

# Retrospective and prospective monitoring in post COVID-19 complications and an approach for vigilance in Post-recovery period

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## ABSTRACT

COVID-19 is a Severe acute respiratory syndrome (SARS-CoV-2). It threatened the whole world and considered as pandemic recently, emergencies and quarantine has been declared all over the world. Many published reviews and research articles, discussed analysis, symptoms, diagnosis, and possible ways of treatments. However, nowadays, more focus is inclined on recovered patients and the possible events faced by these patients in postrecovery period. Specialists, medical care workers are looking for unmistakable approaches to defend their life later on. It is important to have a full background on their physical and psychological status after their recovery with certain guidelines to follow-up. There is more concern, care for family and society as they might suffer from stress, depression, and stigmatization from society. Awareness programs and counseling should be recommended to bring the recovered patients to their normalcy. Surveys and cohort studies will be helpful for prognosis of the disease as well as to be ready to face the second stage of COVID-19. This article will focus on recovered COVID-19 patients, their complications, precautionary methods, and post care.

**Key words:** Care, complications, post COVID-19, recovery

## INTRODUCTION

Covid (CoV) is a major group of infections causing weakness beginning from influenza to greater seriousness, for example, Middle east respiratory syndrome (MERS-CoV) and Severe Acute Respiratory Condition (SARS-CoV).<sup>[1]</sup> The normal indications of Coronavirus are fever, cough, and shortness of breath, migraine, and joint pain and some develop

pneumonia. As the time passed on, new things are coming up which dawdle long after an initial COVID-19 infection. In immunodeficiency and immune compromised individuals, it may cause severe complications and in the elderly and people with chronic diseases such as cancer, diabetes, and lung diseases.<sup>[1,2]</sup> It is indeed that within few weeks, COVID-19 patients will recover completely. However, other people with mild stage of the disease will suffer from severe symptoms after first recovery. Old aged people, who suffered many serious medical and comorbid stages, are highly affected nagging COVID-19 symptoms. In the post COVID-19 state, the patients develop antibodies, which prevent them from contracting the virus again. Still recovery from COVID-19 is posing so many challenges and questions on patients and physicians. However, an expectation of a ray of hope exits if few measures are employed and

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followed and be in a safe zone as long as the virus becomes extinct. This article emphasizes the understanding and following the measures in post-COVID-19 care to decline the complications and there by mortality rate.

## COVID-19 AND RECOVERED PATIENTS

The Center for Disease Control and Prevention (CDC) focuses intensively on the short- and long-term health consequences of COVID-19. In addition to the largest organ affected as the lungs, there are several other organs affected. Most of the COVID-19 patients are recovering and returning to normal, while some have symptoms that persist for weeks or even months after recovery. The most common symptoms are weakness, shortness of breath, cough, joint, and chest pain. Furthermore, the long-term symptoms are difficulty in thinking and concentration (at times termed as "brain fog," depression, muscular pain, headache, irregular fever, and palpitations. Long-term complications involving different organ systems in the body have been observed and documented. The CDC continues to review and provide updated data on these aspects, as well as clinical care Shown in the Figure 1.<sup>[3]</sup>

According to the World Health Organization (WHO), 601,789 people have recovered.<sup>[4]</sup> Nowadays, researchers are trying to find some after affects which may have distinct impacts on recovered patients in the future. They found that it is so hard to manage COVID-19 extent in patients who have been recovered from COVID-19 still carry SARS-CoV-2,<sup>[5]</sup> WHO suggested having a continuous follow-up strategies and continuous polymerase chain reaction (PCR) tests to control infection spread. For these reasons, epidemiological- and immunological-based COVID-19 studies should be applied to control any complications in the future. This will help to provide postacute care in recovered patients for protection of multiorgan damage.<sup>[6]</sup>

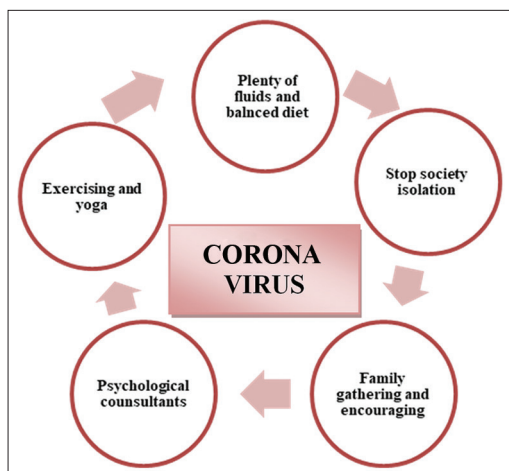


Figure 1: Management of Post-covid condition

## Complications in post-COVID-19 recovered patients

After 2 months of recovery, patients are experiencing signs and major side effects, infected with acute and severe COVID-19. Pains, apnea with significant organ dysfunction mainly associated reported body with the lungs. A study reveals that 110 patients who were hospitalized were treated. Twelve weeks after they recovered, 74% of them were recorded to have difficulty in breathing and weariness. Away from these symptoms, 104 of them were observed to have abnormal chest X-ray with lung function.<sup>[7]</sup>

