A Handbook of COVID-19

Control and Prevention

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Contents

Message from the Translators 6

Those who contribute to the English version are as follows 8

Introduction to Translators 9

Editorial Board 11

Introduction to Editors-in-chief 12

Preface 16

Foreword 17

1. Overview of Coronaviruses 19

1. What are viruses associated with respiratory infections? 19
2. What are the common viruses associated with respiratory infections? 20
3. What are coronaviruses? 21
4. What are the shapes and structures of coronaviruses? 22
5. How are coronaviruses classified? 23
6. Which wild animals carry coronaviruses? 24
7. How do coronaviruses transmit from animals to humans? 25
8. How resilient are coronaviruses in different environments? 26
9. How virulent is the 2019-nCoV? 27
10. Can humans develop immunity to 2019-nCoV? 27
11. What is Severe Acute Respiratory Syndrome (SARS)? 28
12. What is Middle East Respiratory Syndrome (MERS)? 29
13. What is novel coronavirus? Why has it become epidemic? 30

2. Transmission of 2019-nCoV 31

14. What is community-acquired pneumonia? 31
15. What are the diagnostic criteria for community-acquired pneumonia? 31
16. Which pathogens cause community-acquired pneumonia? 33
17. How is community-acquired pneumonia transmitted? 34
18. What are the risk factors for the transmission of community-acquired pneumonia? 34
19. How to prevent community-acquired pneumonia 36
20. Who are susceptible to 2019-nCoV? 37
21. What are the epidemiological characteristics of COVID-19? 38
22. What are the routes of transmission of 2019-nCoV? 39
23. What is droplet transmission? 40
24. What is airborne transmission? 41
25. What is contact transmission? 42
26. What is close contact? 43
27. Why should close contacts be put under isolated medical observation for 14 days? 44

3. Detection, Diagnosis and Treatment 45
28. What are the clinical manifestations of COVID-19? 45
29. Do you know something on laboratory testing for COVID-19? 46
30. What are the characteristics of COVID-19 chest films? 46
31. How to identify COVID-19 cases clinically 47
32. How to confirm COVID-19 cases 47
33. How to diagnose severe COVID-19 cases 48
34. What is the difference between COVID-19 and other pneumonias? 48
35. What should close contacts do with the notice from the Centre of Disease Control? 49
36. What should I do if I am possibly infected with COVID-19? 50
37. How to choose a medical institution for treatment 50
38. What should be done if a patient requires transportation? 51
39. Are there any drugs or vaccines against COVID-19? 51
40. How to treat COVID-19 52
41. What are the clinical criteria for quarantine release and discharge? 53

4. Personal Precautions 54
42. How to prevent respiratory infections in spring and winter 54
43. Why does flu caused by viruses become pandemic? 55
44. How to keep yourself away from the novel coronavirus 56
45. Can a mask block such small coronaviruses? 57
46. What are the features of masks for different purposes? 57
47. Any difference between a KN95 respirator and a N95 respirator? 59
48. How to choose a mask 59
49. How to put on, use, and take off a mask 60
50. How often should a mask be replaced? Can N95 respirators be extendedly used or reused? 61
51. How do I keep my glasses from fogging up with a mask on? 62
52. How should special populations choose a mask? 62
53. Why is handwashing important in preventing respiratory diseases? 63
54. How to wash hands correctly 63
55. Key moments for hand hygiene in daily life 64
56. How to clean hands if clean water is not available 65
57. Does handwashing with soap and clean water work against coronaviruses? 65
58. Can 75% alcohol reduce risk of 2019-nCoV infections? 66
59. How to take care of a COVID-19 patient at home 66
60. Is it necessary for suspected cases with mild symptoms to be quarantined at home? 67
61. How to home quarantine for suspected infections 68
62. What should I do amid close contact with a COVID-19 patient? 71
63. How to control hospital infections 72
64. Why do medical staff of fever clinics wear protective clothing in consultations? 73
65. What personal protective equipment is required for healthcare institutions? 74

