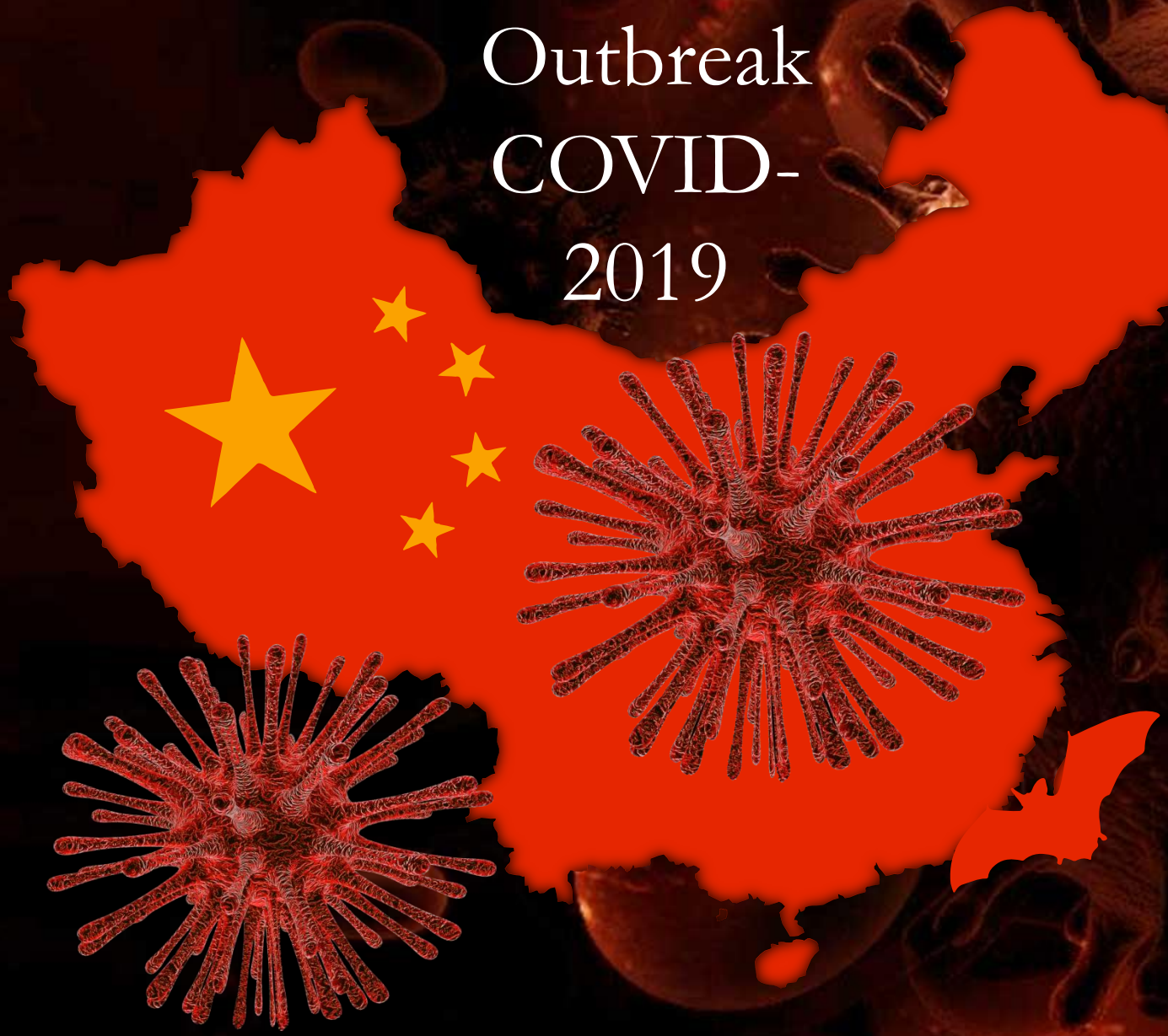
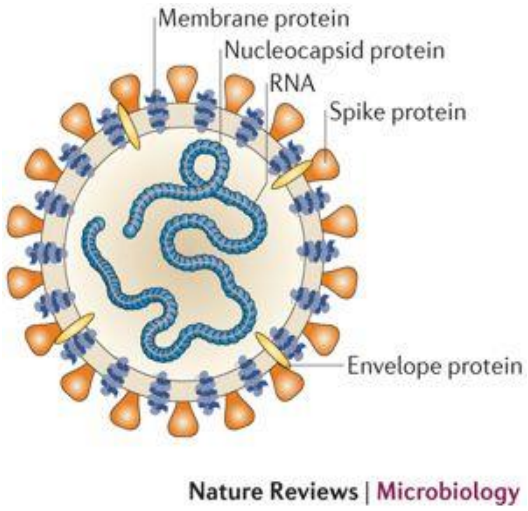
Coronavirus Outbreak COVID-2019