One in six patients has major side effects, of which most of them are life-threatening. It might be due to the cytokine release syndrome (or) a cytokine storm.<sup>[8]</sup> The inflammatory proteins called cytokines released in the blood stream, causing damage to organs such as lungs, heart, and kidneys. Initial research shows that the disease attacks multiple organs other than respiratory system with formation of blood clots and inflammation. A number of reports have been observed and showed that there were a long-term fatigue, headache, vertigo, difficulties with learning and memory along with cardiac issues.<sup>[9]</sup> All these manifestations correlate a significant cellular-damage that this virus can cause.

COVID-19 causes organ damage depending on many factors which are already being explained whilst lungs are mostly affected.<sup>[10]</sup>

The COVID-19 complications are as follows:

## Multi-organ system involvement and clinical symptoms with SARS-CoV-2

Patients should be investigated from time to another that will help in monitoring cases in second pandemic stage. COVID-19 patients who survive may have impairment in overall health state for example in gastrointestinal tract (GIT), heart, brain, eyes, and lungs. Severe pneumonia affects alveoli in the lungs resulting in respiratory distress

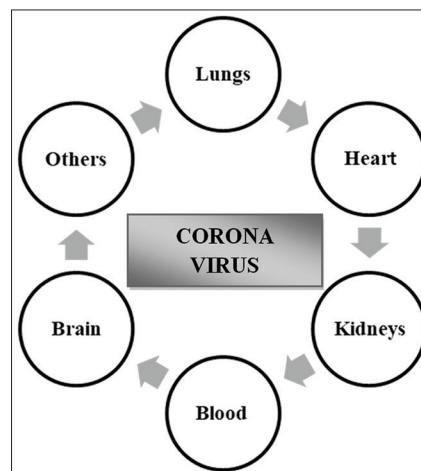


Figure 2: Multiple organs associated with COVID-19 complications

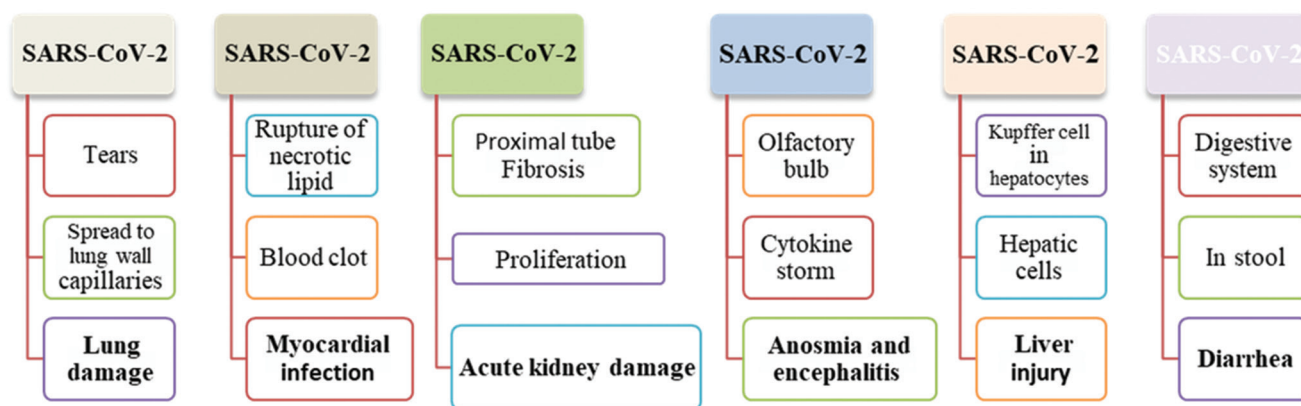


Figure 3: Multiple pathways of SARS-CoV-2 and its effect on different organs

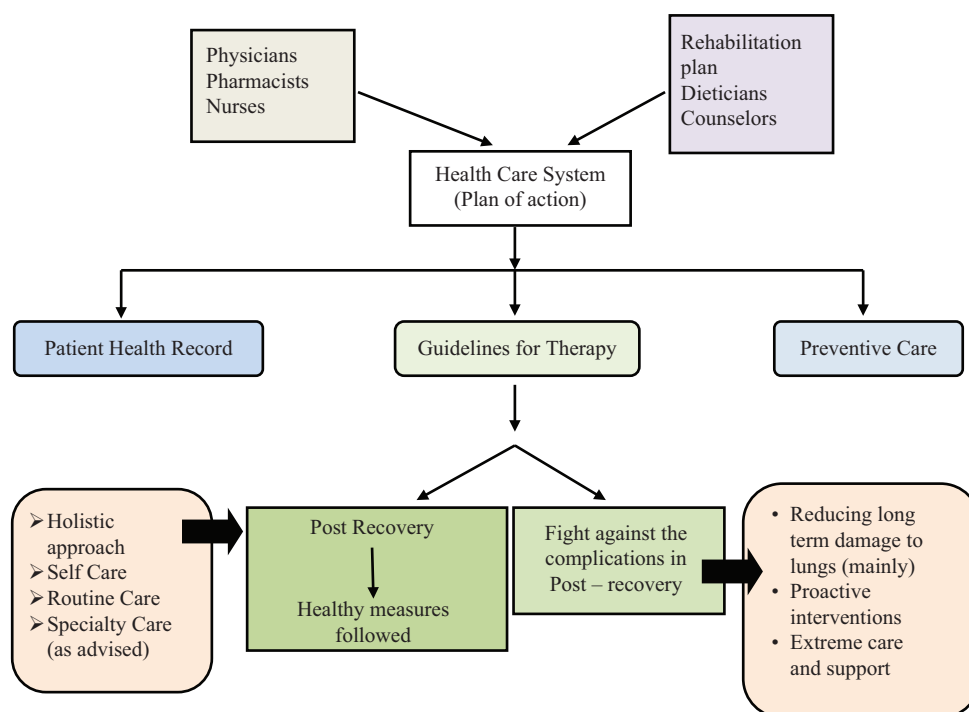


Figure 4: An approach to combat complications during post COVID-19 care period

syndrome, but initial medical interference will help to hinder this condition in the [Figures 2 and 3].