66. What lifestyle is recommended amid the outbreak of COVID-19? 74
67. How to exercise amid the COVID-19 outbreak 76
68. How smoking and drinking affect your immune system 76
69. How to prevent infections of the novel coronavirus at home 77
70. How to ventilate your rooms 78
71. How to prevent infections by 2019-nCoV during travel 79
72. Which commonly-used Chinese herbs can prevent COVID-19? 80
73. How to get mentally prepared during the outbreak of COVID-19 81

5. Precautions in Public Places 84
74. How to prevent infections by 2019-nCoV at farmer's markets 84
75. How to prevent infections by 2019-nCoV in cinemas and theaters 85
76. How to prevent infections by 2019-nCoV when traveling by public transportation 85
77. How to prevent infections by 2019-nCoV in the workplace 86
78. How to prevent infections by 2019-nCoV in elevators 86
79. How to prevent infections by 2019-nCoV at wet markets 87
80. How to prevent infections by 2019-nCoV in hospitals 88
81. How to prevent infections by 2019-nCoV in colleges and universities 88
82. How to prevent infections by 2019-nCoV in primary and secondary schools as well as nurseries 89
83. How students can avoid infections by 2019-nCoV at learning places 91
84. How students can avoid infections by 2019-nCoV in their living spaces? 92
85. How to prevent infections by 2019-nCoV in elder-care settings 93
86. How to prevent infections by 2019-nCoV in canteens 94

6. Basics of Contagious Diseases 96
87. What are notifiable and quarantinable contagious diseases? 96
88. Why has the COVID-19 been classified as a Class B contagious disease while Class A control measures are taken? 97
89. What is a "super-spreader"? 98
90. What is an asymptomatic infection? 98
91. What is 'quarantine for medical observation'? 99
92. How to transport critically-ill patients with infections 100

7. Dispelling The Myths 101

8. Stay Home, Stay Sane 107

9. Global Impact of COVID-19 111

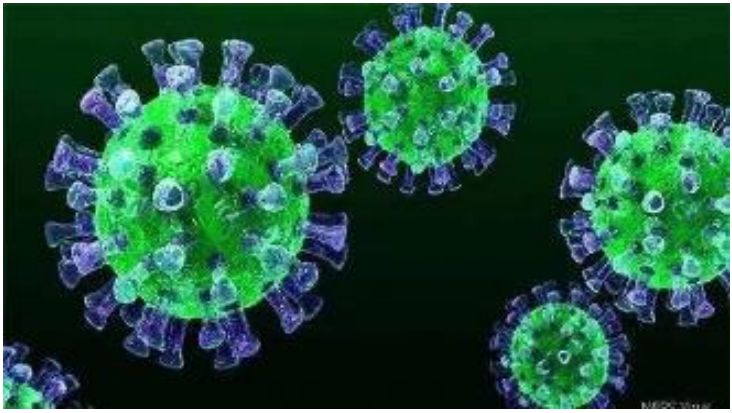
Appendix 117

Postscript 118

1 Overview of Coronaviruses

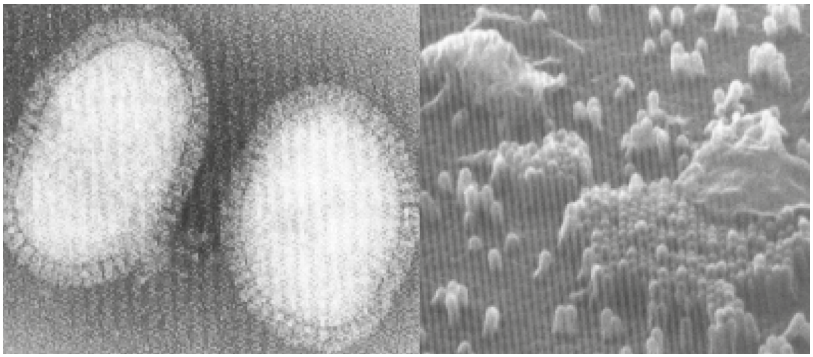
1. What are viruses associated with respiratory infections?

