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Review Article

A Review of Laboratory Studies in COVID-19 in Different Patients

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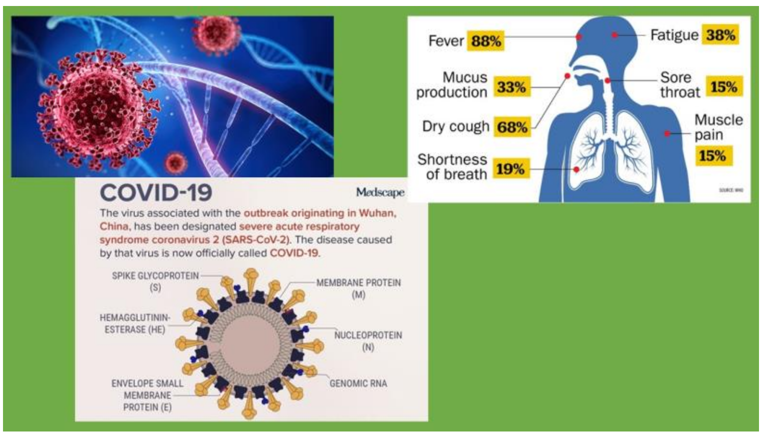
ABSTRACT

The aim of the present study was to review the laboratory studies in COVID 19 in different patients. The outbreak of Coronavirus 2019 (COVID-19) appeared in Wuhan, China, and the reason for its increasing spread is not fully understood. According to research, COVID-19 virus, like other risk factors in any country, has many heterogeneous effects, especially in the field of environment and energy. The clinical symptoms of this disease are nonspecific and cannot be easily distinguished from other acquired pneumonias. Therefore, radiological findings and laboratory tests play an important role in the diagnosis and follow-up of the disease. Preliminary studies have shown that people with underlying diseases are at higher risk for complications and mortality from COVID-19. Approximately 50% of hospitalized patients suspected of having a new coronavirus have other chronic diseases, and about 40% of hospitalized patients with confirmed new SARS-CoV-2 infection have heart disease. They are vascular or cerebrovascular. The researchers have also found a large difference in mortality by age group.

GRAPHICAL ABSTRACT



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Introduction

The occurrence and prevalence of COVID-19 virus has had far-reaching and profound effects on various human, equipment, economic and environmental dimensions of oil companies in the world, of which the National Company for the Southern Oilfields is no exception [1-3]. The effects of the COVID-19 virus on all areas of activity of the National Company for the Southern Oilfields, including supply and demand, human resources, budget, and ultimately the growth rate of occupational accidents, are undeniable. Oil price is a function of the law of supply and demand, which has severely affected the world economy, including the oil market, with the widespread global outbreak of the COVID-19 virus, which has affected almost every country in the world.

Although other factors have contributed to the decline in the oil market, none has been as deep, wide, and rapid as the Quaid-19. Because the normal routine of the company's activities has greatly been affected and has had a wide negative impact on human resources as one of the most important assets of the organization.

Reducing the presence of employees due to upstream requirements, disruption of internal and external processes, transportation, supply of equipment and other resources required for development, repair and restoration operations lead to the maintenance and increase of production of tangible factors due to the outbreak of COVID-virus 19 (Figure 1) which can directly or indirectly lead to a reduction in oil production [4-7].

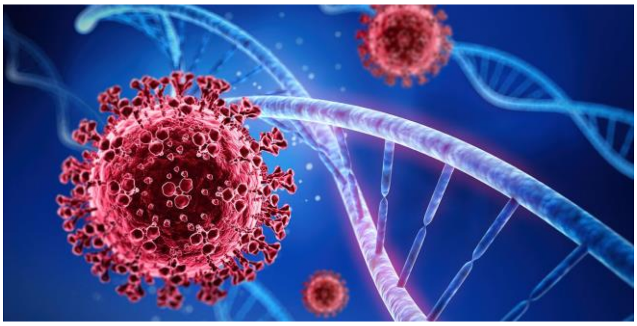

Figure 1: Virus variants are expected, but surveillance should continue to monitor possible changes

Incidence of human errors due to the deep psychological burden of COVID-19 virus, job stress due to high volume of staff, the potential to increase occupational accident rates and irreparable damage, frequent closures and reduced working hours of staff, double pressure on staff, affliction of the key members of the organization, changing work processes, changing shift hours, increasing organizational costs to meet the requirements of defined health protocols, the cost of printing and publishing training items and many other things are among the major reasons that should be considered [8-11].