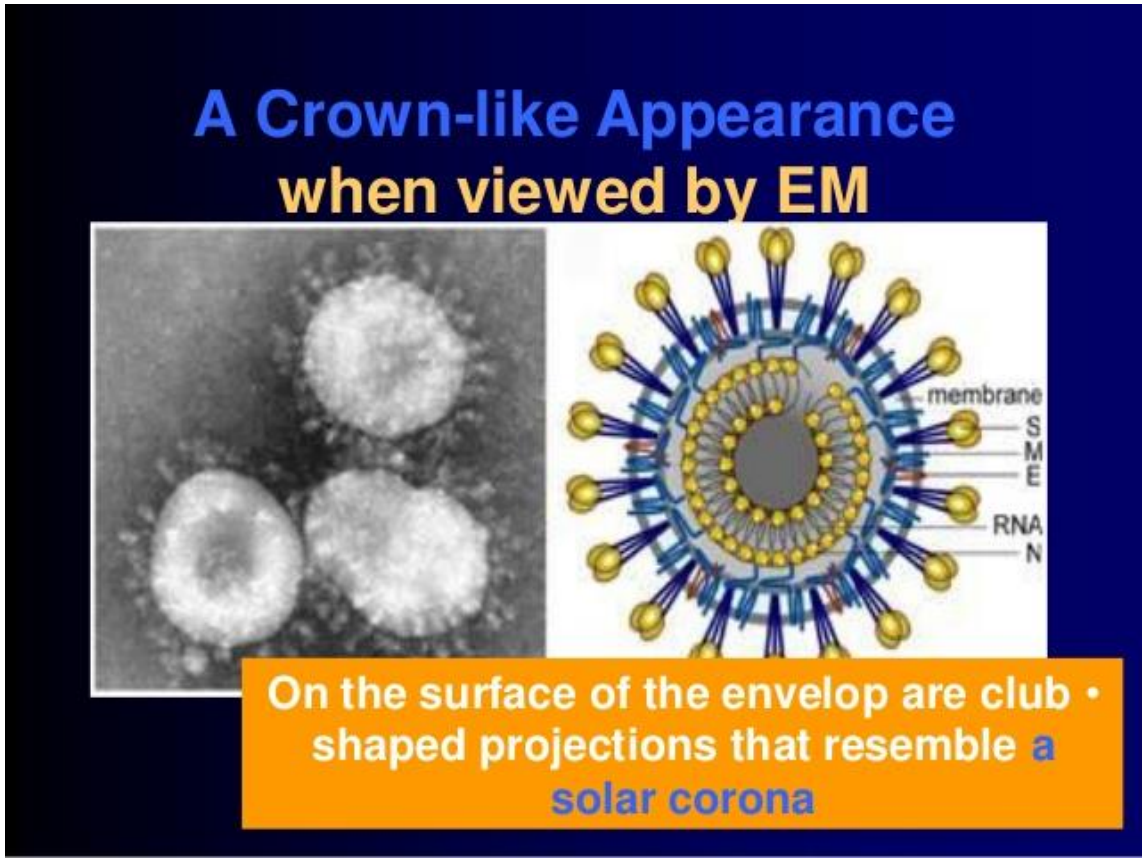


Prof. Amal E. Ali
Head of Microbiology & Immunology Department

FUTURE UNIVERSITY IN EGYPT
FACULTY OF PHARMACEUTICAL SCIENCES AND PHARMACEUTICAL INDUSTRIES

What are Coronaviruses

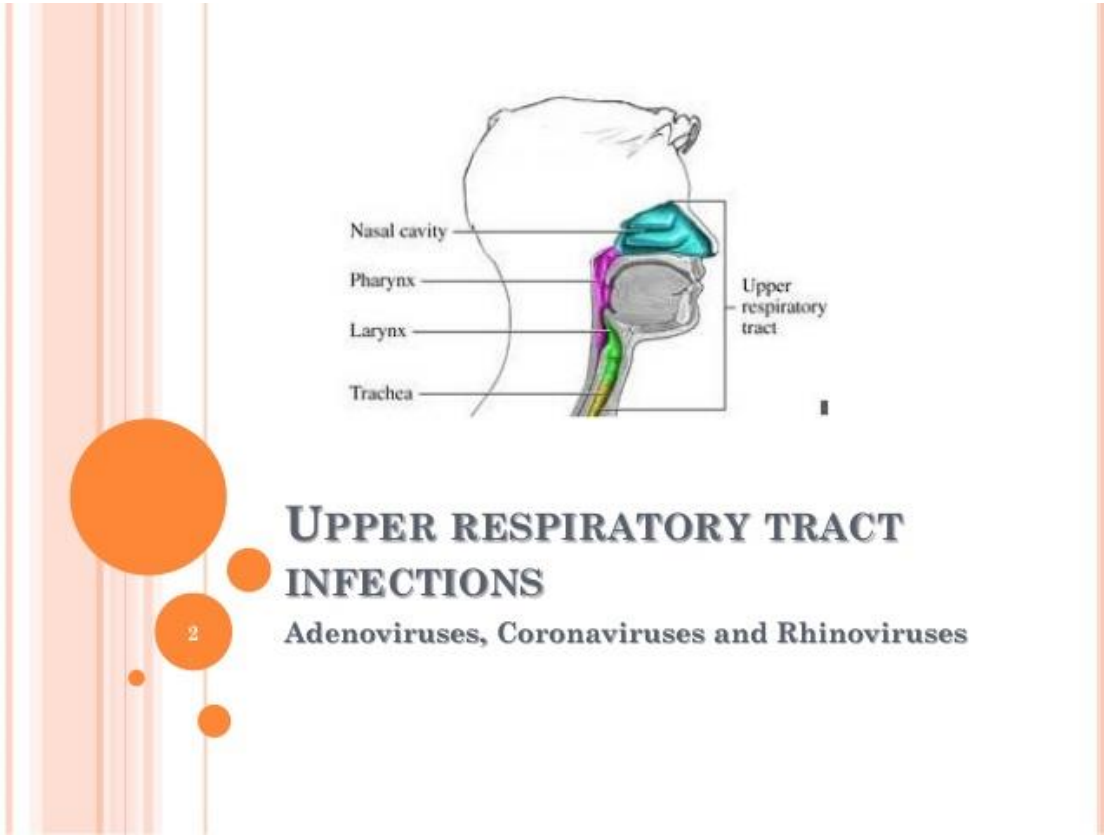




- Enveloped virus
- 120- to 160-nm particles
- Members of *Coronaviridae* family
- Unsegmented genome of single-stranded positive-sense RNA (27–32 kb). The largest genome among RNA viruses.

What are Coronaviruses

- Fifteen species in this family
- Infect human and animals
- They cause upper respiratory diseases, gastroenteritis in a number of avian and mammalian hosts, including humans.



History

- After the discovery of Rhinoviruses in the 1950's, ~30% of colds still could not be ascribed to known agents.

- In 1965, cultures of human ciliated embryonal trachea were used to propagate the first human coronavirus (HCoV) in vitro.

- It was **HCoV-OC43.**

Six strains of human coronaviruses are known:

1. **Human coronavirus OC43 (HCoV-OC43) Found in Egypt.**
2. **Human coronavirus 229E (HCoV-229E)**
3. **Human coronavirus NL63 (HCoV-NL63)**
4. **Human coronavirus HKU1 (HCoV-HKU1)**
5. **Severe acute respiratory syndrome-related cor*on*avirus (SARS-CoV) in 2003.**
6. **Middle East respiratory syndrome-related coronavirus (MERS-CoV), previously known as *novel coronavirus 2012***

The coronaviruses HCoV-229E, OC43, NL63 and HKU1 continually circulate in the human population and cause mild respiratory infections in adults and children world-wide.

Origin of Human Coronaviruses

- Coronaviruses are capable of genetic recombination if 2 viruses infect the same cell at the same time.

