

The SARS-COV. Environmental samples from the Huanan sea food market also tested positive, signifying that the virus originated from there [7]. The number of cases started increasing exponentially, some of which did not have exposure to the live animal market, suggestive of the fact that human-to-human transmission was occurring [8]. The first fatal case was reported on 11th Jan 2020. The massive migration of Chinese during the Chinese New Year fuelled the epidemic. Cases in other provinces of China, other countries (Thailand, Japan and South Korea in quick succession) were reported in people who were returning from Wuhan. Transmission to healthcare workers caring for patients was described on 20th Jan, 2020. By 23rd January, the 11 million population of Wuhan was placed under lock down with restrictions of entry and exit from the region. Soon this lock down was

Prevent further spread of disease at mass gatherings, functions remain canceled in the affected cities, and persons are asked to work from home (232). Hence, it is a relief that the current outbreak of COVID-19 infection can be brought under control with the adoption of strategic preventive and control measures along with the early isolation of subsequent cases in the coming days. Studies also report that since air traffic between China and African countries increased many times over in the decade after the SARS outbreak, African countries need to be vigilant to prevent the spread of novel coronavirus in Africa (225). Due to fear of virus spread, Wuhan City was completely shut down (233). The immediate control of the ongoing COVID-19 outbreaks appears a mammoth task, especially for developing countries, due to their inability to allocate quarantine stations that could screen infected individuals' movements (234). Such underdeveloped countries should divert their resources and energy to enforcing the primary level of preventive measures, like controlling the entry of individuals from China or countries where the disease has flared up, isolating the infected individuals, and quarantining individuals with suspected infection. Most of the sub-Saharan African countries have a fragile health system that can be

The interferon response is one of the major innate immunity defences against virus invasion. Interferons induce the expression of diverse interferon-stimulated genes, which can interfere with every step of virus replication. Previous studies identified type I interferons as a promising therapeutic candidate for SARS¹⁴⁹. In vitro data showed SARS-CoV-2 is even more sensitive to type I interferons than SARS-CoV, suggesting the potential effectiveness of type I interferons in the early treatment of COVID-19 (REF.150). In China, vapor inhalation of interferon- α is included in the COVID-19 treatment guideline¹⁵¹. Clinical trials are ongoing across the world to evaluate the efficacy of different therapies involving interferons, either alone or in combination with other agents¹⁵².

Immunoglobulin therapy. Convalescent plasma treatment is another potential adjunctive therapy for COVID-19. Preliminary findings have suggested improved

clinical status after the treatment ^{153,154}. The FDA has provided guidance for the use of COVID-19 convalescent plasma under an emergency investigational new drug application. However, this treatment may have adverse effects by causing antibody-mediated enhancement of infection, transfusion-associated acute lung injury and allergic transfusion reactions.

Monoclonal antibody therapy is an effective immunotherapy for the treatment of some viral infections in select patients. Recent studies reported specific monoclonal antibodies neutralizing SARS-CoV-2 infection

Including IL2, IL7, IL10, GCSF, IP10, MCP1, MIP1A, and TNFa [15]. The median time from onset of symptoms to dyspnea was 5 d, hospitalization 7 d and acute respiratory distress syndrome (ARDS) 8 d. The need for intensive care admission was in 25-30% of affected patients in published series. Complications witnessed included acute lung injury, ARDS, shock and acute kidney injury. Recovery started in the 2nd or 3rd wk. The median duration of hospital stay in those who recovered was 10 d. Adverse outcomes and death are more common in the elderly and those with underlying co-morbidities (50-75% of fatal cases). Fatality rate in hospitalized adult patients ranged from 4 to 11%. The overall case fatality rate is estimated to range between 2 and 3% [2].