Virology Coronavirus

COVID-19 is a coated virus with a genome of ribonucleic acid length of 29.8 kg. The virus's genome contains 14 open reading frames (ORFs) that encode 27 proteins. The orflab and orfla genes, located at the end of the 15th genome, encode the pplab and ppla proteins, respectively. These two genes express 15 non-structural proteins nsp1-nsp10 and nsp12-nsp16 [12-15].

On the other hand, at the end of '3 genome, four structural proteins including spike surface protein (S), coating protein (E), membrane protein (M), nucleocapsid protein (N) and eight sub-proteins including 3a, 3b, p6, 7a, 7b, 8b, 9b and orf14 are coded. The new coronavirus xenoma is significantly different from the SARS coronavirus xenoma in some areas. For example, protein 8a is present in SARS coronavirus (Figure 2), while this protein is not present in the new SARS-CoV-2 coronavirus. Also, protein 8b in SARS coronavirus contains 84 amino acids, while the length of this protein in the new SARS-CoV-2 coronavirus is longer and 121 amino acids [16-19].

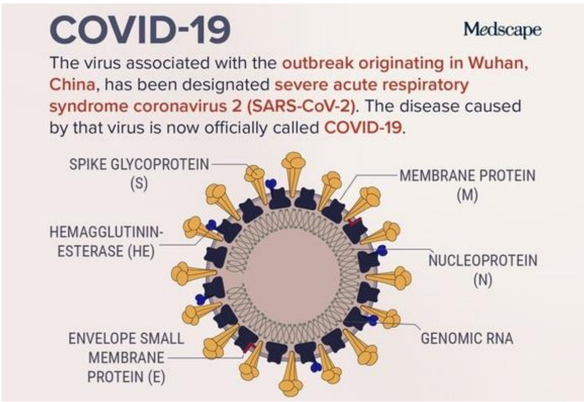

Figure 2: COVID-19 Infographics

On the other hand, protein 3b in SARS coronavirus has a length of 154 amino acids; however, the length of this protein in the new SARS-CoV-2 coronavirus is shorter and 22 amino acids (10). Physiological analysis has shown that the new SARS-CoV-2 coronavirus is closely related to two bat-like SARS-like coronaviruses, bat-SL-CoVZC45 and bat-SL-CoVZXC21 (89-89% similarity), but to coronavirus MD SARS (approximately 79%) and MERS (approximately 50%) are less similar. Phylogenetic analysis also shows that the new coronavirus SARS-CoV-2 is similar to the circulating coronavirus (horseshoe bats), 98.7% nucleotide similarity to the polymorphic gene of the coronavirus strain 4991 and 78% nucleotide similarity with bat coronavirus [20-23].

These findings suggest that these bat coronaviruses and the new SARS-CoV-2 coronavirus share a common ancestor (Figure 3) [24-27].

Based on the information currently available, the new and natural host of the new coronavirus appears to be bats, and then the virus enters an intermediate host, possibly an anteater or other wild animals for sale in Wuhan Bazaar and subsequently transmitted from this host to the average human. Then, the process of human-to-human transmission begins and the present epidemic is formed [28-31].

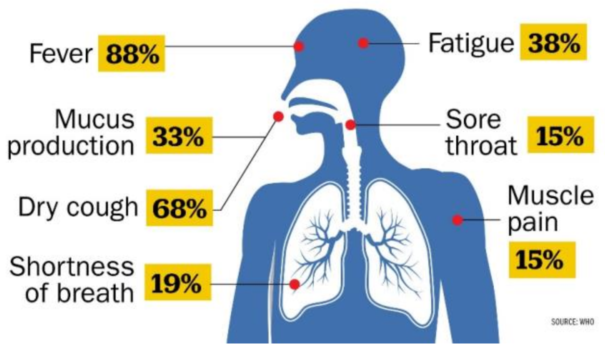

Figure 3. Coronavirus Questions Answered: What We Know About COVID-19

The fact that the anteater is specifically named as the intermediate host is due to the fact that 70% of the anteaters were positive for coronavirus. In addition, coronaviruses isolated from anteaters have a 99% nucleotide similarity to the new coronavirus SARS-CoV-2 [32-34]. Therefore, these anteaters are very likely to act (Fig. 4) as intermediate hosts for the transmission of new coronavirus from bats to humans [35].