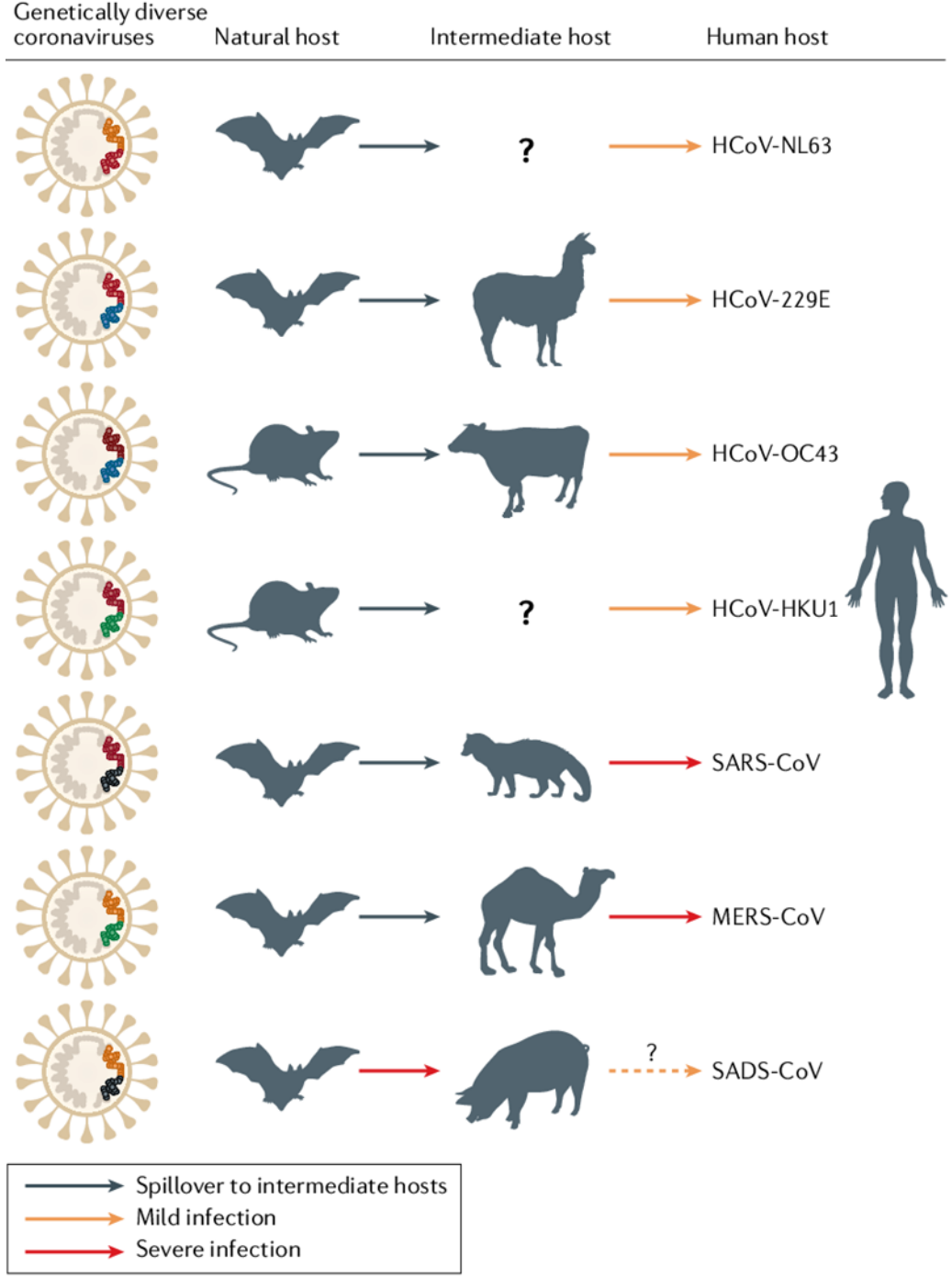
- High mutation rates may allow them to adapt to new hosts

Cui *et al.*, 2017 Origin and evolution of pathogenic coronaviruses. *Nat Rev Microbiol* (2019)

Origin of Human Coronaviruses

- All human coronaviruses have animal origins:
- SARS- CoV, MERS- CoV, HCoV- NL63 and HCoV-229E are considered to have originated in bats
- HCoV- OC43 and HKU1 likely originated from rodents
- They transmitted from their natural hosts to human through domestic animals as intermediate hosts.

Cui *et al.*, 2017 Origin and evolution of pathogenic coronaviruses. *Nat Rev Microbiol* (2019)



Cui *et al.*, 2017 Origin and evolution of pathogenic coronaviruses. *Nat Rev Microbiol* (2019)

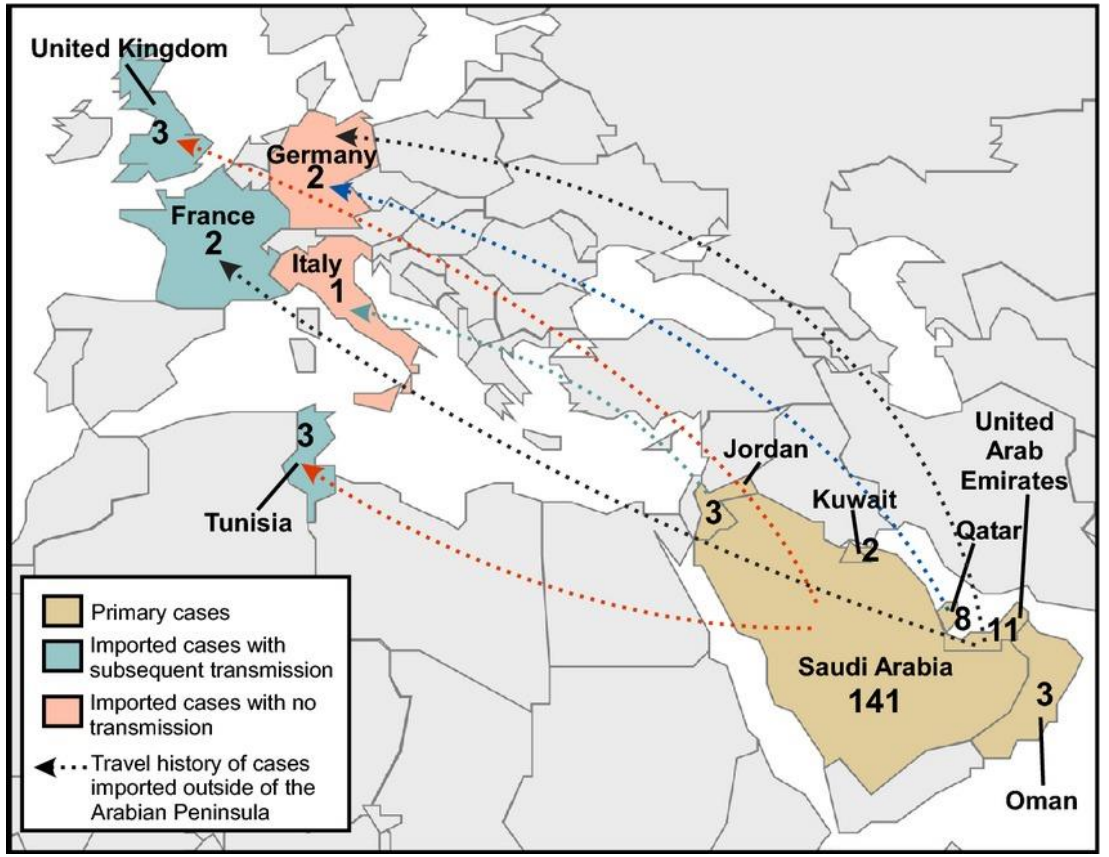
SARS- CoV

- Emerged in Guangdong Province, China in late 2002 to February 2003
- Characterized by severe clinical manifestations of both upper and lower respiratory tract.
  - Symptoms: Fever, cough, myalgia, dyspnea, and diarrhea
  - Spread across 26 countries and caused a cumulative 8,096 cases with a case fatality rate of (9.6%)

Gu, J., & Korteweg, C. (2007). Pathology and pathogenesis of severe acute respiratory syndrome. *The American journal of pathology*,

