



## Review Article

# Novel coronavirus: Pathophysiology, symptoms, diagnosis, and management

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## ABSTRACT

Epidemically increased evidence reveals that the novel coronavirus (COVID-19) virus belongs to the class of severe acute respiratory syndrome and the Middle East Respiratory Syndrome virus. Covid-19 was started from the Wuhan city of China in 2019, and now it gradually affecting the whole world. In this paper, the pathophysiology, symptoms, diagnosis and management of the Covid-19 is discussed briefly. Diagnostic methods used for Covid-19 are serology, and nucleic acid amplification test (NAAT). These tests are done as per the guidelines of World Health Organization (WHO).

**Keywords:** Novel coronavirus, severe acute respiratory syndrome, path physiology, serology, diagnostic methods, World Health Organization

## INTRODUCTION

Novel coronavirus (COVID 19) virus, severe acute respiratory syndrome (SARS), and the Middle East Respiratory Syndrome (MERS) are the class of virus belongs to Coronaviruses. SARS appeared in China in 2002 while MERS appeared in 2012 in Saudi Arabia. COVID 19 appeared in 2019 in China. The World Health Organization (WHO) declares COVID-19, a controllable pandemic. The spread of COVID-19 is becoming unbeatably infected by more than 3,870,958 people in 190 countries. The WHO continues to provide advice on precautionary practices and ways to stop the spread of the disease. Therefore, a coordinated global response is seriously required to draw up health systems to meet this unrivaled challenge.<sup>[1]</sup> Nations that have been unsuitable enough to have been revealing this disease already have, paradoxically, very helpful lessons to pass on. While the containment measures apply in China have at least for the moment-bring down new cases by more than 90%, this depletion is not the case in further countries, including India.<sup>[2]</sup> India had 59,765 confirmed cases, according to Health Ministry India, till May 9, 2020, and 1986 deaths. Only America has recorded more deaths due to this COVID-19 outbreak. The mean age of India was 60+ (63%) and 20–60 (27%) age groups and more than half of them

(56%) were diabetic and almost (47%) have both hypertension and diabetes as well as some of them had cardiac disease also along with hypertension and diabetes. Renal disease, too, was reported in several of those who died.

On March 25, 2020, the Indian Government applied remarkable measures to limit viral transmission-including restricting movement in the region of Indian states that minimize the possibility that people who are not infected come into contact with people who are infected.<sup>[3]</sup> The resolution is certainly bravery and important, but it is enough. Our national health system's capacity to efficaciously respond to the needs of those who are already infected and require an intensive care unit (ICU) for acute respiratory distress syndrome and largely due to SARS-COV-2 pneumonia is a matter of grave concern. Pointedly, the percentage of patients admitted to ICU reported day today in India.<sup>[4]</sup>

In the absence of any known efficacious therapy and because of the circumstances of a "public health emergency," many drugs have been tried recently in the treatment for COVID-19 that includes a low-cost antimalarial drug chloroquine and its derivative hydroxychloroquine (HCQ), by the side of many other antiviral drugs.<sup>[5]</sup> HCQ has been approved in the treatment of Type 2 diabetes in India since 2014 as a third- or fourth-line drug. Trials on some of the patients showed better results for COVID-19 patients. Reports assemble as now suggested that some drugs could have the capability for the treating COVID-19.<sup>[6,7]</sup> There are five hospitals, two from

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Ahmadabad and one each from Chennai, Jodhpur, and Bhopal, which so far have been approved to conduct randomized controlled clinical trials under the WHO solidarity trial to find an effective treatment for COVID-19. The hospitals, including the All India Institutes of Medical Science in Jodhpur, Apollo Hospitals in Chennai, and B J Medical College and Civil hospitals in Ahmadabad, will be conducting clinical trials on four treatment protocols-redeliver, a combination of lopinavir and ritonavir, HCQ, and lopinavir and ritonavir with interferon beta-1a.