The spike (S) surface glycoprotein of coronaviruses plays a key role in receptor binding to the cell surface and plays a key role in tissue orientation. Previous studies have shown that the SARS virus uses the angiotensin-converting enzyme type 2 as a cellular receptor to enter the cell. Recent studies have shown that the new coronavirus SARS-CoV-2 also uses the angiotensin-converting enzyme type 2 as a receptor to enter the cell [36-38].

Criteria for diagnosing COVID-19: In general, the criteria for diagnosing COVID-19 are divided into three categories: a) Based on clinical signs, b) based on radiological findings, and c) based on laboratory tests. The clinical symptoms of this disease are nonspecific and cannot be easily distinguished from other acquired pneumonias. Therefore, radiological findings and laboratory tests play an important role in the diagnosis and follow-up of the disease [39-41].

Based on an overview of COVID laboratory results in various articles in Chen et al.'s study [42], clinical signs were that 78% had fever at the time of hospitalization and 67% after delivery. Also, 44% experienced cough, 33% 22% experienced shortness of breath and weakness. In the study of Lui et al., in which clinical symptoms were analyzed in 10 mothers with coronavirus, the most common symptoms were fever [43-45], cough [4], fatigue [8], and muscle pain, respectively and sore throat and diarrhea. In the study of Zhu et al., the first symptom in these mothers was fever or cough; one case of cholecystitis and one case of diarrhea were reported. In a study of seven pregnant women with the disease, (Figure 4), Yu et al., found that fever was the most common symptom (86%), with 14% having coughs, shortness of breath, and diarrhea [9].

In general, the most common manifestations of COVID-19 disease in pregnant women include fever, cough, and muscle aches. In the study by Chen et al., [5], the patients experienced a 78% decrease in blood leukocytes, a 56% decrease in lymphocytes, a 76% increase in CRP, and a 33%

increase in transferases in the blood. No case of severe COVID-19 pneumonia or death was reported.

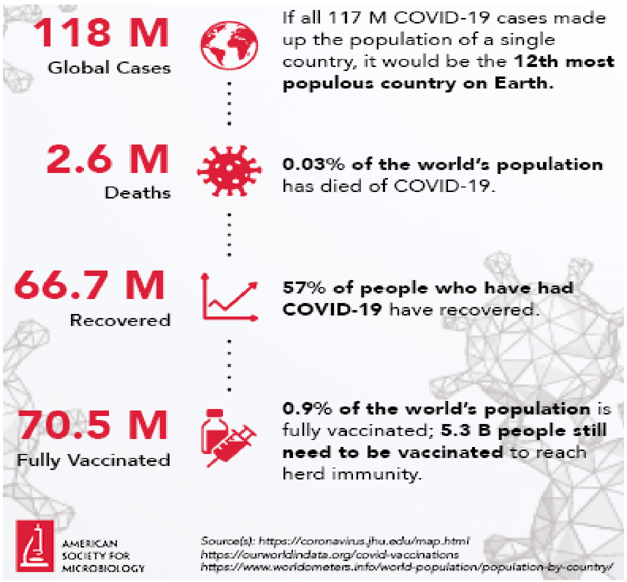

Figure 4: COVID-19 (SARS-CoV-2 Coronavirus) Resources

In the study of Liu et al., [1], the most common abnormal laboratory findings were decreased blood lymphocytes (12.15 patients) and increased CRP Data from laboratory tests. Yu et al., showed that the number of leukocytes was normal in all patients (n = 7) and five cases (71%) had higher neutrophil levels, lymphocytes in 5 patients (%). 71) and platelets in two patients (29%) were below normal. Two patients (29%) had varying degrees of liver dysfunction as well as elevated alanine aminotransferase or aspartate aminotransferase, or both.