MERS-CoV

- **first identified in Saudi Arabia in 2012.**
- The clinical spectrum of MERS-CoV infection ranges from no or mild respiratory symptoms to severe acute respiratory disease and death.
- Typical presentation of MERS-CoV disease is fever, cough and shortness of breath.
- 2494 cases and a case fatality rate of 34%

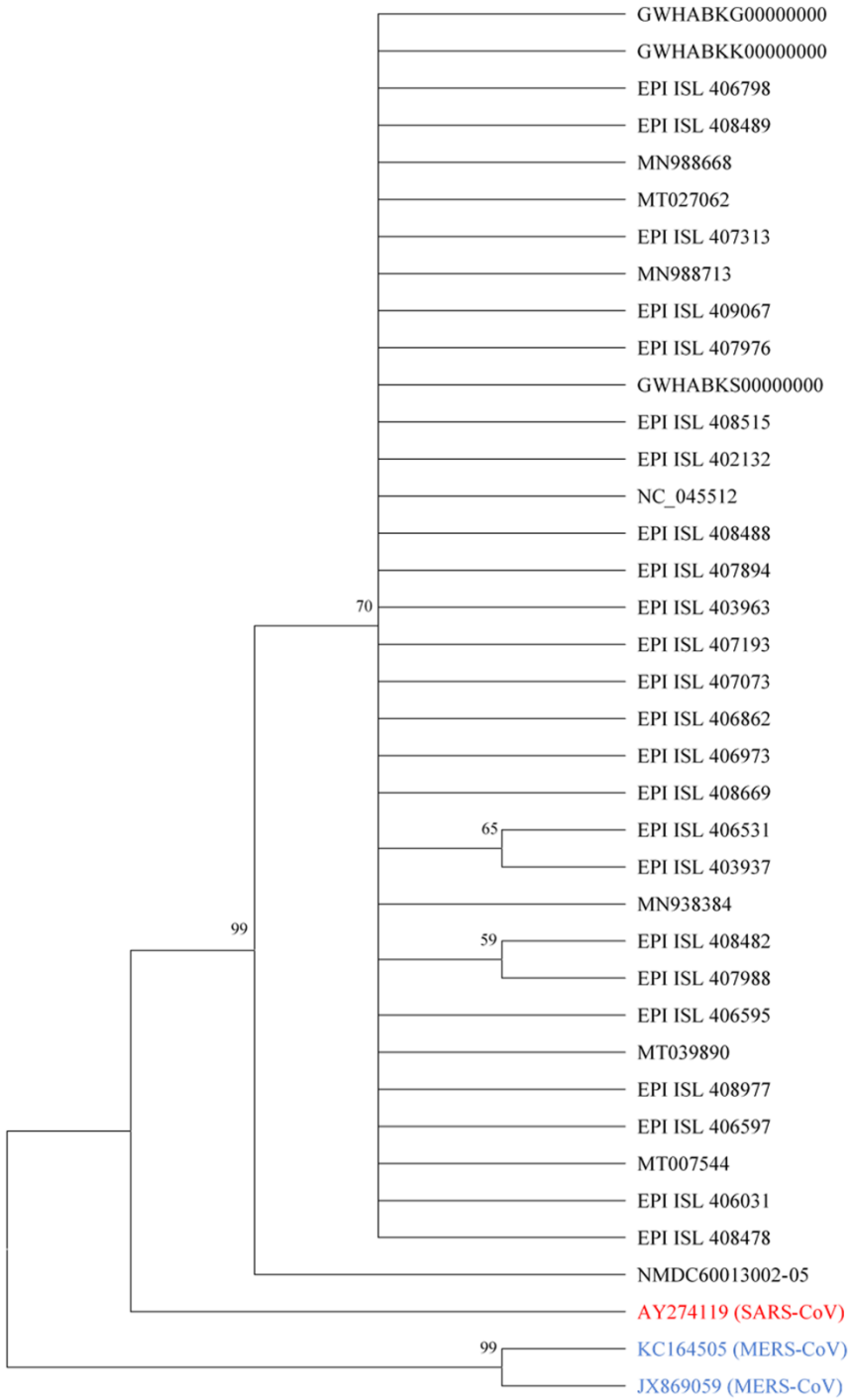


The geographical distribution of MERS-CoV cases up to February 1, 2014
Milne-Price et al., 2014 Pathog Dis.

COVID-2019 What is the Story

- On 31 December 2019, the World Health Organization (WHO) was informed by the People's Republic of China of cases of pneumonia caused by an unknown organism in Wuhan, central China.
- On 9 January 2020, WHO announce that a new coronavirus had been detected in patient samples in Wuhan.
- On 10 January 2020, the first novel coronavirus genome sequence was made publicly available

- The new emerging virus shares about 80% of the gene sequence of SARS-CoV.
- It also has a similarity of 96.2% to coronaviruses isolated from bats and 99% to virus isolated from pangolin.
- These suggest that pangolin is more likely to be one of the intermediate hosts of the new emerging virus.