## PATHOLOGY OF COVID-19

The COVID-19 is also known as the SARS virus [Figure 1]. Pathology of the Covid-19 till now is known, explained below in the three steps [Figure 2].<sup>[8-12]</sup>

## TRANSMISSION OF COVID-19

People get the infection through close contact that has the symptoms from the virus, which includes cough and sneezing. Mostly coronavirus spread from the air-born zoonotic droplets.<sup>[13]</sup> Covid-19 replicates in the epithelium that caused cellular damage and infection at the injection site.<sup>[14]</sup> According to the study published in 2019, angiotensin-converting enzyme 2, a membrane exopeptidase in receptor used by the coronavirus in entry to human cells.

## SYMPTOMS OF COVID-19

Signs and symptoms of Covid-19 may appear or seen from 2 to 14 days after the exposure. Time after exposure and before having symptoms

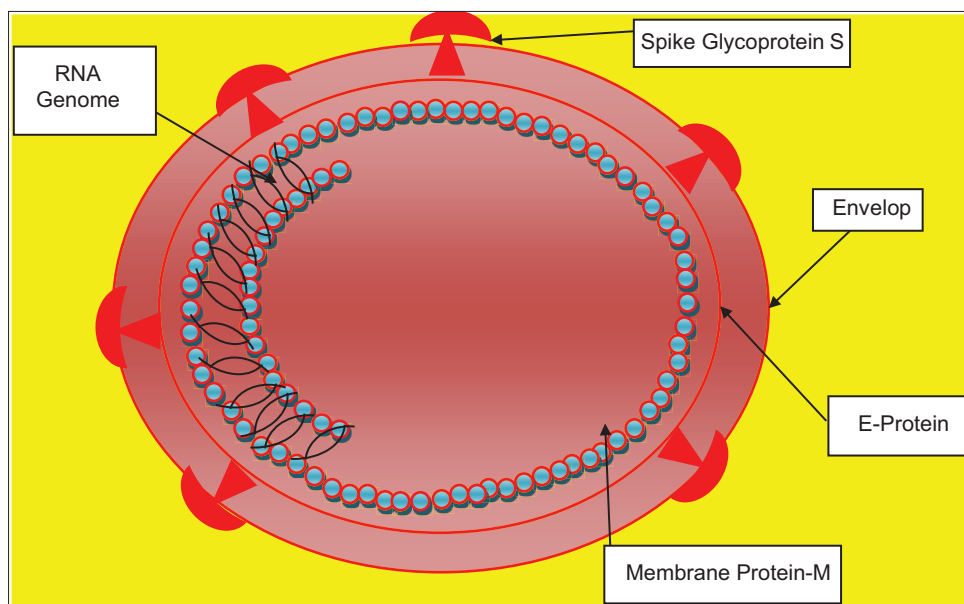


Figure 1: Structure of Covid-19

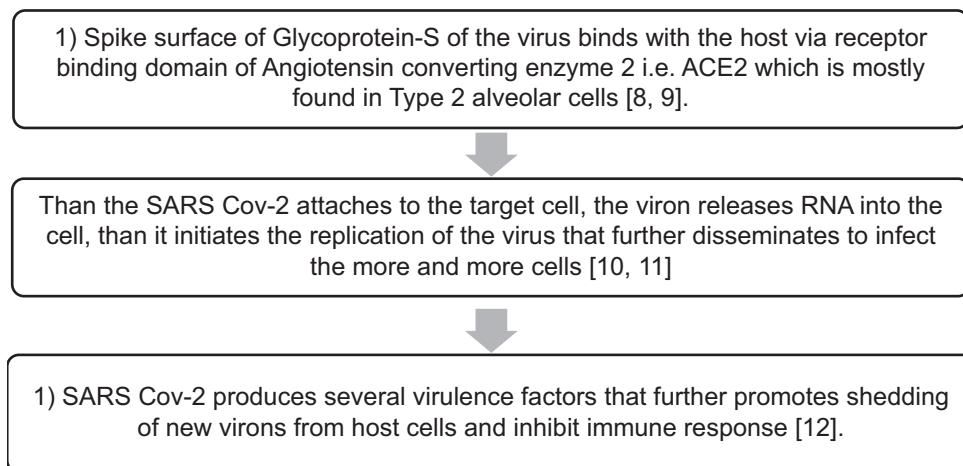


Figure 2: Path physiology of Covid-19

is called the incubation period. The most common symptoms found in the patients of Covid-19 are summarized in Figure 3. The rest of the symptoms are found in very few patients or the patient who are older, or they are suffering from other diseases.<sup>[15]</sup>

## DIAGNOSTIC, TESTING OF COVID-19

It is difficult to find the diagnostic method of COVID-19 in the earlier days of infection, but now there are the various diagnostic methods developed by the WHO. The following recommendations have been made regarding diagnostic, testing, and reporting are mentioned below.

