1 Human Coronaviruses

The 3 highly pathogenic viruses (causing severe resporatory syndrome)

1. SARS-CoV-1
2. MERS-CoV
3. SARS-CoV-2

The 4 human coronaviruses (causing mild upper resporatory diseases in immunocompetent hosts)

1. HCoV-NL63
2. HCoV-229E
3. HCoV-OC43
4. HCoV-HKU1

Coronavirus (CoV): a large family of viruses that can cause diseases in humans and animals

SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus-2): the strain of virus causing the current pandemic

COVID-19 (Coronavirus Disease 2019): the set of symptoms caused by SARS-CoV-2

1.1 Virus Structure

Corona: Latin for crown

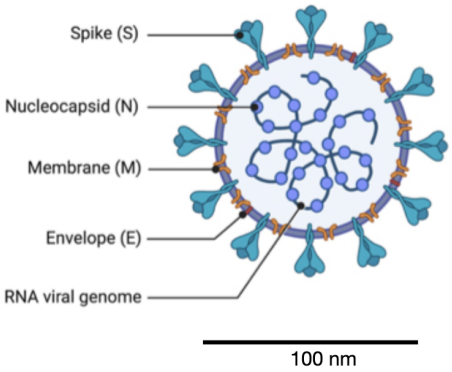

Figure 1: Coronavirus structure

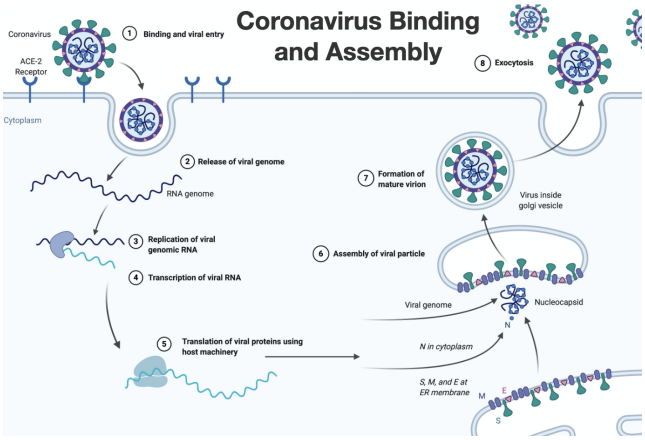

Figure 2: Coronavirus binding and assembly

1.2 ACE2

ACE-2 is expressed throughout the whole body

1. Nasal: Initial infection, spread, loss of smell?
2. Lungs: Pneumonia, ARDS
3. Heart: Direct infection? Lack of oxygen? Formation of blood clots?
4. Ileum: Gastrointestinal symptoms, spread

2 Infection

ACE-2 (Angiotensin-cinverting enzyme 2) Receptor helps regulate blood pressure but is used to help the viral spike join with the host cell

2.1 The Initial Week

The virus lives in the lining of the nose, finding cells expressing ACE-2

Once inside, the virus copies inself and invades new cells

During this time, an infected person may shed much of the virus

Symptoms may be absent, or host will develop a fever, dry cough, sore throat, loss of smell and taste, or head and body aches

2.2 The Lungs

If the immune system doesn't control SARS-CoV-2, the virus attacks the lungs where it can become deadly

The thinner, distant branches of the lung's respiratory tree end in tiny air sacs called alveoli

Alveoli are lined by a single layer of cells, rich in ACE-2 receptors

Alveoli are normally used by oxygen, which cross the alveloli into capillaries

2.3 Pneumonia

The virus replicates in the alveoli

→ As they die, they release inflammatory cytokines and other mediators

→ Cytokines and chemokines lead to a buildup of fluid and dead cells (pus)

2.3.1 Acute Respiratory Distress Syndrome

Although some COVID-19 patient recover, others deteriorate, developing ARDS

Patients commonly end up on ventilators and die

Oxygen levels in blood plummet as their alveoli become stuffed with fluid, white blood cells, mucus, and the detritus of destroyed lung cells

Much of the extreme disease is due to a hyper-activated immune system, rather than a high presences of virally-infected cells

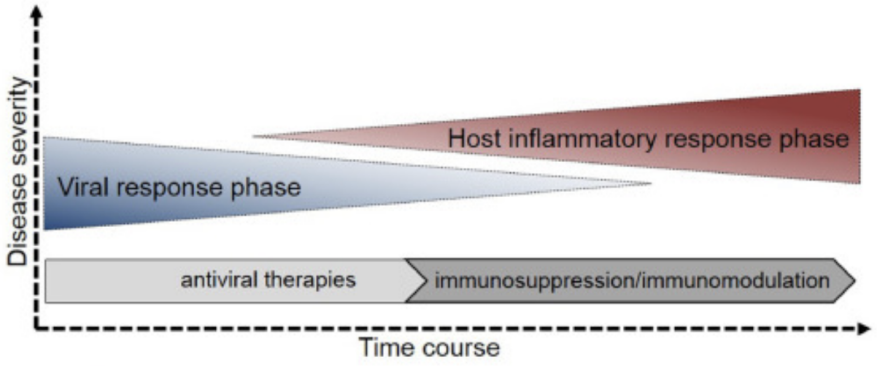

Figure 3: Timeline of viral infection

3 Wastewater

Wastewater is used as an early warning of future COVID outbreaks due to the concentration of SARS-CoV-2 (including asymptomatic) in wastewater samples