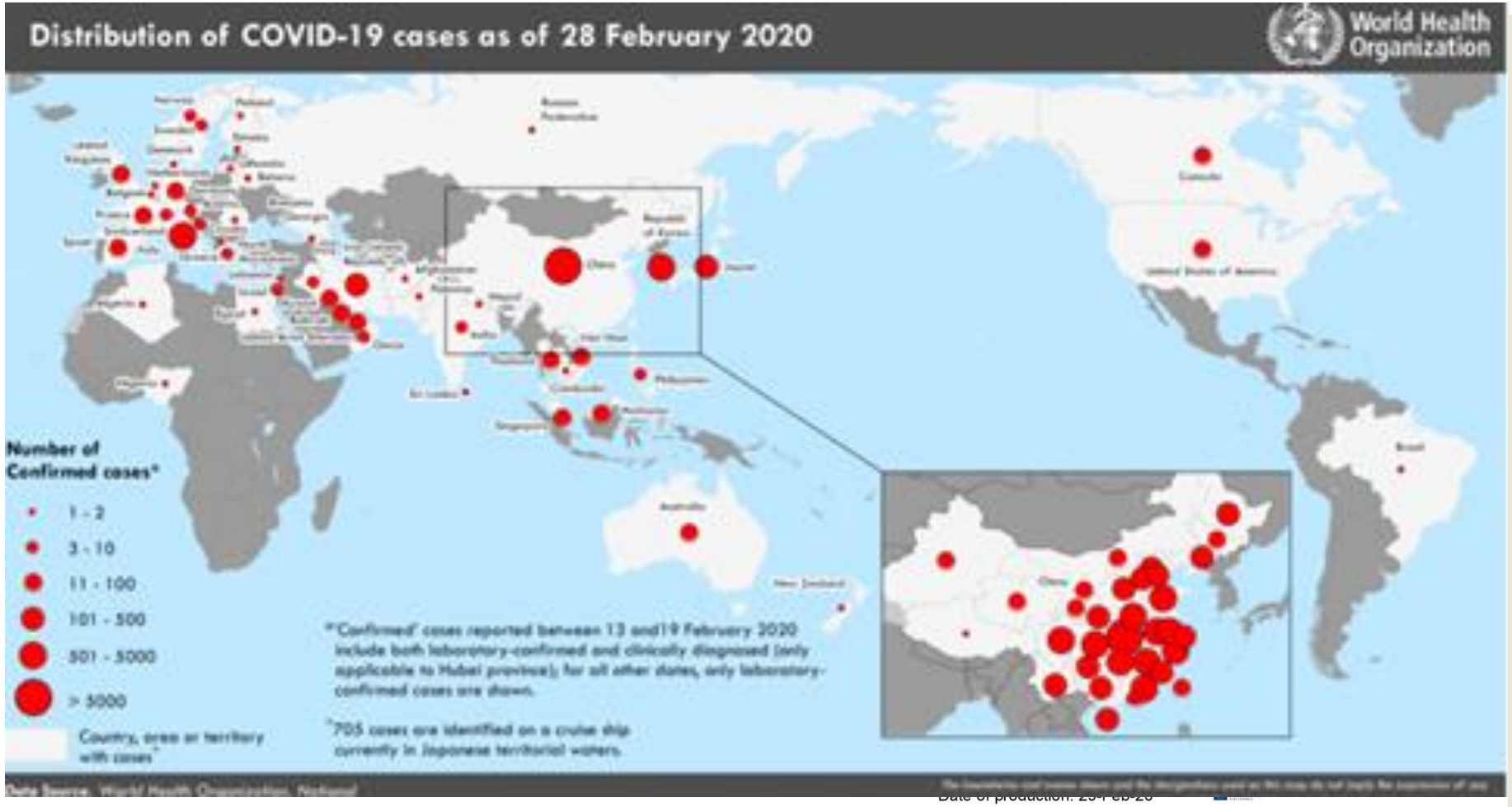
Xu et al., 2020 Viruses

Global Spread and Updates

- In early January a few new cases were found in nearby countries as a result of infected people travelling.
- At the end January, the outbreak was declared as a Public Health Emergency of International Concern by WHO.
- On February 12, the disease was named COVID-2019 and the virus SARS-CoV-2

Global Spread and Updates

https://gisanddata.maps.arcgis.com/apps/opsdashboard/index.html#/bda7594740fd40299423467b48e9ecf6



SITUATION IN NUMBERS

total and new cases in last 24 hours

Globally

87 137 confirmed (1739 new)

China

79 968 confirmed (579 new)

2873 deaths (35 new)

Outside of China

7169 confirmed (1160 new)

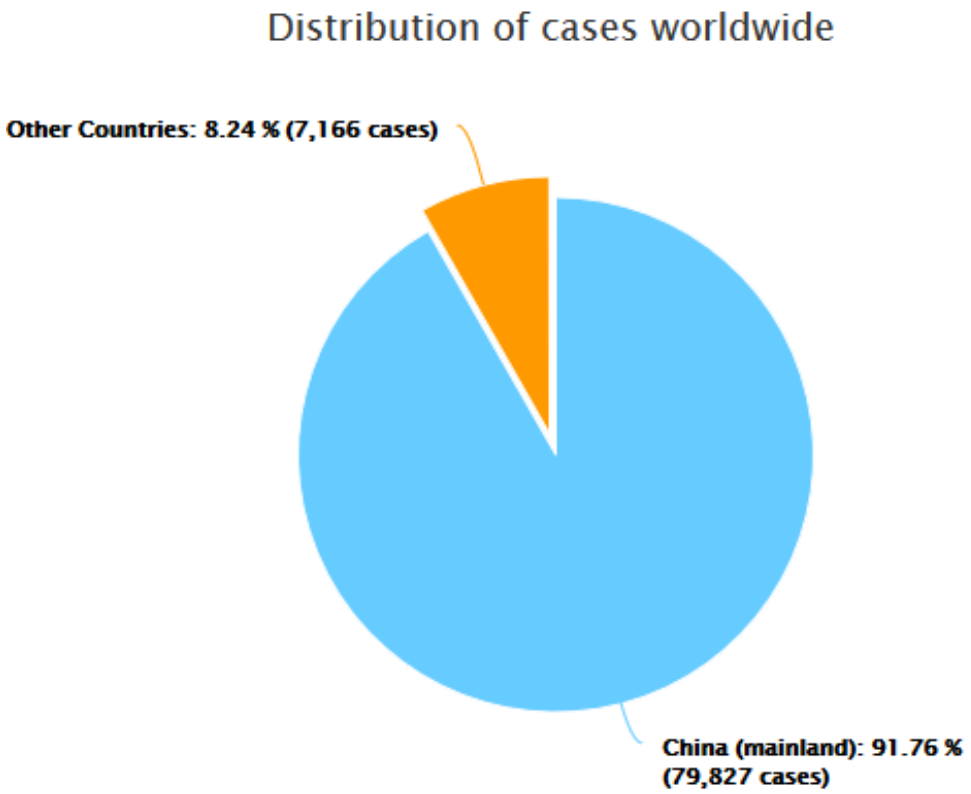
58 countries (5 new)

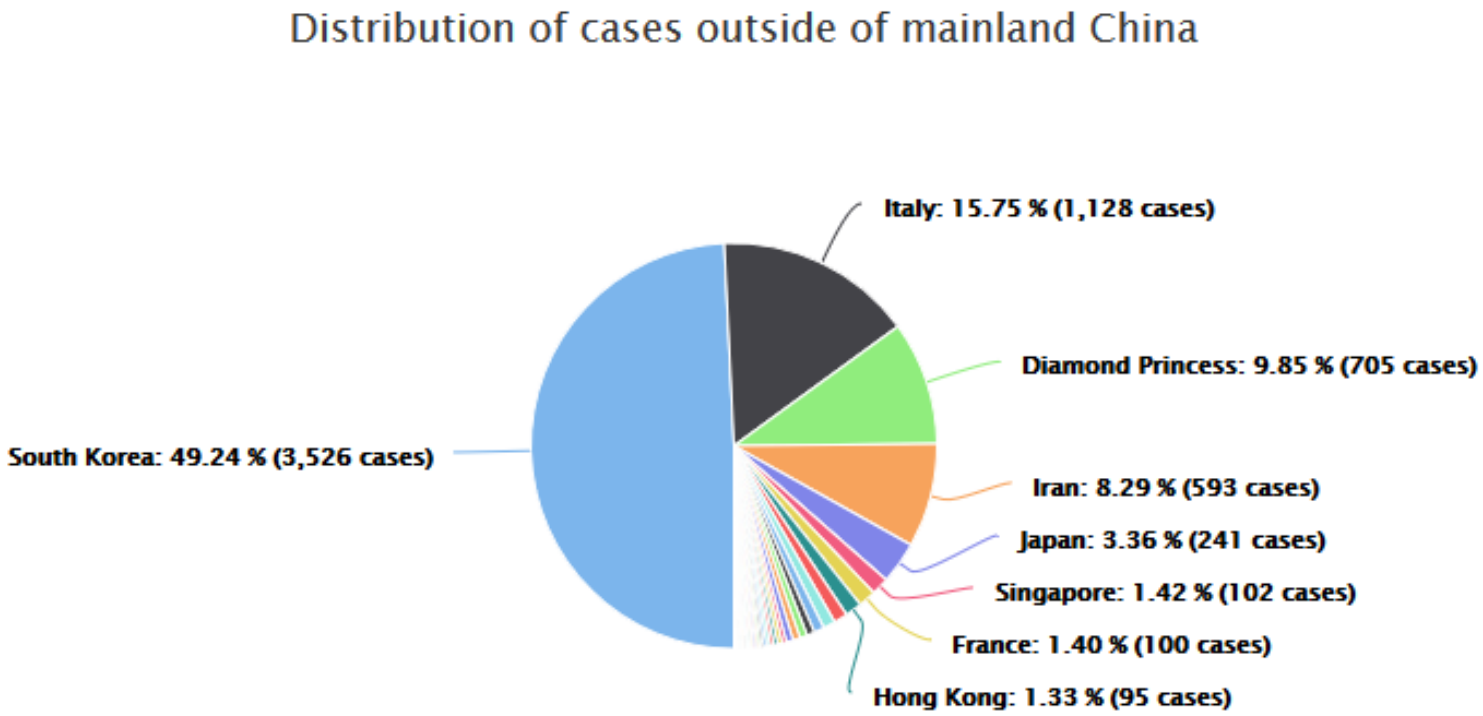
104 deaths (18 new)