- Take nasopharyngeal swab for Covid-19, reverse transcriptase-polymerase chain reaction testing (PCR). Check with your facility regarding test characteristics, including sensitivity and specificity<sup>[18,19]</sup>
- Differentiating Covid-19 from other circulating respiratory viruses is important particularly influenza, consider testing

of usual respiratory pathogens, coinfection has also been reported.<sup>[20]</sup>

The tests which are performed in the patients of Covid-19 are NAAT and Serology. Table 1<sup>[21,23]</sup> states that what the diagnostic tests are performed of the patients of the Covid-19 and also tells about the type of samples which are taken from the patients at needed by the desired time.

## TYPES OF COVID-19 TESTING

There are the basic three types of tests that are performed or done for the Covid-19 testing; they are the molecular test, antibody test, and antigen test. These are mentioned in Table 2:

## MANAGEMENT OF COVID-19 PATIENTS

Covid-19 management and prevention are being controlled by the infection prevention control (IPC), which is a critical part of

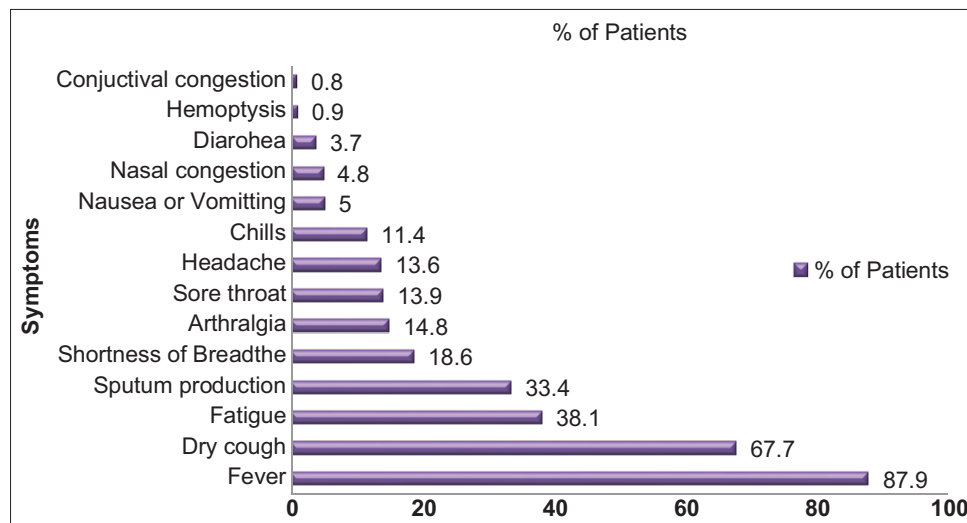


Figure 3: Symptoms of Covid-19<sup>[16,17]</sup>

Table 1: Specimens to be collected from symptomatic patients and contacts

Patient/contact	Test	Type of sample	Timing	Reference
Patient	nucleic acid amplification test	Lower respiratory tract	Collect on presentation	[21,22]
		Sputum Aspirate Lavage	Possibly repeated sampling to monitor clearance Further research needed to determine the effectiveness and reliability of repeated sampling	
Patient	Serology	Upper respiratory tract Nasopharyngeal swab Oropharyngeal swab Nasopharyngeal wash		[21]
		Consider stools, whole blood, urine, and, if diseased, material from an autopsy.		
Contact	NAAT	Nasopharyngeal and oropharyngeal swabs.	With an incubation period of last documented contact	[21,23]
	Serology	Serum for serological testing once validated and available	Baseline serum has taken as early as possible within the incubation period of contact and convalescent serum taken 2–4 weeks after last contact (optimal timing for convalescent samples needs to be established)	