Interestingly, disease in patients outside Hubei province has been

Explored targeting molecular dynamic simulations, evaluating their interaction with corresponding major histocompatibility complex class I molecules. They potentially induce immune responses (176). The recombinant vaccine can be designed by using rabies virus (RV) as a viral vector. RV can be made to express MERS-CoV S1 protein on its surface so that an immune response is induced against MERS-CoV. The RV vector-based vaccines against MERS-CoV can induce faster antibody response as well as higher degrees of cellular immunity than the Gram-positive enhancer matrix (GEM) particle vector-based vaccine. However, the latter can induce a very high antibody response at lower doses (167). Hence, the degree of humoral and cellular immune responses produced by such vaccines depends upon the vector used.

Dual vaccines have been getting more popular recently. Among them, the rabies virus-based vectored vaccine platform is used to develop vaccines against emerging infectious diseases. The dual vaccine developed from inactivated rabies virus particles that express the MERS-CoV S1 domain of S protein was found to induce immune responses for both MERS-CoV and rabies virus. The vaccinated mice were found to be completely protected from challenge with MERS-CoV (169). The intranasal weeks, and the typical symptom occurrence from incubation period to infection takes an average of 12.5 days.²⁹

6 CLINICAL DIAGNOSIS

The symptoms of COVID-19 remain very similar to those of the other respiratory epidemics in the past, which include SARS and MERS, but here the range of symptoms includes mild rhinitis to septic shock. Some intestinal disturbances were reported with the other epidemics, but COVID-19 was devoid of such symptoms. When examined, unilateral or bilateral involvement compatible with viral pneumonia is observed in the patients, and bilateral multiple lobular and sub-segmental consolidation areas were observed in patients hospitalised in the intensive care unit. Comorbid patients showed a more severe clinical course than predicted from previous epidemics. Diagnosis of COVID-19 includes the complete history of travel and touch, with laboratory testing. It is more preferable to choose serological screening, which can help to analyse even the asymptomatic infections; several serological tests are in progress for SARS-CoV-2.^{14, 30}

Anti-SARS-CoV-2 activity is far higher than the maximum plasma concentration achieved by administering the approved dose (340). However, ivermectin, being a host-directed agent, exhibits antiviral activity by targeting a critical cellular process of the mammalian cell. Therefore, the administration of ivermectin, even at lower doses, will reduce the viral load at a minor level. This slight decrease will provide a great advantage to the immune system for mounting a large-scale antiviral response against SARS-CoV-2 (341). Further, a combination of ivermectin and hydroxychloroquine might have a synergistic effect, since ivermectin reduces viral replication, while hydroxychloroquine inhibits the entry of the virus in the host cell (339). Further, in vivo studies and randomized clinical control trials are required to understand the mechanism as well as the clinical utility of this promising drug.

Nafamostat is a potent inhibitor of MERS-COV that acts by preventing membrane fusion. Nevertheless, it does not have any sort of inhibitory action against SARS-CoV-2 infection (194). Recently, several newly synthesized halogenated triazole compounds were evaluated, using fluorescence resonance energy transfer (FRET) based helicase assays, for their ability to inhibit

Or even die, whereas most young people and children have only mild diseases (non-pneumonia or mild pneumonia) or are asymptomatic^{9,81,82}. Notably, the risk of disease was not higher for pregnant women. However, evidence of transplacental transmission of SARS-CoV-2 from an infected mother to a neonate was reported, although it was an isolated case^{83,84}. On infection, the most common symptoms are fever, fatigue and dry cough^{13,60,80,81}. Less common symptoms include sputum production, headache, haemoptysis, ¹diarrhoea, anorexia, sore throat, chest pain, chills and nausea and vomiting in studies of patients in China^{13,60,80,81}. Self-reported olfactory and taste disorders were also reported by patients in Italy. Most people showed signs of diseases after an incubation period of 1-14 days (most commonly around 5 days), and dyspnoea and pneumonia developed within a median time of 8 days from illness onset.