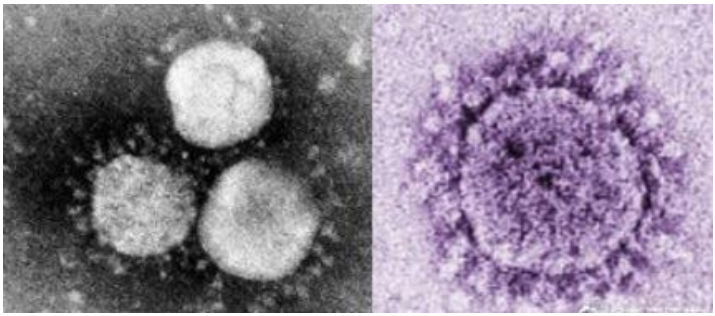
"Viruses associated with respiratory infections" refer to the viruses that invade and proliferate in the epithelial cells of the respiratory tracts that could cause respiratory and systemic symptoms.

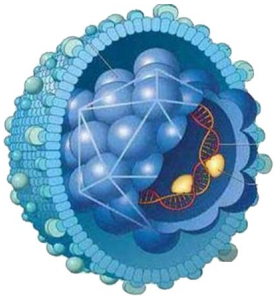


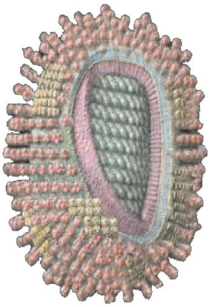
2. What are the common viruses associated with respiratory infections?

Viruses from the family Orthomyxoviridae (influenza viruses), the family Paramyxoviridae (paramyxoviruses, respiratory syncytial virus, measles virus, mumps virus, Hendra virus, Nipah virus and human metapneumovirus), the family Togaviridae (Rubella virus), the family Picornaviridae (rhinovirus), and the family Coronaviridae (SARS coronavirus) are the common respiratory viruses. In addition, adenovirus, reovirus, coxsackie virus, ECHO virus, herpes virus, etc. can also cause infectious respiratory diseases.



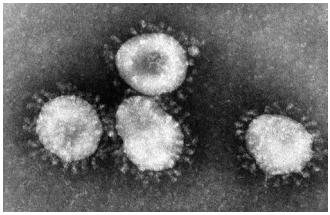


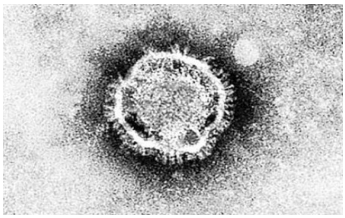


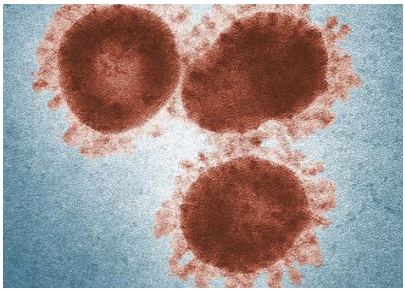


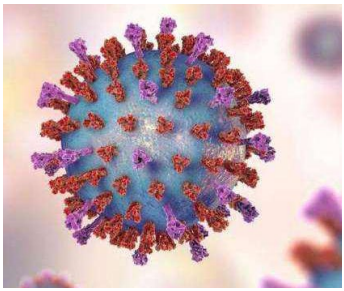
3. What are coronaviruses?

Coronaviruses are unsegmented single-stranded, positive-strand RNA viruses. They belong to the order of Nidovirales, the family Coronaviridae, and the subfamily of Orthocoronavirinae, which is divided into α, β, γ, and δ genera according to their serotypic and genomic characteristics. Coronaviruses belong to the Coronavirus genus of the family Coronaviridae. It is named after the wreath-shaped protrusions on the envelope of the virus.