According to infection-related biomarkers, procalcitonin (measured in six patients) and erythrocyte sedimentation rate (measured in five patients) were higher than normal in four patients (57%) and all patients had concentrations. They had abnormally high levels of C-reactive protein. The results of studies showed that the most common laboratory findings in patients with COVID-19 were decreased blood lymphocytes and increased blood CRP.

In Chen et al.'s study, [3] radiographic results of pregnant mothers showed 5 patients had ground-glass opacities multiple bilateral in their lungs, 3 pregnant women had lungs containing patchy consolidation, but in one woman, the pregnant woman had no problems and her lungs were clear and without infusion (obvious ground-glass opacities).

Liu et al., [4] used a 5-point criterion to assess pulmonary involvement with CT scan. The classification of pulmonary involvement was as follows:

Zero: no conflict,

1: conflict less than 5%,

2: conflict less than 25%,

3: conflict between 25 to 49%,

4: conflict between 50 to 75%,

5: conflict More than 75%.

In this study, 12 pregnant women were classified in category 4, 5 pregnant women were classified in category 3, and 4 were classified in category 2. CT scan images obtained before and after delivery showed no signs of exacerbation of pneumonia [5].

In the study by Zhu et al., [6], pre-treatment CT scan of pregnant women in the study showed typical changes in viral pneumonia, such as bilateral diffuse vitreous opacity, stained lungs, and fragmented margins. As the disease progressed, the lung lesions increased, but after treatment, the lesions disappeared.

CT scan results of 7 patients with COVID-19 in the study of Yu et al. (2020) also showed that 86% of them had large areas of multiple ground-glass opacities and the others had this problem with less conflict. The results of studies showed that lung lesions are in the form of double-sided frosted glass and stained lungs (Figure 5).

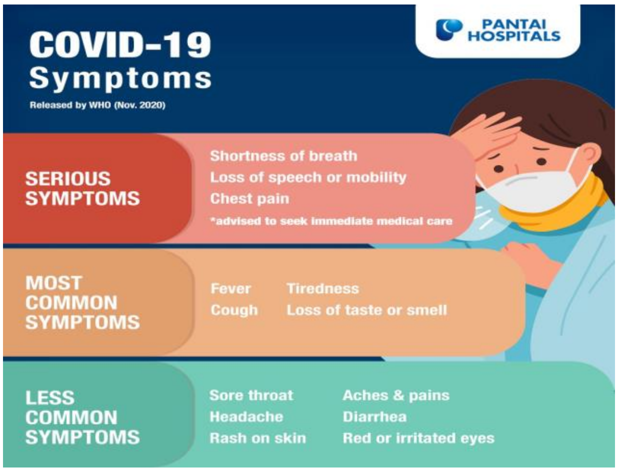

Figure 5: Coronavirus

In the study by Chen et al., [7], all 9 mothers (9.9) underwent cesarean section and all of them were given oxygen through the nose. Antiviral therapy and antibiotic therapy were performed for 6 (67%) for all these mothers (9.9).

In the study by Zhu et al., [8], the interval between the onset of COVID-19 symptoms and delivery was one to six days. Seven pregnant women gave birth by cesarean section and two by vaginal delivery. Prenatal problems include intrauterine distress (6 patients), premature rupture of membranes (5 to 7 hours before the onset of actual labor) (3 patients), abnormal amniotic fluid (2 patients), abnormal umbilical cord (2 patients) and the pair was abnormal (Prova pair) (1 person). The study by Yu et al., [7] showed that out of 11 deliveries, one mother underwent vaginal delivery and 10 mothers underwent cesarean section. The mean delivery time was 39 weeks plus 2 days. Three patients underwent cesarean section at 36-34 weeks of gestation due to their belief in antiviral therapy [58-60]. All patients were treated with oxygen through a nasal catheter. All patients received antiviral therapy (sletamovir, ganciclovir), interferon, and antibiotics (including cephalosporins, quinolones, and macrolides). Also 5 patients (71%) were treated with methylprednisolone after cesarean section. The outcomes of all patients were good. There were no cases in the intensive care unit for mothers during the study period, including before and after delivery. At the end of the follow-up (March 12, 2020), all patients were discharged from the hospital [13].