In a report of 72,314 cases in China, 81% of the cases were classified as mild, 14% were severe cases that required ventilation in an intensive care unit (ICU) and a 5% were critical (that is, the patients had respiratory failure, septic shock and/or multiple organ dysfunction or failure)^{9,86}. On admission, ground-glass opacity was the most common radiologic finding on chest computed tomography (CT)^{13,60,80,81}. Most patients also developed marked lymphopenia, similar to what was observed in patients with SARS and MERS, and non-survivors developed severer lymphopenia over time^{13,60,80,81}. Compared with non-ICU patients, ICU patients had higher levels

Coronavirus is the most prominent example of a virus that has crossed the species barrier twice from wild animals to humans during SARS and MERS outbreaks (79, 102). The possibility of crossing the species barrier for the third time has also been suspected in the case of SARS-CoV-2 (COVID-19). Bats are recognized as a possible natural reservoir host of both SARS-CoV and MERS-CoV infection. In contrast, the possible intermediary host is the palm civet for SARS-CoV and the dromedary camel for MERS-CoV infection (102). Bats are considered the ancestral hosts for both SARS and MERS (103). Bats are also considered the reservoir host of human coronaviruses like HCoV-229E and HCoV-NL63 (104). In the case of COVID-19, there are two possibilities for primary transmission: it can be transmitted either through intermediate hosts, similar to that of SARS and MERS, or directly from bats (103). The emergence paradigm put forward in the SARS outbreak suggests that SARS-CoV originated from bats (reservoir host) and later jumped to civets (intermediate host) and incorporated changes within the receptor-binding domain (RBD) to improve binding to civet ACE2. This civet-adapted virus, during their subsequent exposure to humans at live markets, promoted further adaptations that resulted in the epidemic strain (104). Transmission can also

involved in the COVID-19 outbreak is of great importance, because the strain on their mental wellbeing will affect their attention, concentration, and decision-making capacity. Hence, for control of the COVID-19 outbreak, rapid steps should be taken to protect the mental health of medical workers (229).

Since the living mammals sold in the wet market are suspected to be the intermediate host of SARS-CoV-2, there is a need for strengthening the regulatory mechanism for wild animal trade (13). The total number of COVID-19 confirmed cases is on a continuous rise and the cure rate is relatively low, making disease control very difficult to achieve. The Chinese government is making continuous efforts to contain the disease by taking emergency control and prevention measures. They have already built a hospital for patients affected by this virus and are currently building several more for accommodating the continuously increasing infected population (230). The effective control of SARS-CoV-2/COVID-19 requires high-level interventions like intensive contact tracing, as well as the quarantine of people with suspected infection and the isolation of

infected individuals. The implementation of rigorous control and preventive measures together might control the R_0 number and reduce the transmission risk (228). Considering the zoonotic

species barrier. As a result, the whole world is suffering from novel SARS-CoV-2, with more than 4,170,424 cases and 287,399 deaths across the globe. There is an urgent need for a rational international campaign against the unhealthy food practices of China to encourage the sellers to increase hygienic food practices or close the crude live-dead animal wet markets. There is a need to modify food policies at national and international levels to avoid further life threats and economic consequences from any emerging or reemerging pandemic due to close animal-human interaction (285). Even though individuals of all ages and sexes are susceptible to COVID-19, older people with an underlying chronic disease are more likely to become severely infected (80). Recently, individuals with asymptomatic infection were also found to act as a source of infection to susceptible individuals (81). Both the asymptomatic and symptomatic patients secrete similar viral loads, which indicates that the transmission capacity of asymptomatic or minimally symptomatic patients is very high. Thus, SARS-CoV-2 transmission can happen early in the course of infection (82). Atypical clinical manifestations have also been reported in COVID-19 in which the only reporting symptom was fatigue. Such patients may lack respiratory signs, such as fever, cough, and sputum (83). Hence, the clinicians