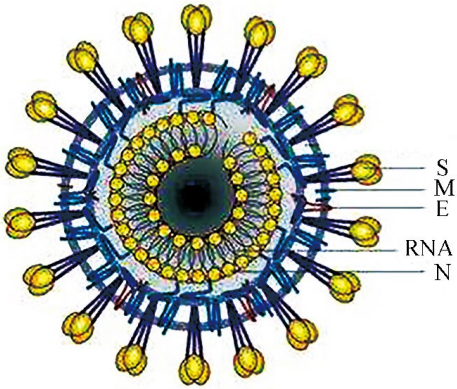






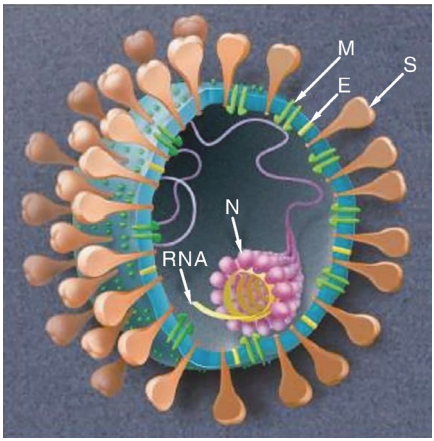
4. What are the shapes and structures of coronaviruses?

Coronaviruses have an envelope encasing the RNA genome), and virions (the whole virus) are round or oval, often polymorphic, with a diameter of 50 to 200 nm. The novel coronavirus is 60 to 140 nm in diameter. The spike protein is located on the surface of the virus and forms a rod-like structure. As one of the main antigenic proteins of the virus, the spike protein is the main structure used for typing. The nucleocapsid protein encapsulates the viral genome and can be used as a diagnostic antigen.



Constitutive Proteins:

- Spike Protein （S）
- Envelope Protein （E）
- Membrane Protein （M）
- Nucleo Protein （N）

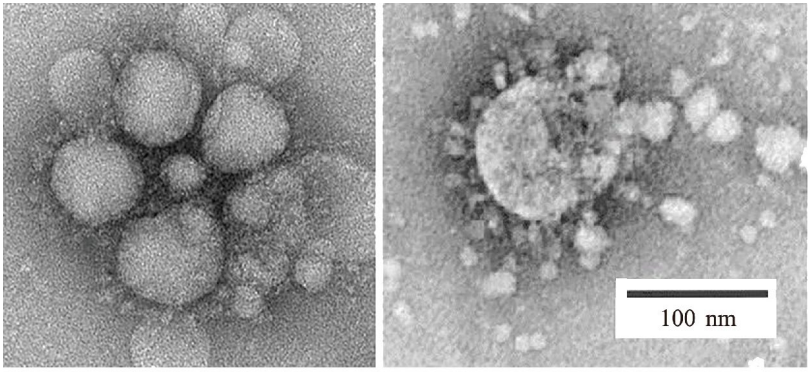


5. How are coronaviruses classified?

Most coronaviruses infect animals. Currently, three types of coronaviruses have been isolated from humans: Human Coronaviruses 229E, OC43, and SARS coronavirus (SARS-CoV). There are 6 types of coronaviruses previously known to infect humans. 229E and NL63 (of alphacoronaviruses), OC43 (of betacoronaviruses), HKU1, Middle East Respiratory Syndrome Coronavirus (MERS-CoV), and Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV).

Recently, a novel coronavirus was isolated from the lower respiratory tract of patients, who were suffering from pneumonia due to unknown causes. WHO called it 2019-nCoV while the International Committee on the Taxonomy of Viruses (ICTV) named it SARS-CoV-2. It was subsequently confirmed that the virus is capable of human-to-human transmission.

This novel coronavirus is very similar to six previously discovered coronaviruses, in terms of the genome sequences. An analysis of their genetic sequence homology revealed that the new virus has many similarities with SARS-CoV. This novel coronavirus is now classified as a beta-coronavirus.



MERS-CoV SARS-CoV

6. Which wild animals carry coronaviruses?

Many wild animals carry pathogens and are potential transmission vectors of certain contagious diseases. Bats, civets, badgers, bamboo rats, wild camels, etc. are known hosts of coronaviruses.

Novel coronavirus pneumonia has many similarities to the SARS outbreak in 2003 in that both began in the winter and both were caused by a previously unknown coronavirus.