### Organ damage caused by COVID-19

#### Cardiovascular system

The most complication is pneumonia, which in turns affect the whole body later, leading to blood clotting and heart attack. ACE-2 facilitates the entry of SARS-CoV-2 to myocardium causing myocarditis. Interaction between the virus and ACE-2 receptors completely changes the signaling pathways leading to myocardial infarction.<sup>[11]</sup> There is an increased proliferation of cardiac muscle, leading to formation of blood clots with necrotic lipid core rupture causing myocardial infarction. It was investigated that troponin in the heart muscle, controls the normal function of the heart when a person is infected with SARS-CoV-2.<sup>[12]</sup>

According to a study, about a third of people had blood clots and were kept in the intensive care unit (ICU).<sup>[13]</sup> According to BMJ, a weaker immune system, or absence of antibody or no response, relapse or re-infection, inflammatory reactions, and mental factors contribute to longer-term symptoms.<sup>[14]</sup>

#### Lungs

COVID-19 damages the tiny air sacs in the lungs, resulting in fibrosis. Studies were performed on patients, which revealed that 3/4<sup>th</sup> of them had double pneumonia and more than half suffered with lesions.<sup>[15]</sup> It was observed that patients after recovery still showing lung opacities, ultimately making researcher to find out the proper ways to reduce complications and spread of the infection.

## Brain

COVID-19 patients suffer from neurological symptoms such as hyposmia, hypogeusia, and hypoplasia due to the disturbances in immune system. SARS-CoV-2 enters CNS through nasal route then to the olfactory bulb region of the brain.<sup>[16]</sup> Among cases and evidences, there was a suggestion that COVID-19 infection activates cytokine storm in brain as result to immune system deterioration and finally causing nervous system deaths.<sup>[17]</sup>

## Ocular infection

COVID-19 may enter the body through the eyes and lacrimal system as it will spread through conjunctiva in the eye.<sup>[18]</sup> Patients may suffer from conjunctivitis, chemosis, and swelling of the conjunctiva.

