprising differences in receptors, body temperature, and immune responses—usually prevents transmission, but rare successful spillovers can lead to pandemics.

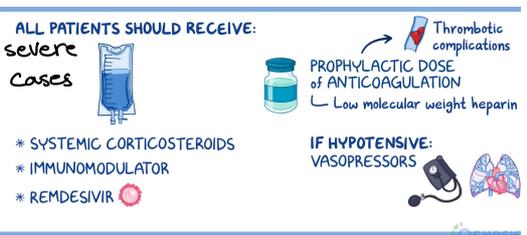
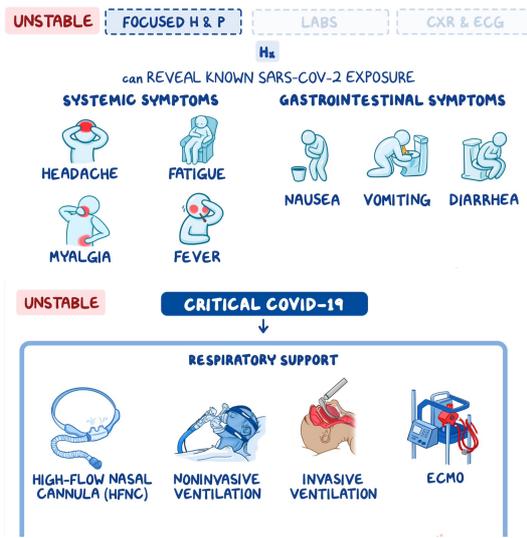
• **RNA Genomes:** High adaptability due to error-prone replication, which allows for the accumulation of adaptive mutations, recombination, or re-assortment.

• **Population Vulnerability:** A lack of prior immunity leads to rapid geographic spread and recurrent waves of infection until population-level immunity is established.

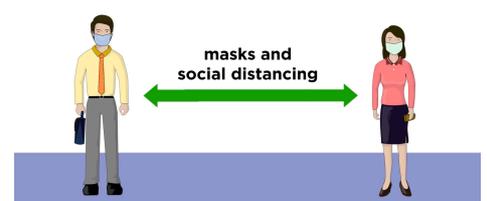
# SARS-CoV



Same



## SARS-CoV-2 Prevention



### III. SARS-CoV-1 (2002–2004)

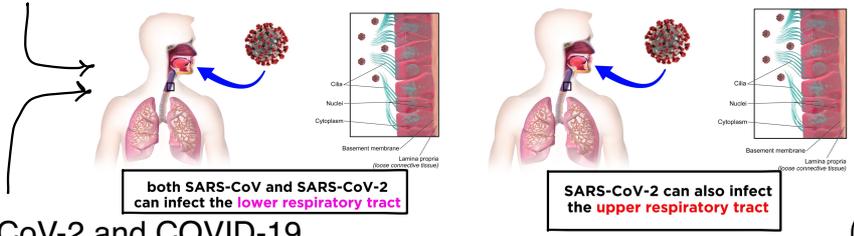
•Virology: A betacoronavirus that utilizes the **ACE2 receptor**, with higher expression in the **lower respiratory tract epithelium**.

•Clinical Profile:

•Replication occurs mainly in the **bronchioles and alveoli**, leading to predominant viral pneumonia and ARDS.

•Viral loads peak late in the illness, meaning transmission usually **occurs after symptom onset**.

•Epidemiology and Control: Transmission was primarily limited to households and healthcare settings. It was effectively contained using standard public health tools like **isolation, PPE, and contact tracing**.



### IV. SARS-CoV-2 and COVID-19

•Biological Distinctions: While it uses the **same ACE2 receptor** as SARS-CoV-1, it has a much higher binding affinity and a furin cleavage site for more efficient entry.

•Transmission Dynamics: **Unlike SARS-CoV-1**, it replicates efficiently in the upper respiratory tract, enabling pre-symptomatic and asymptomatic spread through talking and breathing.

•Disease Progression:

•**Incubation**: Median of 5 days (range 2–14 days). The majority developed symptoms by day 2-10.