WHO RISK ASSESSMENT

China	Very High
Regional Level	Very High
Global Level	Very High

Global Spread and Updates





Estimated Transmission rate : 2-3	Estimated Fatality rate (WHO) 3%
Incubation period: 3-14 days	Countries and Territories affected: 64

Global Spread and Updates

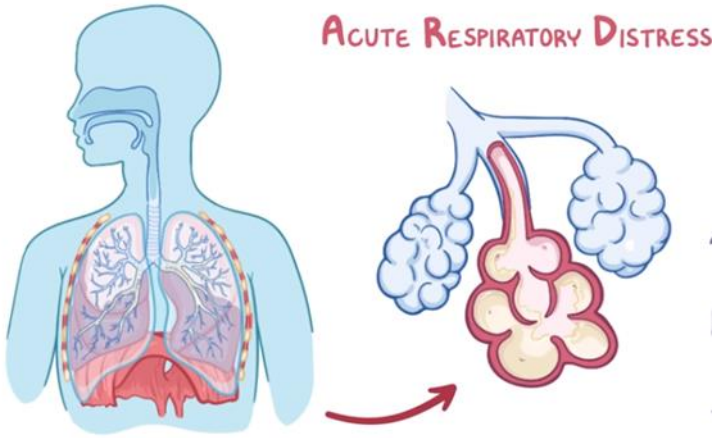
Country, Other	Total Cases	New Cases	Total Deaths	New Deaths	Active Cases	Total Recovered	Serious Critical
Azerbaijan	3				3		
Czechia	3	+3			3		
Georgia	3				3		
Iceland	3	+2			3		
India	3				0	3	
Qatar	3	+2			3		
Romania	3				2	1	
Belgium	2	+1			1	1	
Brazil	2				2		
Egypt	2	+1			1	1	
Indonesia	2	+2			2		
Russia	2				0	2	
Afghanistan	1				1		
Armenia	1	+1			1		
Belarus	1				1		

https://www.worldometers.info/coronavirus/March 02, 2020

Mechanism of disease

- SARS-CoV2

bind



angiotensin-converting enzyme 2 (ACE2) receptor in type Ⅰ and Ⅱ alveolar epithelial cells in human lung

Decreased ACE2 expression

Increased Angiotensin Ⅱ

damages alveolar cells, pulmonary vascular permeability and trigger systemic reactions

Mechanism of disease

- Receptor-binding ability of SARS-CoV-2 is 10-20 times stronger than that of SARS-CoV.

- SARS-CoV-2: A higher ability to infect but a lower pathogenicity than SARS-CoV

COVID-2019

Reported illnesses have ranged from mild symptoms to severe illness and death.

Symptoms

Fever
Cough
Shortness of breath

Fever

Cough

Shortness of breath

Characteristics of patients who have been infected with 2019-nCoV, MERS-CoV, and SARS-CoV[32]

	2019-nCoV*	MERS-CoV	SARS-CoV
Demographic			
Detection date	December 2019	June 2012	November 2002
Detection place	Wuhan, China	Jeddah, Saudi Arabia	Guangdong, China
Age average	49	56	39.9
Age range	21–76	14–94	1–91
Male:female ratio	2.7:1	3.3:1	1:1.25
Confirmed cases	835†	2494	8096
Case fatality rate	25† (2.9%)	858 (37%)	744 (10%)
Health-care workers	16‡	9.8%	23.1%
Symptoms			
Fever	40 (98%)	98%	99–100%
Dry cough	31 (76%)	47%	29–75%
Dyspnoea	22 (55%)	72%	40–42%
Diarrhoea	1 (3%)	26%	20–25%
Sore throat	0	21%	13–25%
Ventilatory support	9.8%	80%	14–20%

*: symptoms based on the first 41 patients. †: Data as of 23 January 2020.

‡: Data as of 21 January 2020; other data up to 21 January 2020. Published on 24 January 2020