**Table 2: Types of COVID-19 tests**

Type of test	Molecular test	Antibody test	Antigen test
	This molecular detects genetic material from the virus	These tests detect antibodies: Y-shaped molecules made by the immune response to disable a virus or mark it for destruction	This is the newest of the three testing types. These tests detect antigens: Pieces of a virus that the immune system recognizes. A single virus has many antigens
Sample collection	A nasal or throat swab collects infected cells	A blood draw collects antibodies produced by immune cells	A nasal swab collects infected cells
Detection	A series of chemical reactions copies viral genetic material. If no infection, then there will not be any viral material to copy	The test measures whether these antibodies bind to the Covid-19	Chemicals fragment the virus, and then antibodies attached to a plate detect these fragments
What the test tells you	If you are infected now	If you were infected in the past	If you are infected now
Why it's helpful	Used to isolate those infected so treatment can be provided, and other potential causes of infection can be traced	Identifies people who may have immunity and whose antibodies could be used to treat Covid-19 patients	It provides the same information as a molecular test in 15 min and can be done in the doctor's office
Limitations	A negative result does not guarantee immunity in the future	Unclear if antibodies provide protection, how long immunity lasts, or what level and kind of antibody response is protective	A negative result does not guarantee immunity in the future. Molecular tests are more accurate
Some local test-makers	Mesa biotech Hologic	Diazyme Genalyte	Quidel received FDA emergency authorization for the first antigen tests
Where can you get a test?	State and county testing sites, hospitals, community clinics	Community clinics: Also commercially available. Genalyte has partnered with the San Diego Blood Bank to do broad-based antibody testing	Antigen testing for the Covid-19 is still new, but tests would likely be administered in hospitals and doctor's offices

the clinical management of patients and should be initiated at the point of entry of the patient to the hospital.<sup>[24]</sup> Standard precautions should always be routinely applied in all areas of health care facilities. Standard precautions should be taken, which include hand hygiene, use of PPE to avoid direct contact with patients' blood, body fluids, secretions, and non-intact skins.<sup>[25]</sup> IPC has also implemented the infection prevention and control measures for patients with suspected or confirmed COVID-19 infection in Table 3.

### Present scenario of testing strategy in India

- All asymptomatic people who have undertaken international travel, they all should stay in home quarantine for 14 days<sup>[28]</sup>
- People should be tested only if they become symptomatic (fever, cough, difficulty in breathing, etc.)<sup>[29]</sup>
- If the test result of the symptomatic people is positive, then they should be isolated and treated<sup>[30]</sup>
- All contacts of laboratory positive cases should stay in home quarantine for 14 days<sup>[31]</sup>
- They should be tested only if they become symptomatic, if the test result is positive, then they should be isolated and treated<sup>[30]</sup>
- Healthcare workers managing Covid-19 should be tested only if they become symptomatic.<sup>[32]</sup>

### Discharge protocol

The discharge protocol of the patient of Covid-19 is mentioned in Flow Chart 1:<sup>[33]</sup>

### Preventive measures against Covid-19

During this pandemic, a person should keep themselves safe and their family too. Hence, there are the various preventive measures which should be performed by the peoples to protect themselves safe from the Covid-19. Some of the measures are mentioned in Table 4.<sup>[34,35]</sup>