Coronaviruses are a diverse group of viruses infecting many different animals, and they can cause mild to severe respiratory infections in humans. In 2002 and 2012, respectively, two highly pathogenic coronaviruses with zoonotic origin, severe acute respiratory syndrome coronavirus (SARS-CoV) and Middle East respiratory syndrome coronavirus (MERS-CoV), emerged in humans and caused fatal respiratory illness, making emerging coronaviruses a new public health concern in the twenty-first century¹. At the end of 2019, a novel coronavirus designated as SARS-CoV-2 emerged in the city of Wuhan, China, and caused an outbreak of unusual viral pneumonia. Being highly transmissible, this novel coronavirus disease, also known as coronavirus disease 2019 (COVID-19), has spread fast all over the world^{2,3}. It has overwhelmingly surpassed SARS and MERS in terms of both the number of infected people and the spatial range of epidemic areas. The ongoing outbreak of COVID-19 has posed an extraordinary threat to global public health^{4,5}. In this Review, we summarize the current understanding of the nature of SARS-CoV-2 and COVID-19. On the basis of recently published findings, this comprehensive Review covers the basic biology of SARS-CoV-2, including the genetic characteristics, the potential zoonotic origin and its receptor binding. Furthermore, we will discuss the clinical and epidemiological features, diagnosis of and countermeasures against COVID-19.

Emergence and spread

In late December 2019, several health facilities in Wuhan, in Hubei province in China, reported clusters of patients with pneumonia of unknown cause⁶. Similarly to patients with SARS and MERS, these patients showed symptoms of viral pneumonia, including fever, cough

Even though a high similarity has been reported between the genome sequence of the new coronavirus (SARS-CoV-2) and SARS-like CoVs, the comparative analysis recognized a furin-like cleavage site in the SARS-CoV-2 S protein that is missing from other SARS-like CoVs (99). The furin-like cleavage site is expected to play a role in the life cycle of the virus and disease pathogenicity and might even act as a therapeutic target for furin inhibitors. The highly contagious nature of SARS-CoV-2 compared to that of its predecessors might be the result of a stabilizing mutation that occurred in the endosome-associated-protein-like domain of nsp2 protein.

Similarly, the destabilizing mutation near the phosphatase domain of nsp3 proteins in SARS-CoV-2 could indicate a potential mechanism that differentiates it from other CoVs (100). Even though the CFR reported for COVID-19 is meager compared to those of the previous SARS and MERS outbreaks, it has caused more deaths than SARS and MERS combined (101). Possibly related to the viral pathogenesis is the recent finding of an 832-nucleotide (nt) deletion in ORF8, which appears to reduce the replicative fitness of the virus and leads to attenuated phenotypes of SARS-CoV-2 (256). Coronavirus is the most prominent example of a

(96.7%), and S genes (90.4%). The RBD of S protein in CoV isolated from pangolin was almost identical (one amino acid difference) to that of SARS-CoV-2. A comparison of the genomes suggests recombination between pangolin-CoV-like viruses with the bat-CoV-RaTG13-like virus. All this suggests the potential of pangolins to act as the intermediate host of SARS-CoV-2 (145).

Human-wildlife interactions, which are increasing in the context of climate change (142), are further considered high risk and responsible for the emergence of SARS-CoV. COVID-19 is also suspected of having a similar mode of origin. Hence, to prevent the occurrence of another zoonotic spillover (1), exhaustive coordinated efforts are needed to identify the high-risk pathogens harbored by wild animal populations, conducting surveillance among the people who are susceptible to zoonotic spillover events (12), and to improve the biosecurity measures associated with the wildlife trade (146). The serological surveillance studies conducted in people living in proximity to bat caves had earlier identified the serological confirmation of SARS-related CoVs in humans. People living at the wildlife-human interface, mainly in rural China, are regularly exposed to SARS-related CoVs (147). These findings will not have any significance until a

category A agents (cholera, plague). Patients should be placed in separate rooms or cohorted together. Negative pressure rooms are not generally needed. The rooms and surfaces and equipment should undergo regular decontamination preferably with sodium hypochlorite. Healthcare workers should be provided with fit tested N95 respirators and protective suits and goggles. Airborne transmission precautions should be taken during aerosol generating procedures such as intubation, suction and tracheostomies. All contacts including healthcare workers should be monitored for development of symptoms of COVID-19. Patients can be discharged from isolation once they are afebrile for at least 3 d and have two consecutive negative molecular tests at 1 d sampling interval. This recommendation is different from pandemic flu where patients were