Due to the similarities in the genomic sequences between the novel coronavirus and the coronavirus found in bats, which is 85% or higher, it is speculated that bats are the natural hosts of the novel coronavirus. Like the SARS coronavirus that caused the outbreak in 2003, the novel coronavirus' likelihood of having intermediate hosts between bats and humans is not yet known to us.

Therefore, one should refrain from the consumption of uninspected wild animals or uncooked food such as meat sold by roadside sellers.

7. How do coronaviruses transmit from animals to humans?

Many coronaviruses that infect humans can be found in bats, which are natural reservoirs of coronaviruses. Bats are likely to be the original host of the novel coronavirus. Transmission from bats to humans might have occurred after mutation via an intermediate host(s). The genomic sequence analysis showed a more than 85% homology between the novel coronavirus and a coronavirus in bats. However, there are several other possible intermediate hosts between bats and humans, which have not been confirmed yet. Animal-to-human or human-to-human transmissions rely mainly on two routes: contact and droplets.

The coronaviruses that are currently known to cause pneumonia in humans include HKU1, SARS-CoV, MERS-CoV, and 2019-nCoV.

8. How resilient are coronaviruses in different environments?

Viruses generally can survive for several hours on smooth surfaces. If the temperature and humidity permit, they can survive for several days. The novel coronavirus is sensitive to ultraviolet rays and heat. Exposure to sustained heat at 56 °C for 30 minutes, ether, 75% alcohol, chlorine-containing disinfectants, peracetic acid, chloroform, and other lipid solvents can effectively inactivate the virus. Chlorhexidine (also known as chlorhexidine gluconate) also effectively inactivates the virus.

The survival times of the novel coronavirus 2019-nCoV at different environmental temperatures are as follows.

Different environments	Temperature	Survival time
Air	10～15℃	4 hours
	25℃	2 ~ 3 minutes
Droplets	<25℃	24 hours
Nasal mucus	56℃	30 minutes
Liquid	75℃	15 minutes
Hands	20 ～30℃	<5 minutes
Non-woven fabric	10 ～15℃	<8 hours
Wood	10 ～15℃	48 hours
Stainless steel	10 ～15℃	24 hours
75% alcohol	Any temperature	<5 minutes
Bleach	Any temperature	<5 minutes

9. How virulent is the 2019-nCoV?

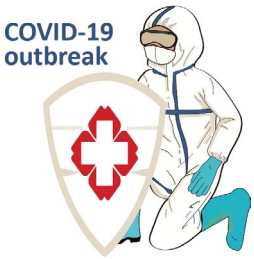
Common coronaviruses mainly infect adults or older children, causing the common cold. Some strains can cause diarrhea in adults. These viruses are mainly transmitted by droplets, and can also be spread via the fecal-oral route. The incidence of corona virus infection is prevalent in winter and spring. The incubation period for coronaviruses is usually 3 to 7 days.

2019-nCoV is a coronavirus that underwent antigenic mutations. The incubation period of the virus is as short as 1 day but generally considered to be no longer than 14 days. But it should be noted that some reported cases had an incubation period of up to 24 days.

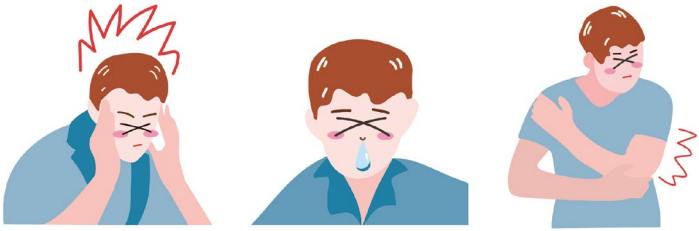
To measure the degree of harm caused by a virus, both infectivity and lethality should be considered. The new coronavirus is highly-infectious and can be fatal, but its lethality has not been determined at present.