Chen et al., [6] evaluated nine babies born to mothers with coronary artery disease. 4 infants were fuller and 2 infants weighed less than 2500 g. All infants had an Apgar score above 8 to 1 to 5 minutes after delivery. None of the infants developed neonatal asphyxia or mortality. In the study of Zhu et al., [4] out of 10 infants studied, six preterm infants and three infants weighing less than 2500 g were born. The most common symptoms in newborns were shortness of breath (6/10), fever (2.10) and vomiting, respectively. In laboratory results, thrombocytopenia was observed in 2 infants and liver dysfunction was observed in 2 infants. Imaging of the infant's lungs revealed disorders such as infection, neonatal respiratory distress syndrome, and pneumothorax, one of which had pneumothorax [5].

Approximately one day after delivery, 5 infants were discharged, 4 infants were hospitalized but in good general condition, and one infant died. Liu et al., (2019) reported the results of their study in relation to neonatal outcomes [8]. Of the 10 mothers with coronavirus, 11 were born (twins). 90% were cesarean section and 4 were terminated, and the reason for being terminal in all infants was the start of antiviral drugs in pregnant women, which experts preferred to terminate the pregnancy [1].

The results of a study by Yu et al., [2] showed that of the 7 infants born to mothers with COVID-19, all were healthy with Apgar scores 9 and above and none had neonatal asphyxia. The results of a case study by Wang et al., (2018) showed that a mother was hospitalized with suspected symptoms) of coronary artery by cesarean section due to fetal meconium excretion. After a positive RT-PCR test in the mother, separation of mother and infant and breastfeeding the formula was done. 36 hours after birth, the baby's pharyngeal secretions were sampled and the RT-PCR test was positive, and the combination of radiographic evidence confirmed coronavirus infection in the infant, but the RT-PCR test was negative in the breast milk sample, as well as the nuclear test. Nucleic acid was negative in cord blood and placental samples. The authors of the study stated that the vertical transmission of the corona virus from mother to fetus is unknown. According to the first study on patients with the new coronavirus SARS-CoV-2, the incubation or incubation period of the virus was reported to be 5 days on average and ranged from 4 to 7 days (Figure 6) [3]. The time interval between a person's exposure to the virus and the onset of clinical symptoms is called the incubation period or latent period of the virus. Various health organizations around the world have reported different municipalities for COVID-19 [4].