(181). CEPI has also funded Moderna to develop a vaccine for COVID-19 in partnership with the Vaccine Research Center (VRC) of the National Institute of Allergy and Infectious Diseases (NIAID), part of the National Institutes of Health (NIH) (182). By employing mRNA vaccine platform technology, a vaccine candidate expressing SARS-CoV-2 spike protein is likely to go through clinical testing in the coming months (180). On 16 March 2020, Jennifer Haller became the first person outside China to receive an experimental vaccine, developed by Moderna, against this pandemic virus. Moderna, along with China's CanSino Biologics, became the first research group to launch small clinical trials of vaccines against COVID-19. Their study is evaluating the vaccine's safety and ability to trigger immune responses (296).

Scientists from all over the world are trying hard to develop working vaccines with robust protective immunity against COVID-19. Vaccine candidates, like mRNA-1273 SARS-CoV-2 vaccine, INO-4800 DNA coronavirus vaccine, and adenovirus type 5 vector vaccine candidate (Ad5-nCoV), are a few examples under phase I clinical trials, while self amplifying RNA vaccine, oral recombinant COVID-19 vaccine, BNT162, plant-based COVID-19 vaccine, and li-Key peptide COVID-19 vaccine are

in asymptomatic patients. These abnormalities progress from the initial focal unilateral to diffuse bilateral ground-glass opacities and will further progress to or coexist with lung consolidation changes within 1 to 3 weeks (159). The role played by radiologists in the current scenario is very important. Radiologists can help in the early diagnosis of lung abnormalities associated with COVID-19 pneumonia. They can also help in the evaluation of disease severity, identifying its progression to acute respiratory distress syndrome and the presence of secondary bacterial infections (160). Even though chest CT is considered an essential diagnostic tool for COVID-19, the extensive use of CT for screening purposes in the suspected individuals might be associated with a disproportionate risk-benefit ratio due to increased radiation exposure as well as increased risk of cross infection. Hence, the use of CT for early diagnosis of

SARS-CoV-2 infection in high-risk groups should be done with great caution (292).

More recently, other advanced diagnostics have been designed and developed for the detection of SARS-CoV-2 (345, 347, 350-352). A reverse amplification (RT-LAMP), namely, iLACO, has been developed for rapid and colorimetric detection of this

and Middle East respiratory syndrome coronavirus (MERS-CoV), but has lower fatality. The global impact of this new epidemic is yet uncertain.

Keywords: 2019-nCoV, SARS-CoV-2, COVID-19, Pneumonia, Review

Introduction

The 2019 novel coronavirus (2019 nCoV) or the severe acute respiratory syndrome corona virus 2 (SARS-CoV-2) as it is now called, is rapidly spreading from its origin in Wuhan City of Hubei Province of China to the rest of the world [1]. Till 05/03/2020 around 96,000 cases of coronavirus disease 2019 (COVID-19) and 3300 deaths have been reported [2]. India has reported 29 cases till date. Fortunately so far, children have been infrequently affected with no deaths. But the future course of this virus is unknown. This article gives a bird's eye view about

Viruses in nasal washes, saliva, urine and faeces for up to 8 days after infection, and a few naive ferrets with only indirect contact were positive for viral RNA, suggesting airborne transmission⁷⁸. In addition, transmission of the virus through the ocular surface and prolonged presence of SARS-CoV-2 viral RNA in faecal samples were also documented^{101,102}. Coronaviruses can persist on inanimate surfaces for days, which could also be the case for SARS-CoV-2 and could pose a prolonged risk of infection¹⁰³. These findings explain the rapid geographic spread of COVID-19, and public health interventions to reduce transmission will provide benefit to mitigate the epidemic, as has proved successful in China and several other countries, such as South Korea^{89,104,105}.