10. Can humans develop immunity to 2019-nCoV?

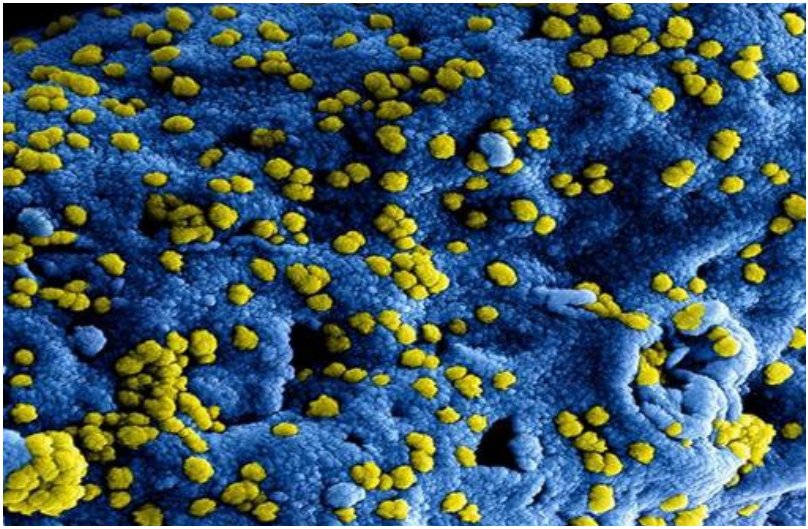
Scientific data on the level and the duration of protective immune antibodies produced in patients after infection of the novel coronavirus remain scarce. In general, the protective antibodies (immunoglobulin G, IgG) against a virus can be produced two weeks or so after an infection, and may exist for several weeks to many years, preventing re-infection of the same virus after recovery. Currently, efforts are underway to test whether the recently-recovered from the 2019-nCoV infection carry protective antibodies in their blood.



11. What is Severe Acute Respiratory Syndrome (SARS)?

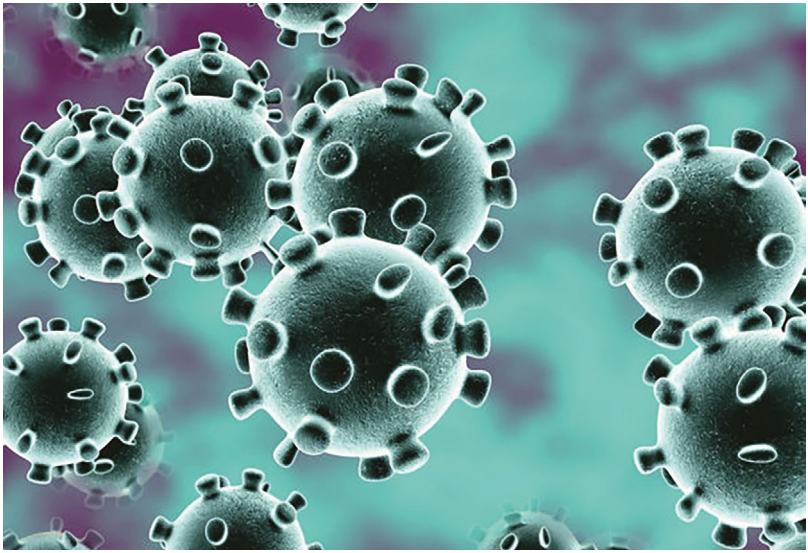


Severe acute respiratory syndrome (SARS) is a disease caused by SARS-CoV. The main symptoms of SARS include fever, cough, headache, muscle pain, and other symptoms of respiratory infection. Most SARS patients recover with or without medical treatment. Its fatality rate is about 10%; those over 40 years of age or with underlying diseases (such as coronary heart disease, diabetes, asthma, and chronic lung diseases) are most at risk to develop the fatal disease.



12. What is Middle East Respiratory Syndrome (MERS)?

Middle East Respiratory Syndrome is caused by MERS-CoV. It was first reported in middle-eastern countries including Saudi Arabia, United Arab Emirates, etc. People who are infected by MERS-CoV can develop acute respiratory distress syndrome (ARDS), while the most common manifestations show symptoms such as fever with tremors, coughing, shortness of breath, sore muscles and gastrointestinal symptoms such as diarrhea, nausea, vomiting or stomachache. Severe cases are featured by respiratory failure which require mechanical ventilation and supportive treatment in ICU. Some patients developed organ failures, especially renal failure and sceptic shock which eventually led to death. The case fatality rate is about 40%. Since the onset of the first MERS case in September 2012 until May 2015, MERS cases have been reported in 25 countries around the world, posing a serious threat to public health.