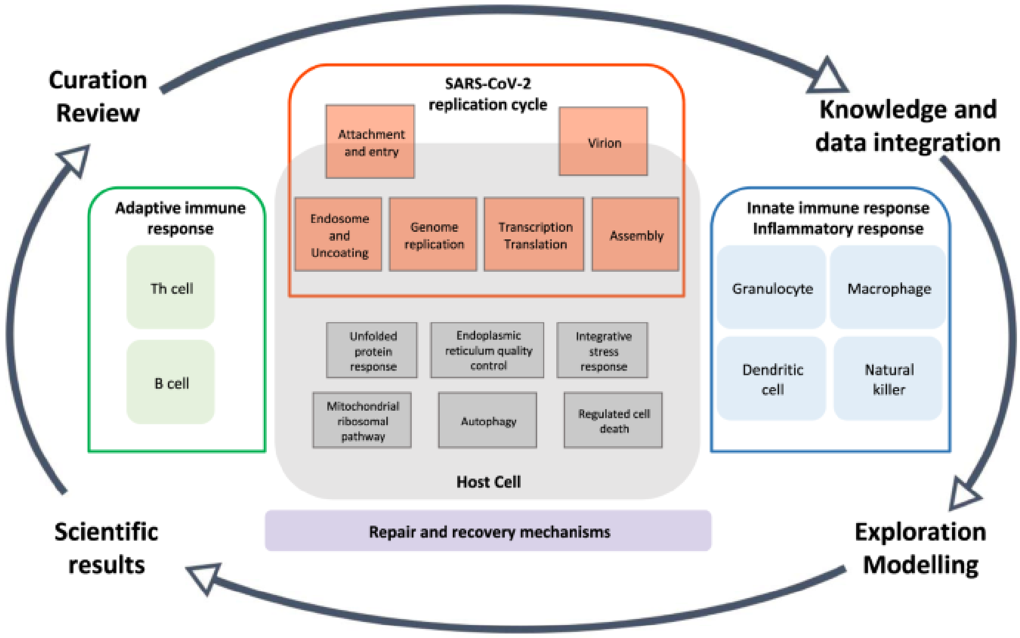

Figure 6: COVID-19 Disease Map, building a computational repository of SARS-CoV-2 virus-host interaction

According to the World Health Organization (WHO) [4], the numerical number is between 2-10 days, the Chinese National Health Commission is numerical between 10-14 days and the US Centers for Disease Control and Prevention is numerical between 2-14 days for this period. However, other different results have been reported in relation to the incubation period of the disease. For example, a recent study of six members of a family infected with the virus found that one infected person had a long incubation period of 19 days.

February 22, 2020, the disease with the longest incubation period (27 days). Accordingly, the duration of incubation or latent period of COVID-19 disease in patients is very variable and its mean is longer than SARS disease [7].

Coronavirus SARS-CoV-2 multiplies efficiently in the upper respiratory tract. Infected people produce large amounts of the virus in their upper respiratory tract during an introductory period, which leads to more spread of the virus to other people. In contrast, coronavirus SARS is not easily transmitted during this introductory period and most transmission occurs when the patient shows severe symptoms of the disease. Coronavirus SARS-CoV-2 also tends to cells located in the lower respiratory tract and, by multiplying in these areas, will cause lesions in the lower respiratory tract.

Approximately 81% of patients with the new SARS-CoV-2 coronavirus develop mild symptoms and recover at home (Figure 7). In 14% of cases, it shows severe symptoms, including pneumonia and shortness of breath. In 5% of cases, the patient's condition worsens, which is associated with respiratory failure, infectious shock and failure in other organs of the body.