**Table 3: Prevention and control measures for confirmed COVID-19 patient<sup>[26,27]</sup>**

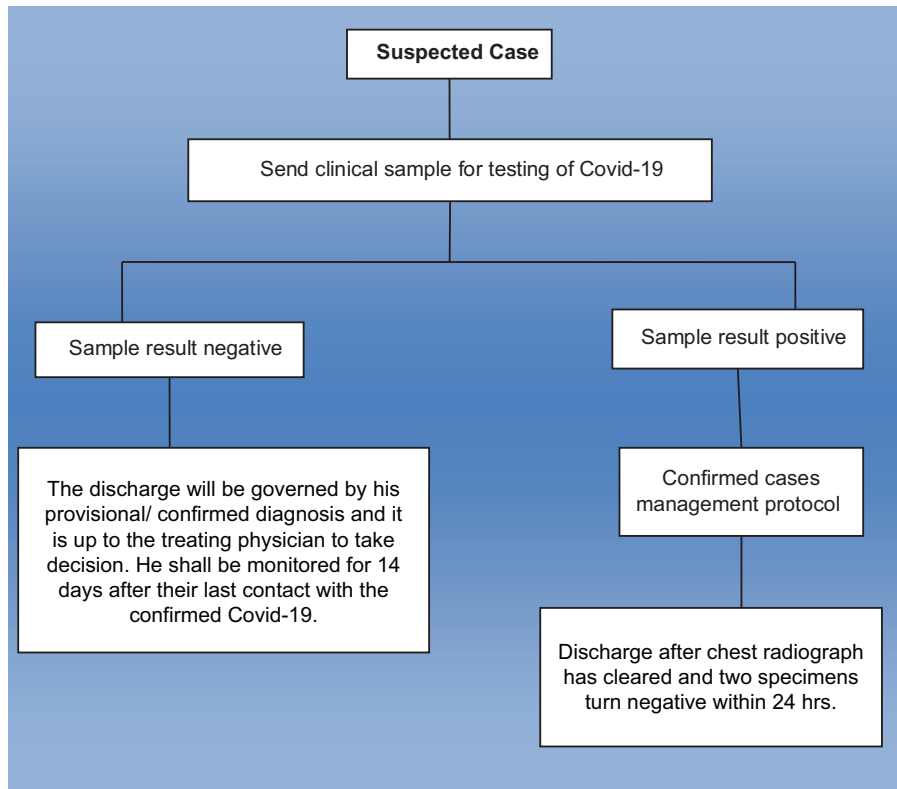
At triage	Suspected patient, given a triple layer surgical mask, and direct to separate an area, an isolation room. Keep at least 1-m distance between suspected patients and other patients. Instruct all patients to cover nose and mouth during coughing or sneezing with a tissue or flexed elbow for others. Perform hand hygiene after contact with respiratory secretions
Apply droplet precautions	Use a triple layer surgical mask if working within 1–2 m of the patient. Place patients in single rooms or groups together with the same etiological diagnosis. When providing care in close contact with patients with respiratory symptoms (e.g., cough or sneezing), use eye protection (facemask or goggles), because the spray of particles may occur. Limit movement of patients within the campus and ensure that patients wear triple-layer surgical masks when outside their rooms
Apply contact precautions	Contact and droplet precautions prevent direct or indirect transmission from contact with the contaminated surfaces or equipment. Use PPE when entering the room and remove PPE while leaving the room. If pieces of equipment need to be shared among patients, clean, and disinfect between each patient use. Furthermore, ensure that healthcare workers refrain from touching their eyes, nose, and mouth with potentially contaminated hands
Apply airborne precautions when performing an aerosol-generating procedure	The healthcare workers performing aerosol-generating procedures use PPE, including gloves, long-sleeved gowns, eye protection, and fit tested particulate respirators (N95). Whenever possible, use adequately ventilated single rooms when performing aerosol-generating procedures, meaning negative pressure rooms. Avoid the presence of unnecessary individuals in the room. Care for the patient in the same type of room after mechanical ventilation commences is to be done

PPE: Personal protective equipment

### Case studies

#### India

In India, the patient was detected with Covid-19 in Kerala's Trissur district and was kept in an isolation ward while the many other peoples are under observation. The condition of women patient was stable, the



