Coronavirus Disease 2019 (COVID-19)

Coronavirus Disease 2019 (COVID-19) is an infectious disease caused by the **severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)** . First identified during an outbreak of pneumonia in **Wuhan, Hubei Province, China** , it was reported to the World Health Organization (WHO) on **December 31, 2019** . The virus was officially named **SARS-CoV-2** in February 2020, and the disease it causes was designated **COVID-19** , short for *Coronavirus Disease 2019* , to avoid stigmatization.

Virology and Structure

SARS-CoV-2 is a **positive-sense, single-stranded RNA virus (+ssRNA)** belonging to the **Coronaviridae** family. It is **enveloped** and has one of the largest genomes among RNA viruses, ranging from **26–32 kb** .

Structural Proteins

The virus contains **five major structural proteins** :

- **Spike (S)** : Facilitates entry into host cells via **ACE2** and **basigin (BSG/CD147)** receptors.
- **Envelope (E)** : Involved in viral assembly and release.
- **Membrane (M)** : Maintains virion shape.
- **Nucleocapsid (N)** : Binds viral RNA genome.
- **Hemagglutinin-esterase (HE)** : Present in some ?-coronaviruses; aids in host-cell entry.

The **S protein** , projecting from the viral envelope, gives the virus its characteristic **“crown-like”** appearance on electron microscopy and mediates host cell attachment.

Pathophysiology

SARS-CoV-2 primarily targets cells expressing **ACE2 receptors** , which are abundant in:

- **Type II alveolar cells** of the lungs
- **Epithelial cells** of the intestines and kidneys
- **Vascular endothelium**

Viral entry triggers **ACE2 downregulation** , potentially disrupting **angiotensin homeostasis** and contributing to **lung injury** , inflammation, and **ARDS** (acute respiratory distress syndrome).

Transmission

SARS-CoV-2 is primarily transmitted via:

- **Respiratory droplets** (>5 ?m) from coughing, sneezing, or speaking

- **Aerosolized particles** (<5 ?m), especially in enclosed spaces
- **Fomite transmission** (via contaminated surfaces, although less common)
- **Asymptomatic and pre-symptomatic carriers**

Incubation and Infectivity

- **Incubation period** : 2–14 days (median ~5 days)
- **Infectious period** : Begins ~2 days before symptom onset and lasts up to 10 days for mild cases and longer for severe cases.
- **R? (Basic Reproduction Number)** : Estimated between **2.2–3.5**

Risk Factors

Individuals at higher risk of severe illness include:

- Adults >60 years old
- Individuals with comorbidities (e.g., **diabetes** , **cardiovascular disease** , **chronic lung disease** , **cancer**)
- Immunocompromised patients
- Healthcare workers exposed to high viral loads

Clinical Features

COVID-19 presents with a wide clinical spectrum, from **asymptomatic** to **critical illness** .

Common Symptoms *(per CDC and WHO)*

- **Fever** (~98%)
- **Cough** (~76%)
- **Fatigue** , malaise (~44%)
- **Myalgia**
- **Shortness of breath**
- **Loss of taste or smell**
- **Sore throat** , **diarrhea** , **headache** , and **nasal congestion** (less common)

Disease Severity

- **80%** : Mild/asymptomatic
- **15%** : Severe (requiring oxygen)
- **5%** : Critical (requiring ventilation/ICU)

Complications

- **Pneumonia**
- **ARDS**
- **Sepsis and septic shock**
- **Thromboembolic events**
- **Multisystem Inflammatory Syndrome (MIS-C in children)**

Diagnostic Testing

Gold Standard :

- **RT-PCR (real-time reverse transcription polymerase chain reaction)** of nasopharyngeal swabs for viral RNA detection

Other Testing Methods :

1. **Antigen testing** (rapid but lower sensitivity)
2. **Serologic (antibody) testing** – indicates past exposure
3. **CT scan of the chest** – shows bilateral ground-glass opacities in moderate to severe pneumonia

Infectious Cycle & Shedding

- **Viral shedding** can occur **1–2 days before symptoms appear** .
- **Shedding duration** : 10–14 days for mild cases; longer for immunocompromised or severe cases.
- **Survival on surfaces** : Up to 72 hours (plastic/steel); shorter on paper, copper, or under UV exposure.

Epidemiology

As of early 2020, COVID-19 spread rapidly:

  - 137,000 confirmed cases
  - 5,000 deaths globally within 3 months

- Declared a **pandemic by WHO on March 11, 2020**

  Update: As of 2025, over 770 million confirmed cases and nearly 7 million deaths have been reported globally (WHO).

Public Health Concerns and Strategies

CDC and WHO Strategies

- **Non-pharmaceutical interventions (NPIs)** :
  - Social distancing
  - Masking
  - Isolation of infected individuals
  - Hand hygiene
- **Vaccination campaigns** (from late 2020 onward)
- **Global surveillance and reporting**

Healthcare System Impact

- Increased hospitalization rates
- ICU strain and ventilator shortages
- Mental health challenges among healthcare workers

Prevention

- **Vaccination** (mRNA, viral vector, inactivated)
- **Mask-wearing in high-risk settings**
- **Hand hygiene** (?60% alcohol-based sanitizers)
- **Avoiding crowded or poorly ventilated areas**
- **Testing and contact tracing**

Key Takeaways

Feature	Description
Causative agent	SARS-CoV-2
Transmission	Respiratory droplets, aerosols, fomites
Incubation period	2–14 days (median 5 days)
Common symptoms	Fever, cough, fatigue, dyspnea
High-risk groups	Elderly, comorbid patients, healthcare workers
Diagnostic test	RT-PCR (gold standard)
Prevention	Vaccination, hygiene, masks, isolation
Severity distribution	80% mild, 15% severe, 5% critical
Complications	ARDS, shock, thromboembolism, myocarditis, long COVID