13. What is novel coronavirus? Why has it become epidemic?

The newly-discovered coronavirus is a mutated novel coronavirus (β genus), which was named 2019-nCoV by the WHO and SARS-CoV-2 by the ICTV. On January 10, 2020, genomic sequencing of the first sample of 2019-nCoV was completed, and the viral genomic sequences of five more samples were subsequently announced.

Due to the antigenic mutations that made this corona virus new to humans, the general population lacks immunity against the new strain. Furthermore, there is more than one routes of transmission for this virus. These factors resulted in the novel coronavirus becoming an epidemic.

3 Detection, Diagnosis and Treatment

28. What are the clinical manifestations of COVID-19?

The onset of COVID-19 is mainly manifested as a fever, but some early patients may only experience chills and respiratory symptoms; which can occur together with mild dry cough, fatigue, poor breathing, diarrhea, etc. However, runny nose, sputum, and other symptoms are rare. Patients may gradually develop dyspnea. In severe cases, the disease can progress rapidly, causing acute respiratory distress syndrome, septic shock, irreversible metabolic acidosis, and coagulation disorders in just a matter of days. Some patients start out with mild symptoms without fever. The majority of patients see a good prognosis, while few become critically and sometimes fatally ill.

29. Do you know something on laboratory testing for COVID-19?

2019-nCoV can be identified by real-time reverse transcription polymerase chain reaction (rRT-PCR). For each case, specimens to be tested should be from the lower respiratory tracts; such as bronchial/ alveolar lavage fluid and deep sputum. Additionally, serum samples should be collected both at the onset of symptoms and after 14 days.

In the early stages of the disease, the white blood cell count stays normal or lower, but the lymphocyte count is decreased. While some patients have elevated liver enzymes, muscle enzymes, and myoglobin, most patients have elevated C-reactive protein and erythrocyte sedimentation rate. The procalcitonin levels stay normal and D-dimer is elevated in severe cases.

30. What are the characteristics of COVID-19 chest films?

In the early stages, chest films feature multiple small patchy shadows and interstitial changes, especially in the peripheral third of the chest; which then progresses to bilateral ground glass opacities and pulmonary infiltrates. In severe cases, pulmonary consolidations and even "white-outs" of the lungs are seen. Pleural effusions are rare.

31. How to identify COVID-19 cases clinically

Persons who meet both the following conditions are considered suspected cases.

1. Epidemiological history. The case has a travel or residence history in the epidemic areas within two weeks of the onset, or had contact(s) with patients from the epidemic areas within 14 days of the onset, or other patients with fever and respiratory symptoms in the communities with reported cases or clustered outbreak.

2. Clinical features. The most common symptom is fever. However, some patients may exhibit fevers, but only chills and respiratory symptoms. Chest films show characteristics of viral pneumonia. During the early stage of the disease, the white blood cell count is normal or below normal, while the lymphocyte count may decrease.

32. How to confirm COVID-19 cases

Once a case is identified as a suspected case, a positive result for 2019-nCoV nucleic acid on rRT-PCR testing of specimens (sputum, throat swabs, lower respiratory tract secretions etc.) or highly homologous sequences to the known novel coronavirus found after gene sequencing of the virus from a patient can confirm the diagnosis.

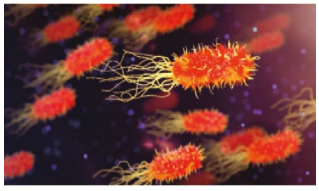
33. How to diagnose severe COVID-19 cases

Severe cases refer to patients with unstable vital signs and rapid disease progression, with dysfunction or even failures of more than two organ systems. The progression of the disease may endanger the lives of patients.