Diagnosis

Early diagnosis is crucial for controlling the spread of COVID-19. Molecular detection of SARS-CoV-2 nucleic acid is the gold standard. Many viral nucleic acid detection kits targeting ORF1b (including RdRp), N, E or S genes are commercially available¹¹⁰⁶⁻¹⁰⁹. The detection time ranges from several minutes to hours depending on the technology^{106,107,109-111}. The molecular detection can be affected by many factors. Although SARS-CoV-2 has been detected from a variety of respiratory sources, including throat swabs, posterior oropharyngeal saliva, nasopharyngeal swabs, sputum and bronchial fluid, the viral load is higher

in lower respiratory tract samples^{11,96,112-115}. In addition, viral nucleic acid was also found in samples from the intestinal tract or blood even when respiratory samples were negative⁶. Lastly, viral load may already drop from its peak level on disease onset^{96,97}. Accordingly, false negatives can be common when oral swabs are used, and so multiple detection methods should be adopted to confirm a COVID-19 diagnosis^{17,118}. Other detection methods were therefore used to overcome this problem. Chest CT was used to quickly identify a patient when the capacity of molecular detection was overloaded in Wuhan. Patients

and SARS, along with adopting and strengthening a few precautionary measures owing to the unknown nature of this novel virus (36, 189). Presently, the main course of treatment for severely affected SARS-CoV-2 patients admitted to hospitals includes mechanical ventilation, intensive care unit (ICU) admittance, and symptomatic and supportive therapies. Additionally, RNA synthesis inhibitors (lamivudine and tenofovir disoproxil fumarate), remdesivir, neuraminidase inhibitors, peptide (EK1), anti-inflammatory drugs, abidol, and Chinese traditional medicine (Lianhuaqingwen and ShuFengJieDu capsules) could aid in COVID-19 treatment. However, further clinical trials are being carried out concerning their safety and efficacy (7). It might require months to a year(s) to design and develop effective drugs, therapeutics, and vaccines against COVID-19, with adequate evaluation and approval from regulatory bodies and moving to the bulk production of many millions of doses at commercial levels to meet the timely demand of mass populations across the globe (9). Continuous efforts are also warranted to identify and assess viable drugs and immunotherapeutic regimens that revealed proven potency in combating other viral agents similar to SARS-CoV-2.

COVID-19 patients showing severe signs are

understanding of the lung inflammation associated with this infection (24).

SARS is a viral respiratory disease caused by a formerly unrecognized animal CoV that originated from the wet markets in southern China after adapting to the human host, thereby enabling transmission between humans (90). The SARS outbreak reported in 2002 to 2003 had 8,098 confirmed cases with 774 total deaths (9.6%) (93). The outbreak severely affected the Asia Pacific region, especially mainland China (94). Even though the case fatality rate (CFR) of SARS-CoV-2 (COVID-19) is lower than that of SARS-CoV, there exists a severe concern linked to this outbreak due to its epidemiological similarity to influenza viruses (95, 279). This can fail the public health system, resulting in a pandemic (96).

MERS is another respiratory disease that was first reported in Saudi Arabia during the year 2012. The disease was found to have a CFR of around 35% (97). The analysis of available data sets suggests that the incubation period of SARS-CoV-2, SARS-CoV, and MERS-CoV is in almost the same range. The longest predicted incubation time of SARS-CoV-2 is 14 days. Hence, suspected individuals are isolated for 14 days to avoid the risk of further spread (98). Even though a high similarity has been reported

Subfamily and is entirely afferent from the viruses responsible for MERS-CoV and SARS-CoV (3). The newly emerged SARS-CoV-2 is a coronavirus (2). The genome sequences of SARS group 2B CoV-2 obtained from patients share 79.5% sequence similarity to the sequence of SARS-CoV (63).