**Flow Chart 1:** Discharge protocol

**Table 4: Preventive measures against COVID-19**

Do's	Don'ts
Cover your nose and mouth with disposable tissue or handkerchief	People suspected of influenza-like illness must consult a doctor
Frequently wash your hands with soap and water	Hugging, kissing, and shaking hands while greeting
Avoid crowded places	Spitting in public places
People suffering such as influenza-like illness must be confined at home	Taking medicine without consulting doctor
Stay more than one arm's length distance from persons sick with the flue	Disposal of used napkins or tissue paper in open areas
Take adequate sleep and rest	Touching surfaces usually used by the public (railing, doors, etc.)
Drink plenty of water/liquids and eat nutritious food	Avoid the usage of public transport
People suspected of influenza-like illness must consult the doctor	Don't panic, take it easy
Do practice social distancing, stay 3–6 feet away from other people	Don't go to doctor unless necessary

women now in the isolation ward at the general hospital in Trissur, is likely to be shifted to the Medical College Hospital. Health officials are awaiting a result of one more test-gene sequencing only after which it can be stated that the patient was affected with the Covid-19.<sup>[36]</sup> Three others who had returned from China are kept in the isolation wards in Trissur. The four students returned from China; one has been tested positive. Of the total 1053 people who were under observation after traveling to China, as many as 247 arrived in the state.<sup>[37]</sup>

### Japan

On January 15, 2020, the case of Covid-19 was reported by the Ministry of Health, Labor and Welfare, Japan from Wuhan, Hubei, China. The patient was male, age 30–39 years living in Japan.<sup>[36]</sup> The patient had traveled to Wuhan, China, in December and had a fever on January 3, 2020, while staying in Wuhan. He has indicated that he was in close contact with a person with pneumonia. On January 6, 2020, he returned to Japan and tested negative for influenza when he visited a local clinic on the same day. On January 10, 2020, due to his continuous symptoms of cough, sore throat, and fever, when he visited a local hospital and was found to have abnormal chest X-ray with infiltrates.<sup>[38]</sup> He was admitted to the hospital on the same day and remained fevered. On January 14, 2020, the doctor notified the case to a local public health authority under the surveillance system for “unidentified serious infectious illness.” The sample was collected and sent to the National Institute of Infectious Disease (NIID), and at NIID, PCR testing and sequencing was performed, which identified a very small amount of Covid-19 RNA on January 15, 2020.<sup>[39]</sup>

### The spread of Covid-19 in India

Covid-19 registered cases and the registered deaths in the different states of India, as per the report of the Ministry of Health and Family Welfare, May 14, 2020, is mentioned in Table 5.

**Table 5: Registered confirmed cases in India reported by MoHFW on May 14, 2020**

State/UT	Confirmed cases	Cured/ discharged	Deaths
Andaman and Nicobar Islands	33	33	0
Andhra Pradesh	2137	1142	47
Arunachal Pradesh	1	1	0
Assam	80	39	02
Bihar	940	388	07
Chandigarh	187	28	03
Chhattisgarh	59	55	00
Dadra Nagar Haveli	01	00	00
Delhi	7998	2858	106
Goa	07	07	00
Gujarat	9267	3562	566
Haryana	793	418	11
Himachal Pradesh	66	39	02
Jammu and Kashmir	971	466	11
Jharkhand	173	79	03
Karnataka	959	451	33
Kerala	534	490	04
Ladakh	43	22	00
Madhya Pradesh	4173	2004	232
Maharashtra	25922	5547	975
Manipur	02	02	00
Meghalaya	13	10	01
Mizoram	01	01	00
Odisha	538	143	03
Puducherry	13	09	01
Punjab	1924	200	32
Rajasthan	4328	2459	121
Tamil Nadu	9227	2176	64
Telangana	1367	940	34
Tripura	155	16	00
Uttarakhand	72	46	01
Uttar Pradesh	3729	1902	83
West Bengal	2290	702	207
Total No. of confirmed cases in India	78003	26235	2549

## CONCLUSION

Covid-19 is a deadly disease that is first witnessed in Wuhan city of China. After that, this disease is now spreading the nearly whole world and it has also shown its harsh effect in some of the top economic countries. The infection is transmitted through droplet infection. The symptoms that are mostly found in the patients are fever, dry cough, and fatigue. The various tests that are performed to check the patients for Covid-19 infection are, according to the WHO, are NAAT and serology. Till now, no clinically proven medicine is made for the treatment of Covid-19. The measures to stay away from the disease are just to take precautions and do not come in contact with the infected person.

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