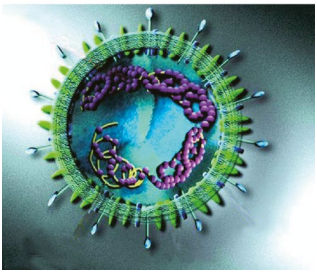
34. What is the difference between COVID-19 and other pneumonias?

1. Bacterial pneumonia. Common symptoms include coughing, coughing up sputum, or exacerbation of the original respiratory symptoms; with purulent or bloody sputum, with or without chest pain. It is generally not considered a contagious disease.

2. SARS/MERS. Although the novel coronavirus is in the same family as the SARS and MERS coronaviruses, a genetic evolution analysis shows that it belongs to a different branch of the same subgroup. It is neither a SARS nor a MERS virus,



based on the viral genomic sequences. Due to the similarities between COVID-19 and SARS/MERS-caused pneumonia, it is challenging to distinguish them with clinical manifestations and imaging results. Therefore, a pathogen identification test by rRT-PCR is needed.



3. Other viral pneumonias. Pneumonia caused by the influenza virus, rhinovirus, adenovirus, human metapneumovirus, respiratory syncytial virus, and other coronaviruses.

35. What should close contacts do with the notice from the Centre of Disease Control?

Please follow the self-monitoring instructions and stay at home. Don't panic. Don't go to work. Don't go out too often. Perform daily checks on health conditions, report the records to the authority, and follow up with your community doctors regularly. If fever, cough, or other symptoms appear, please go to community health centers for further evaluation and treatment.

36. What should I do if I am possibly infected with COVID-19?

Promptly go to the local designated medical institution for evaluation, diagnosis, and treatment. When a seeking medical attention for a possible infection of 2019-nCoV, you should inform your doctor about your recent travel and residence history (especially if you've been to epidemic areas recently); and any history of contact with pneumonia patients, suspected 2019-nCoV cases, and animals. It is extra important to note that surgical masks should be worn throughout the visit to protect yourself and others.

37. How to choose a medical institution for treatment

Isolation and treatment should be performed in a hospital with proper conditions for isolation and protection. Critical cases should be admitted to an ICU as soon as possible.

38. What should be done if a patient requires transportation?

Patients should be transported in designated vehicles that are regularly disinfected and manned with well protected personnel.

39. Are there any drugs or vaccines against COVID-19?

At present, there are no specific antiviral treatments against COVID-19. Patients generally receive supportive care to relieve symptoms. Avoid irresponsible or inappropriate antimicrobial treatment, especially in combination with broad-spectrum antimicrobials.

There is currently no vaccine against the new disease. Developing a new vaccine may take a while.

40. How to treat COVID-19

1. Put patients to bed rest, provide supportive care, maintain good hydration, electrolyte balance, and internal homeostatis, and closely monitor vital signs and oxygen saturation.

2. Monitor routine blood and urine test results, C-reactive protein (CRP), biochemical indicators (liver enzyme, myocardial enzyme, renal function, etc.), and coagulation function accordingly. Perform an arterial blood gas analysis when needed, and regularly review chest X-ray images.

3. According to the changes in oxygen saturation, provide timely effective oxygen therapies; via nasal catheter, oxygen mask, transnasal high-flow oxygen therapy, noninvasive or invasive mechanical ventilation, etc.

4. Antiviral therapy: There are currently no antiviral drugs with good efficacy.

5. Apply antibacterial drug treatment: Strengthen bacteriological monitoring, and start antibacterial treatment when there is evidence of a secondary bacterial infection.

6. Traditional Chinese medicine treatment: Treat according to the syndrome.

41. What are the clinical criteria for quarantine release and discharge?

1. The condition of the patient is stable and fever has subsided.

2. Lung imaging shows a significant improvement with no sign of organ dysfunction.

3. The patient has had stable breathing, body temperatures, clear consciousness, unimpaired speech, and normal diets for more than 3 days. Respiratory symptoms have improved significantly, and two consecutive tests for respiratory pathogenic nucleic acid have been negative (at least one day in-between tests).