## Gastrointestinal tract

GIT symptoms that are related to COVID-19 infection include nausea, vomiting, abdominal pain, and GIT bleeding in addition to sore throat, dizziness, headache, and fever.<sup>[19]</sup>

## Renal injury

Kidney damage is a fact that kidney contains ACE-2 receptors as COVID-19 patients showed higher levels of COVID-19 and ACE-2 binding.<sup>[20]</sup> The entry of the virus into the kidney showed inflammation and apoptosis causing kidney injury.<sup>[21]</sup>

## Multisystem inflammatory syndrome in children

In children, multisystem inflammatory syndrome or pediatric multisystem inflammatory syndrome, was noticed with fever, stomach pain, vomiting, diarrhea, rash, headache, and confusion causing inflammation of blood vessels.<sup>[22,23]</sup>

## Trouble with temper and exhaustion

Individuals who suffer from severe signs of COVID-19 often need to be admitted to ICU with some supportive measures like ventilators to breathe. This kind of experience makes a patient develop posttraumatic stress syndrome along with anxiety disorders.<sup>[24]</sup> As observed from patients who have recovered from SARS, have developed chronic exhaustion syndrome that inferior with physical or mental activity. The same may appear for people who have had COVID-19.<sup>[25]</sup>

## Prevention is better than cure

Prevention is always better than cure, hence following below are the few points as advised by the WHO.<sup>[26]</sup>

1. Stay home and self-isolate
2. Clean hands frequently
3. Cover nose and mouth
4. Avoid touching
5. Maintain physical distancing of at least 1 m from others
6. Stay away from crowds
7. Use a fabric mask

8. Use a medical/surgical mask
9. Regularly clean and disinfect.

## Post-COVID-19 care

After being recovered from COVID-19 infection, it is important to follow certain aspects such as healthy life style and make a note of alarming signals as in the Figure 4.<sup>[27,28]</sup> Few are explained underneath:

### Exercise consistently

Once the body is fit for physical activity, you can exercise, making everyone both mentally and physically strong. Practice Yogasana, Pranayama (breathing exercises), meditation, daily as much as health permits or as prescribed.

### Making intake of nutritious food

A practice of having a nutrient and supplement rich meal regimen is needed during and after recovery. Coronavirus makes a body to explore to stress and the medicines and enfeebles the body. Thus, well-planned eating regimen loaded with organic products, vegetables, eggs, and safe poultry is essential.

### Self-caring

After getting a negative test for COVID-19, do not dream to get back to normal life. Better, try to not overexert. Take time to adjust to older routine in a slower pace.

### Improving memory

Playing puzzles, memory games, and exercises make one's brain normally functional.

### *Paying attention to warning signs and symptoms*

Always approach a doctor if any issues blow-up, in post recovery, whether it is a nagging headache or a shortness of breath.

### Revising medications

Take regular medications as per the doctor's advice and for managing comorbid conditions, if any.

### Intake of adequate water

Drink sufficient amount of water and keep hydrated unless it is contraindicated. Must take immunity boosters if any.

BMJ released new guidelines in the month of August for health providers to treat long-haul patients. They need to undergo specific blood tests, referred to pulmonary rehabilitation, and to use pulse Oximeter.<sup>[29]</sup> Few measures such as strict supervision of workplace safety, awareness programs, surveys, and PCR tests follow-up should be recommended.

### Vaccines

It is very early to understand whether 19 vaccines have a long-term safety for COVID-19. Based on this, further

research is needed. Data are available with reports that individuals who recover from COVID-19 develop antibodies that provide them with re-infection defense for some time. Most vaccines for COVID-19 are given as two regimens. In general, vaccines are formulated and produced to recognize and combat the antigens in the body's immune system. At present, two vaccines are authorized and recommended, they are Pfizer-BioNTech and Moderna's COVID-19 vaccines.<sup>[30]</sup>

## CONCLUSION

It has become mandatory to remember that majority of people who suffered COVID-19 recover quickly.<sup>[31]</sup> This disease has a number of queries involved, compared to the usual respiratory virus. Hence, it is always advisable to be cautious in maintaining one's own health. Keeping in view of potentially long-lasting problems and chances of re-infection in special cases (with less immunity and elder people) of COVID-19 infection, it is foremost to follow sanitary precautions such as wearing masks, avoiding crowds, and keeping hands clean. Finally, re-building mind and muscle strength to get back to normal routine is also essential. It can be concluded that health line workers provide opportunity to educate and support people about COVID-19, involve alleviating anxiety and fear during post COVID-19 recovery period.

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## Conflicts of interest

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