• **Early/mild disease** (URTI): Fever, dry cough, sore throat, nasal congestion, anosmia, ageusia, malaise, myalgia.

• **Moderate** (LRTI): Dyspnea, persistent cough, chest tightness, and hypoxemia.

• **severe/critical**: hypoxemic respiratory failure, **ARDS, shock**, multi organ dysfunction. **ICU-level**

•Diagnosis and Management:

•Diagnosed via **RT-PCR, antigen tests** (best for high viral loads), or **serology**.

•Management includes **supportive care for mild cases**, antivirals (e.g., Remdesivir) for **moderate cases**, and **corticosteroids** (e.g., dexamethasone) for **severe disease requiring oxygen**.

•Prevention relies on **vaccination** (which reduces severity but not all infections) and non-pharmaceutical interventions like physical distancing.

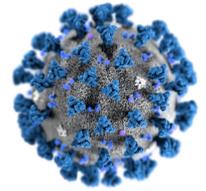
## V. MERS-CoV (Middle East Respiratory Syndrome)

•Virology: Uses the DPP4 (CD26) receptor, expressed in the lower respiratory tract, kidneys, and immune cells.

•Reservoir: Dromedary camels are the established reservoir; humans are infected through repeated zoonotic introductions.

•Clinical Impact: It has limited human-to-human spread, occurring mostly in healthcare settings, but carries a high case fatality rate of approximately 37%.

### Middle East Respiratory Syndrome Coronavirus (MERS-CoV)



MERS-CoV causes a lower respiratory tract infection



SARS-CoV  
10% mortality

MERS-CoV  
35% mortality

## VI. Avian Influenza

•Virology: Influenza A viruses have segmented RNA genomes, allowing for antigenic shift through genetic reassortment.

•Receptor Specificity:

•Avian strains bind  $\alpha$ -2,3 sialic acid (found in the human lower respiratory tract).

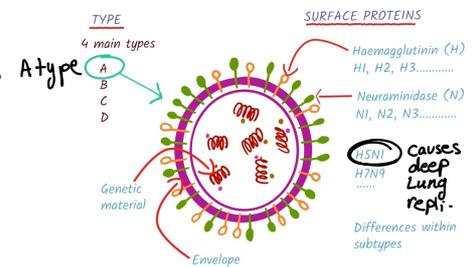
•Human strains bind  $\alpha$ -2,6 sialic acid (upper respiratory tract).

•H5N1 Strain:

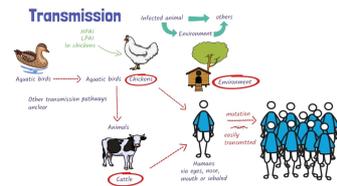
•Causes deep lung replication and severe cytokine release.

•Has a very high case fatality rate of 50–60%.

### The influenza virus



•Prevention Limitations: Seasonal flu vaccines do not provide effective neutralizing antibodies against avian HA proteins like H5N1 or H7N9.



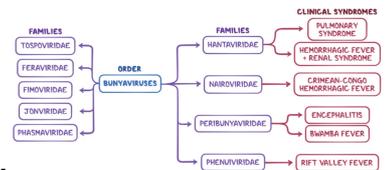
## VII. Hantavirus Pulmonary Syndrome (HPS)

•Virology and Transmission:

•Enveloped, segmented RNA viruses from the order Bunyvirales.

•Humans are dead-end hosts infected by inhaling aerosolized rodent excreta (urine, saliva, feces).

•Pathogenesis: The virus infects endothelial cells, causing a massive immune-mediated capillary leak.

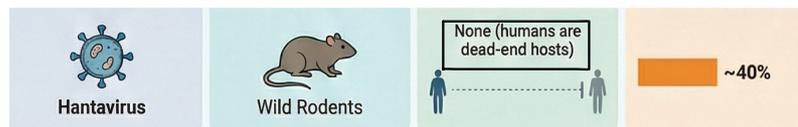


•Clinical Course:

•Starts with a flu-like prodrome.

•Followed by a sudden cardiopulmonary phase characterized by pulmonary edema and rapid respiratory failure.

•Case fatality rate can reach up to 40%.



Fatality Rate