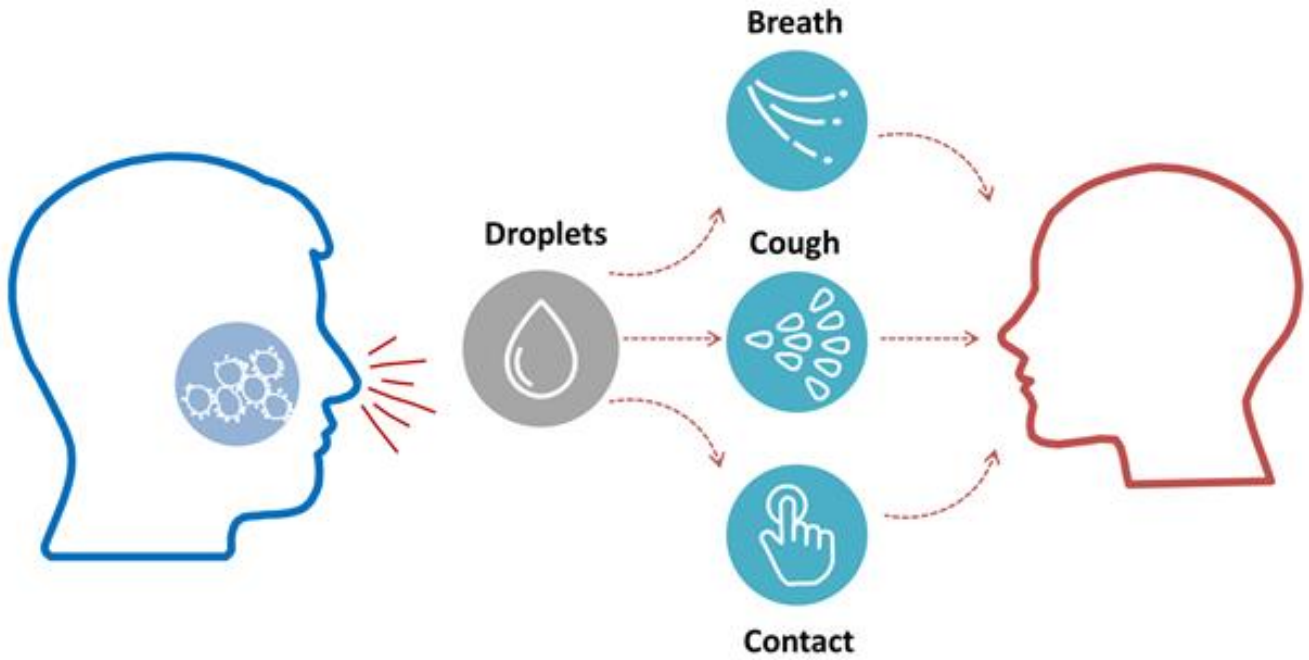
Clinical Symptoms

COVID-19 can be classified into light, normal, severe, and critical types based on the severity of the disease

1. Mild cases
2. Normal cases
3. Severe cases
4. Critical cases

How the virus is transmitted

- Between people who are in close contact with one another (within about 6 feet)
- Via respiratory droplets produced when an infected person coughs or sneezes.
- These droplets can land in the mouths or noses of people who are nearby or possibly be inhaled into the lungs.
- By touching a surface or object that has the virus on it and then touching their own mouth, nose.



The incubation period varies from 3–7 days on average, for up to 14 days

Virus is transmitted from symptomatic and asymptomatic carriers

Prevention and Control

- Avoid close contact with people who are sick.
- Avoid touching your eyes, nose, and mouth.
- Stay home when you are sick.
- Cover your cough or sneeze with a tissue, then throw the tissue in the trash.
- Wash your hands often with soap and water for at least 60 seconds, especially after going to the bathroom; before eating; and after blowing your nose, coughing, or sneezing. use an alcohol-based hand sanitizer with at least 60% alcohol
- Clean and disinfect frequently touched objects and surfaces using a regular household cleaning spray or wipe.

Hand Washing Technique

https://www.who.int/gpsc/clean_hands_protection/en/

Prevention and Control

- CDC does not recommend that people who are well wear a facemask to protect themselves from respiratory diseases, including COVID-19.

Facemask should be used by people who show symptoms of COVID-19. It is also crucial for health workers

- Place mask carefully to cover mouth and nose and tie securely to minimize any gaps between the face and the mask.
- Remove the mask by using appropriate technique (i.e. do not touch the front but remove the lace from behind).
- After removal if you touch a used mask, clean hands by using an alcohol-based hand rub or soap and water.
- Replace masks with a new clean, dry mask as soon as they become humid

Treatment and management

- As of 5 February 2020, there are no vaccines or antiviral drugs to prevent or treat human coronavirus infections.

- Attempts to relieve the symptoms include taking regular (over the-counter),flu medications, drinking fluids, and resting.

- Depending on the severity, oxygen therapy, intravenous fluids, and breathing support may be required.

Treatment and management

- Research into potential treatments for the disease were initiated in January 2020, and new therapies may take until 2021 to develop.

- Clinical trials with the available antiviral drugs on the hospitalized patients has been initiated quickly to assess their efficacy and safety.

- Remdesivir (Ebola), Ribavirin (RSV and HCV), Chloroquine (Malaria, Amoeba and rheumatoid), and Lopinavir/Ritonavir (HIV), all of which seemed to have "fairly good inhibitory effects" on 2019-nCoV at the cellular level in exploratory research


BioScience Trends
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Journal issue
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Breakthrough: Chloroquine phosphate has shown apparent efficacy in treatment of COVID-19 associated pneumonia in clinical studies
Jianjun Gao, Zhenxue Tian, Xu Yang
Author information
Keywords: COVID-19, SARS-CoV-2, 2019-nCoV, pneumonia, chloroquine
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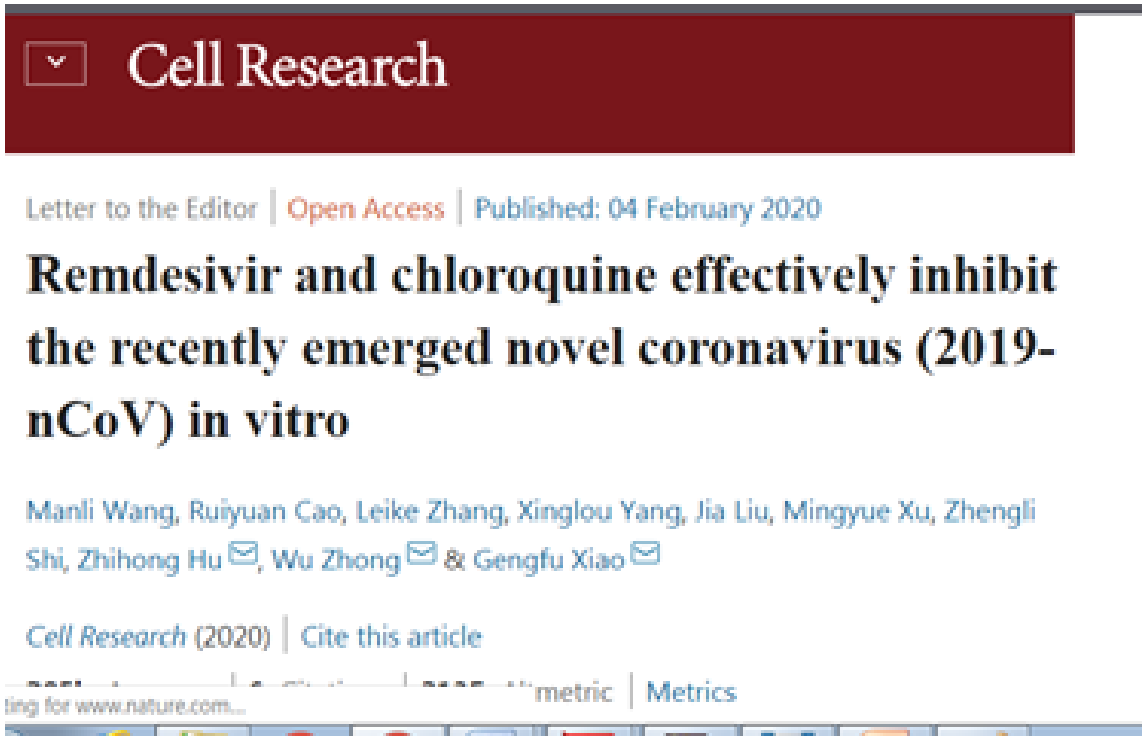
Article ID: 2020 01047