As of 13 May 2020, a total of 4,170,424 confirmed cases of COVID-19 (with 287,399 deaths) have been reported in more than 210 affected countries worldwide (WHO Situation Report 114 and other SARS-CoVs (FIG. 2). Using sequences of five conserved replicative domains in ppla (3C-like protease (3CLpro), nidovirus RNA-dependent RNA polymerase (RdRp)-associated nucleotidyltransferase (NIRAN), RdRp, zinc-binding domain (ZBD) and HEL1), the Coronaviridae Study Group of the International Committee on Taxonomy of Viruses estimated the pairwise patristic distances between SARS-CoV-2 and known coronaviruses, and assigned SARS-CoV-2 to the existing species SARSr-CoV¹⁷. Although phylogenetically related, SARS-CoV-2 is distinct from all other coronaviruses from bats and pangolins in this species.

The SARS-CoV-2 S protein has a full size of 1,273 amino acids, longer than that of SARS-CoV (1,255 amino acids) and known bat SARSr-CoVs (1,245-1,269 amino acids). It is distinct from the S proteins of most members in the subgenus Sarbecovirus, sharing amino acid sequence similarities of 76.7-77.0% with SARS-CoVs from civets and humans,

4 VIROLOGY

Coronaviruses, a family of viruses within the nidoviruses superfamily, are further classified according to their genera, alpha-, beta-, gamma- and deltacoronaviruses (α -, β -, γ - and δ -). Among those, alpha and beta species are capable of contaminating only mammals, whereas the other two genera can infect birds and could also infect mammals.^{13, 14} Two of these genera belong to human coronaviruses (HCOVs): α -coronaviruses, which comprise human coronavirus 229E (hcov229E) and human coronavirus NL63 (hcovNL63), and β coronaviruses, which are human coronavirus HKU1, human coronavirus OC43, MERS-COV (known as Middle East respiratory syndrome coronavirus) and SARS-CoV (referred to as severe acute respiratory syndrome coronavirus),¹⁵

The severe acute respiratory syndrome CoV-2 (SARS-CoV-2) is now named novel COVID-19 (coronavirus disease 2019).¹⁶ Genome sequencing and phylogenetic research revealed that the COVID-19-causing coronavirus is a beta-coronavirus that belongs to the same subtypes as SARS virus, but still exists in a variant group. The receptor-binding gene region

Repurposed broad-spectrum antiviral drugs having proven uses against other viral pathogens can be employed for SARS-CoV-2-infected patients. These possess benefits of easy accessibility and recognized pharmacokinetic and

pharmacodynamic activities, stability, doses, and side effects (9). Repurposed drugs have been studied for treating CoV infections, like lopinavir/ritonavir, and interferon-1 β revealed in vitro anti-MERS-CoV action. The in vivo experiment carried out in the nonhuman primate model of common marmosets treated with lopinavir/ritonavir and interferon beta showed superior protective results in treated animals than in the untreated ones (190). A combination of these drugs is being evaluated to treat MERS in humans (MIRACLE trial) (191). These two protease inhibitors (lopinavir and ritonavir), in combination with ribavirin, gave encouraging clinical outcomes in SARS patients, suggesting their therapeutic values (165). However, in the current scenario, due to the lack of specific therapeutic agents against SARS-CoV-2, hospitalized patients confirmed for the disease are given supportive care, like oxygen and fluid therapy, along with antibiotic therapy for managing secondary bacterial infections (192). Patients with novel coronavirus or COVID-19 pneumonia who are mechanically ventilated often require sedatives, analgesics, and even muscle COVID-19 has also been confirmed on a cruise.