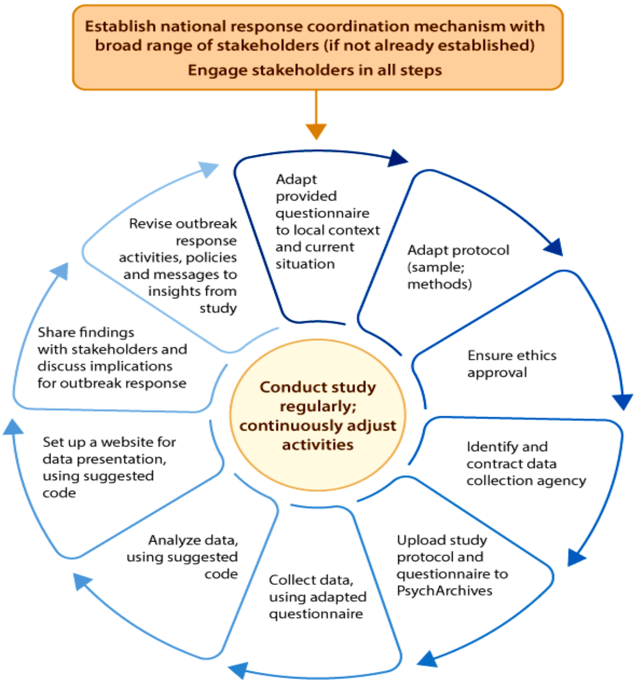

Figure 7: Coronavirus disease (COVID-19) outbreak

A study by Huang (2018) 41 confirmed cases of new SARS-CoV-2 coronavirus infection admitted to Wuhan Hospital were found with fever (98%), cough (76%), and shortness of breath (55%) and muscle pain and fatigue (44%) were the most common clinical symptoms of this infection, respectively. These findings were confirmed in another study conducted in China. Unlike patients with typical coronavirus infections, symptoms of the upper respiratory tract such as sore throat and runny nose were less common in patients with new coronavirus. Also, unlike coronavirus SARS, gastrointestinal symptoms such as diarrhea are rarely seen in patients with coronavirus SARS-CoV-2. Because of the similarities between coronavirus SARS and SARS-CoV-2, there is speculation about the time of the virus (presence of the virus in the blood) and contamination of tissues other than the respiratory tract. However, there is currently no information in this regard. As with SARS coronavirus infection, chest X-ray and tomography results showed bilateral lung involvement in 114 patients (81%) out of 140 patients with SARS-CoV-2 coronavirus infection. According to the latest meta-analysis study of 50,466 patients with COVID-19, the death rate from the virus has reached 4.3%. However, most of those who died had previous underlying conditions, such as high blood pressure, diabetes, or cardiovascular disease whose immune systems were weakened. The results of this extensive study showed that fever (89.1%), cough (72.2%) and muscle pain or fatigue (42.5%) were the most common clinical symptoms of patients. Acute Respiratory Distress Syndrome was also observed in 14.8% and abnormal chest radiographs in 96.6% of COVID-19 cases. Also, 18.1% of patients were in critical condition. However, the mortality rate of COVID-19 coronavirus is changing and the number of improved cases is increasing. The mortality rate of the new coronavirus is significantly lower than that of the coronavirus SARS (approximately 9.6%) and coronavirus MERS (approximately 35.2%) (Table 1).

Table 1: Mortality rate from COVID-19 according to the patient's background conditions

Background Conditions	***Mortality Rate (Percentage)***
Cardiovascular Disease	10.5
Diabetes	7.3
Chronic Respiratory Disease	6.3
blood Pressure	6
Cancer	5.6
No Underlying Disease	9.0

In studies, the incubation period or new corona virus has been mentioned as 5 days on average and with a range of 4 to 7 days. However, according to the definition of the latency period, which is from the time a person is exposed to the virus until the onset of clinical symptoms, this period is according to the report of the WHO, 10-14 days. Coronavirus SARS-CoV-2 has the ability to multiply in this part due to the presence of ACE_2 receptor in the cells of the upper respiratory tract. Therefore, infected people produce large amounts of the virus in their upper respiratory tract, which leads to further spread of the virus and involvement of other organs. However, coronavirus SARS is not easily transmitted during this introductory period and most transmission occurs when the patient shows symptoms of the disease [13].

Common signs and symptoms can include fever, cough, fatigue, shortness of breath, muscle aches, chills, sore throat, headache, chest pain, and gastrointestinal symptoms. As a result, the manifestations of COVID-19 infection are very specific. These symptoms can occur in infection with several factors and are common between different diseases such as influenza. Therefore, specific diagnostic tests for this infection are needed to confirm patients' suspicions. Computed tomography (CT) (Figiure 8) scan of the chest can serve as a complementary diagnostic tool, allowing physicians to diagnose SARS-CoV-2 infection more effectively in cases of false-negative RT-PCR. The sensitivity of CT scan, especially in the diagnosis of SARS-CoV-2 pneumonia, is much higher than RT-PCR. Studies have shown that SARS-CoV-2 viral pneumonia is diagnosed by CT-Scan on day 7 of the disease and RT-PCR was detected on day 14. However, it is less specific than RT-PCR and may be confused with other pneumonias. As a result, in areas with a large number of COVID-19 cases, CT may be a better diagnostic tool than RT-PCR [33].