Cell Research
Letter to the Editor | Open Access | Published: 04 February 2020
Remdesivir and chloroquine effectively inhibit the recently emerged novel coronavirus (2019-nCoV) in vitro
Manli Wang, Ruiyuan Cao, Leike Zhang, Xinglou Yang, Jia Liu, Mingyue Xu, Zhengli Shi, Zhihong Hu, Wu Zhong & Gengfu Xiao
Cell Research (2020) | Cite this article
Metrics


PERSPECTIVES | Published: 11 February 2020
Old Weapon for New Enemy: Drug Repurposing for Treatment of Newly Emerging Viral Diseases
Deyin Guo
Virologica Sinica (2020) | Cite this article
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The Best Defense Is Early Detection

Effective prevention and control measurements must include early detection and isolation

Flowchart to Identify and Assess 2019 Novel Coronavirus

For the evaluation of patients who may be ill with or who may have been exposed to 2019 Novel Coronavirus (2019-nCoV)

A. Identify

if in the ***past 14 days since first onset of symptoms*** a history of ***either***

Travel to China	OR	**Close contact with** a person known to have 2019-nCoV illness*

B. AND the person has

Fever or symptoms of lower respiratory illness
(e.g., cough or shortness of breath)

if both exposure and illness are present

1. Isolate

- Place facemask on patient
- Isolate the patient in a private room or a separate area
- Wear appropriate personal protective equipment (PPE)

2. Assess clinical status

EXAM	**Is fever present?**	**Is respiratory illness present?**
	☐ Subjective?	☐ Cough?
	☐ Measured? _____°C/F	☐ Shortness of breath?

3. Inform

- Contact health department to report at-risk patients and their clinical status
- Assess need to collect specimens to test for 2019-nCoV
- Decide disposition

If discharged to home

Instruct patient

As needed depending on severity of illness and health department consultation

- Home care guidance
- Home isolation guidance

Advise patient

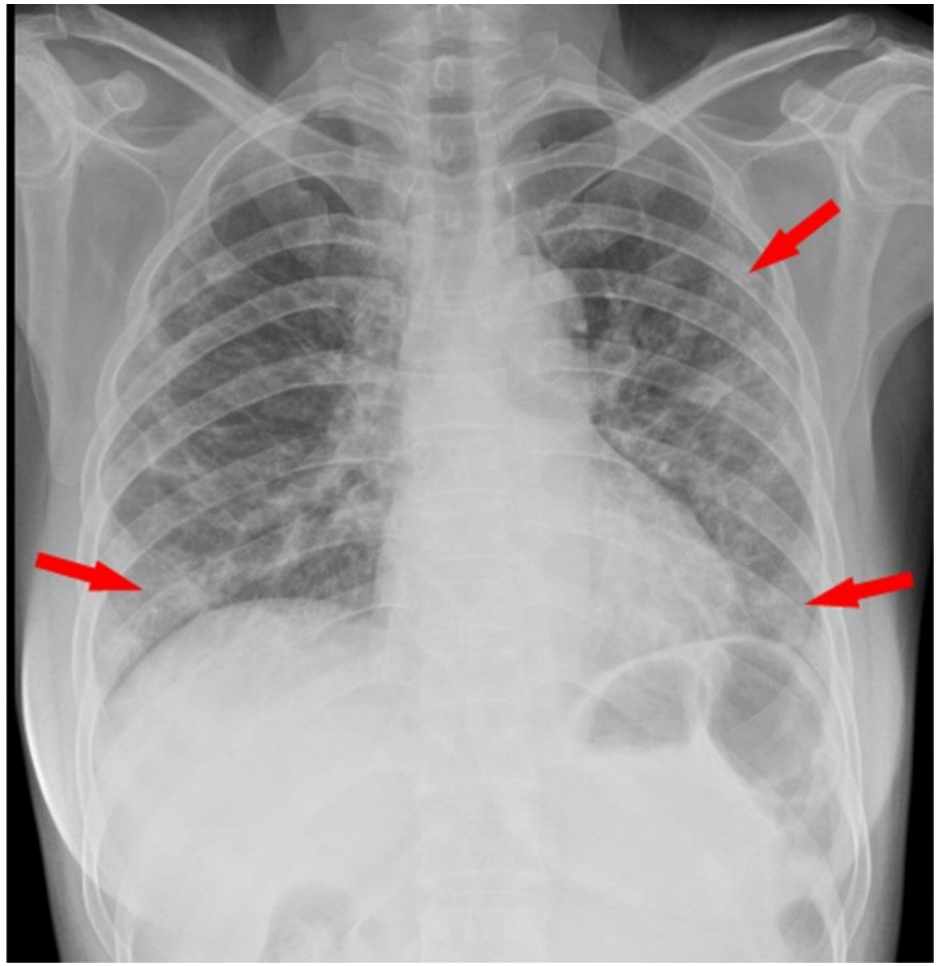
If the patient develops new or worsening fever or respiratory illness

- Call clinic to determine if reevaluation is needed
- If reevaluation is needed call ahead and wear facemask

* Documentation of laboratory-confirmation of 2019-nCoV may not be possible for travelers or persons caring for patients in other countries. For more clarification on the definition for close contact see CDC's Interim Guidance for Healthcare Professionals: www.cdc.gov/coronavirus/2019-nCoV/hcp/clinical-criteria.html

- Chest radiography of confirmed COVID-19 pneumonia A 53-year-old female had fever and cough for 5 days. Multifocal patchy opacities can be seen in both lungs (arrows).

- Characteristic chest CT imaging features and Wuhan exposure or close contact history, highly suggest COVID-19 pneumonia, although RT-PCR remains the reference standard



Zu et al., Radiology, 2020

Tests for COVID-2019

- CDC has developed a new laboratory test kit for use in testing patient specimens for 2019 novel coronavirus
- It is a Real-Time Reverse Transcriptase (RT)-PCR Diagnostic Panel.
- This test is intended for use with upper and lower respiratory specimens collected from persons.

Prognosis

- Early data indicates that among the first 41 confirmed cases admitted to hospitals in Wuhan, less than half had underlying diseases including diabetes, hypertension and cardiovascular.

- 13 (32%) individuals required intensive care

Comparison of Case fatality rate and transmissibility of SARS-CoV2 with the commonly known emerging virus infections

Virus	Case Fatality Rate (%)	R_0
SARS-CoV2	3	1.4–5.5
SARS-CoV	10	2-5
MERS-CoV	40	>1
Avian H7N9 (2013)	40	>1
H1N1 (2009)	0.03	1.2-1.6
H1N1 (1918)	3	1.4-3.8
Measles Virus	0.3	12-18
Rhinovirus	<0.01	6
Ebola Virus	70	1.5-2.5
HIV	80[b]	2-4
Small Pox Virus	17	5-7

Chen, 2020. Microbes and Infection

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THANK YOU