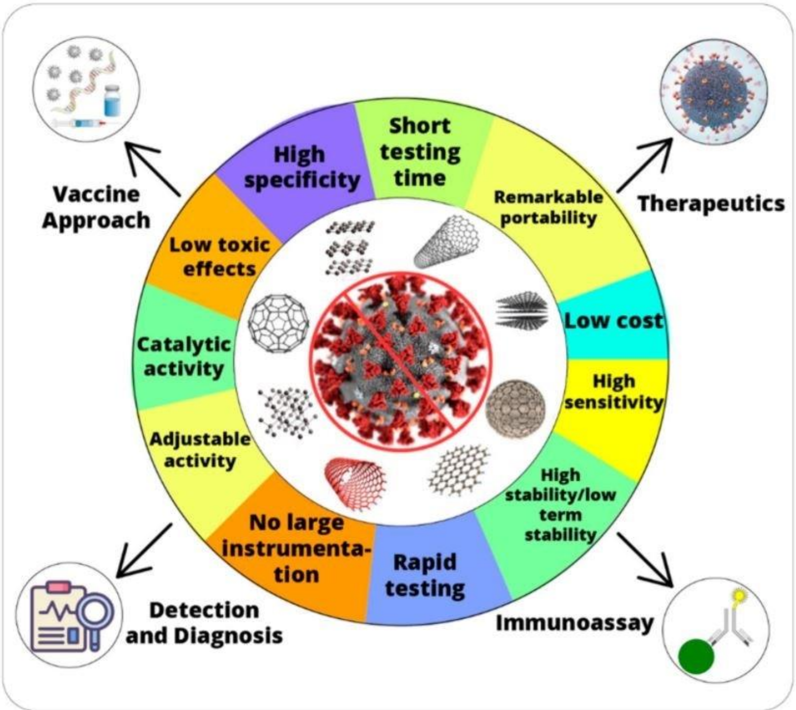

Figure 8. Nanozymes to the rescue - potential role in fighting COVID-19

Studies show that the combined Ab / RT-PCR test reduces the number of false negatives compared to RT-PCR alone. The combination of two complete antibody methods (IgG, IgM, IgA) and RT-PCR increases the detection sensitivity from 60% (in the case of PCR) to more than 80%. Accurate diagnosis of people infected with SARS-CoV-2 is essential to curb the global outbreak of COVID-19. In light of the above statements, there are current diagnostic tests for SARS-CoV-2 virus infection that have not been detected by RT-PCR [12]. These experiments can only be performed in centrally equipped laboratories and by qualified experts. Therefore, these experiments are practically limited and cannot be widely used, especially in developing countries, remote areas, and areas with decentralized laboratories. Rapid LFIA and CLIA automated tests for IgM and IgG can complement the existing RT-PCR test to detect infection with the COVID-19 virus. However, before using them to diagnose COVID-19, there is a need to carefully evaluate the clinical performance of commercial trials. Explore new biomarkers involved in the early stages of SARS-CoV-2 infection [11].

The recently developed Abbott ID Now—COVID-19 test, which detects SARS-COV-2 infection in 5 minutes, is a significant achievement and could play a transformative role in COVID-19 diagnostic tests. Further continuous efforts lead to the achievement of reliable, robust, fast and easy methods for implementing laboratory diagnostics and intelligent diagnostics for COVID-19. There is still a significant knowledge gap in health research for an effective public health response to major epidemics, which is very important. This highlights the need for all nations to invest in health research and to become an integral part of health care systems.

Conclusion

A review of the results of studies has shown that clinical signs, laboratory results and radiographic criteria in patients with COVID-19 indicate that the virus is dangerous to the health of all humans at all ages. Common manifestations of COVID-19 disease included fever, cough, and muscle aches. The most common laboratory results are decreased blood lymphocytes and increased blood CRP. From an economics perspective, the economic damage caused by the COVID-19 epidemic is largely due to declining demand. This means that there is no consumer to buy goods and services in the global economy. This effect can be clearly seen in the affected industries such as airlines and tourism. Countries have imposed travel restrictions to slow the spread of the virus, and many people cannot use airlines for vacations or business trips. This reduction in consumer demand causes airlines to lose their planned revenue and be forced to reduce their costs by reducing the number of flights; if the government does not help them, eventually, airlines will have to reduce staff and lay off staff to further reduce costs. Despite the obvious danger to the global economy, there are reasons to expect such pessimistic scenarios to be avoided. Governments have learned from previous crises that the effects of a demand-driven recession can be offset by rising government spending. As a result, many governments, while increasing the monetary welfare of their citizens, try to facilitate the access of various businesses to the required financial resources so that they do not have problems in keeping their employees during the epidemic period.

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Authors' contributions

All authors contributed toward data analysis, drafting and revising the paper and agreed to be responsible for all the aspects of this work.

Conflict of Interest

We have no conflicts of interest to disclose.

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