Prognosis and the Global Impact of the COVID-19 Pandemic - A Comprehensive Review

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ABSTRACT

Background: The novel coronavirus 2019 or SARS-CoV-2 appeared first in the December, 2019, in the Wuhan, China. The virus later effected almost every part of the world.

Aim of the Review: The review is aimed to deliver a detailed prognosis of SARS-CoV-2 on basis of evaluation of different attributes of the virus reported or published.

Method: Articles were searched on Google Scholar and PubMed databases. All articles concerning SARS-CoV-2 were included. The duplicate articles were identified with EndNote and excluded. Related data from WHO, FDA and CDC were also included.

Results: The following parameters were found to show an important role in the prognosis of the SARS-CoV-2 i.e., physical properties, evolution, pathogenesis, epidemiology, demography, geography, diagnosis method, laboratory findings and clinical features. Moreover, several approaches were found to fight the viral infection including proposed therapies, proposed drugs, and vaccines. However, till the development of effective and safe approach the preventive measures are recommended to be strictly followed.

Conclusion: The global impact of this virus is beyond reconciliation and rapprochement. Its impact on various major industries such as agriculture, petroleum & oil, manufacturing industry, education and healthcare, and the pharmaceutical industries is inexplicable.

Keywords: COVID-19, SARS-CoV-2, Pandemic, Evolution, Pathogenesis, Treatment, Vaccine, Economy, Global Impact.

INTRODUCTION

Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) also known as 2019 novel coronavirus or simply COVID-19 has halted the world at the end of 2019. The first case was reported on 19th December 2019 in Wuhan City, Hubei Province, China. On March 11th, 2020, the World Health Organization (WHO) declared it a global pandemic.

There is the uncertainty of the origin however first cases were reported back to Huanan Seafood market where uninhabited animals and specifically bats are sold. [1]. Genetically, SARS-CoV-2 is an RNA enveloped virus. It resembles the Acute Respiratory Syndrome Coronavirus 1 or SARS-CoV-1 and the Middle East Respiratory Syndrome Coronavirus or MERS-CoV [2]. COVID-19 is highly contagious, social
distancing has decreased the transmission rates and the mortality rates.[1]

SARS-CoV-2 and SARS-CoV-1 have got similarities, and reservoirs were found in camels, however, SARS-CoV was discovered 18 years before the COVID-19 pandemic.[3]. It has been proposed the Bat-CoV acts as a reservoir for the COVID-19 transmit to humans.[4]. Characterization and identification of SARS-CoV-2 samples in the laboratory studied a full-length genome sequence of the five patients and revealed 79.6% and 96% similarity in gene arrangement with SARS-CoV and bat-virus respectively. The sequence of seven conserved nonstructural proteins has shown its belonging to the SARS-CoV.[5]. SARS-CoV-2 has 10 to 20 folds more binding potential of binding to ACE-2 receptors than the earlier coronaviruses. Its silent and efficient transmission is due to potentially high levels of loads in the nasal secretions of asymptomatic individuals[6].

SARS-CoV-2, SARS-CoV-1, and MERS-CoV have nearly the identical lower respiratory tract related symptoms including shortness of breath and similar chest computed tomography related findings due to SARS-CoV-2 infection[7]. Geriatrics are at more danger of developing severe clinical conditions. The fatality rate of SARS-CoV-2 has been estimated at 3.4%, lower than SARS-CoV-1 and MERS-CoV (10% and 34%) [8, 9].

**AIM OF THE REVIEW**

The review is aimed to provide a detailed prognosis of SARS-CoV-2 on basis of evaluation of its different attributes reported and published. These attributes such as physical properties, evolution, pathogenesis, epidemiology, demography, geography, diagnosis, and clinical features related to Covid19 are explored in detail.

**METHOD**

All articles concerning SARS-CoV-2 were included in this review. The articles were in English language. Articles were searched on google scholar and PubMed using keywords “(SARS-CoV-2 OR coronavirus OR novel coronavirus OR coronavirus 2019) AND (physical properties OR evolution OR pathogenesis OR epidemiology OR demography OR geography OR diagnosis OR laboratory OR findings OR clinical features OR proposed therapies OR proposed drugs OR vaccines OR preventive measure)” on August 26, 2020. All the articles were included except duplicates. The duplicates were identified using EndNote software. Data from WHO, FDA and CDC were also included.

**RESULTS / FINDING**

**Physical properties**

SARS-CoV-2 is a Positive-Sense Single-Stranded RNA (+ssRNA) Virus, belongs to the genus Betacoronavirus. Its genome size is almost 27.9 kb [10]. The genome of SARS-CoV-2 has coding of polyproteins which are large and nonstructural, abbreviated as ORF1a/b, which are further broken down 15-16 proteins, four structural and four accessory proteins [11]. The virus needs structural proteins, the envelope (E) protein, nucleocapsid (N) protein, spike (S) surface glycoprotein, and membrane (M) protein for its assembling and infecting to the hosts. The attachment of the virus with the host's cells is by the help of spike proteins which is further breakdown into S1 and S2 proteins, known as N-terminal S1 subunit and a membrane-bound C-terminal S2 region [12].

**Evolution**

Literature review reveals marked similarity in origin of COVID-19 and SARS-CoV-2 however similar treatments were ineffective to cure COVID-19 infection [13]. Human Transmissible CoVs include epidemics like MERS, SARS-CoV-1 and pandemics like SARS-CoV-2. Bats are primary vector of transmission, majority belonging to the α-CoV and β-CoV genera.

[14,15]. Phylogenetic studies of RNA-polymerase (RdRp) gene of SARS-CoV-2 matches 98.7% with bat coronavirus strain Bt CoV/4991 and 87.9% with bat-SL-CoVZC45 and bat-SL-CoVZXC21 strains. Evolutionary studies confirm SARS-CoV-2 is a new virus [16]. SARS-CoV-2’s genomic studies suggested origin is bat or their droppings found in Wuhan seafood market [5].

**Pathogenesis**

The spike proteins of the virus attach to ACE-2 receptors in humans, following RNA-based viral genome replication with a unique sequencing for adaption in the human body CoVs genetic mutants by insertion, recombination, deletion, and exchange of
genes which is the basis for its classification. 4 genera and 38 species of CoVs are reported each having different mechanisms of pathogenesis. [14,17,18,19]. The S protein of the virus binds to the ACE-2 receptors (ACE2 acts as the receptor for the SARS-CoV-2) resulting in conformational changes in amino acids and salt bridge creation which enhances the Vander Waals interactions [20-22].

SARS-CoV-2 leads to increased expression of ACE-2 hence damaging alveolar tissues. As soon as the virus reaches the host cell, it enters into cytoplasm where it replicates by using transcriptase polyproteins and later is released.[23-25]. The symptoms include, nasal congestion, fatigue, sore throat, myalgia, shortness of breath, fever, dry cough, and conjunctival congestion. Thirty five (35%) percentile to ninety (90%) percentile of the patients suffer from taste or olfactory dysfunctions. [26-28]. [29, 30]. The rate of Infection is denoted by R0. R0 > 1 means, Rate of transmission very high i.e. an epidemic can convert into a pandemic. The R0 for SARS-CoV-2 is 3.28 comparatively greater than SARS-CoV-1 [31].

Epidemiology
The exact origin of virus is unidentified however first infected individual was traced back to seafood market of Wuhan. Initial viral transmission was from animal to human and then it proliferated by humans confirming zoonotic nature. WHO declared SARS-CoV-2 pandemic on 11th March 2020. Individuals infected by virus lied between 25 to 89 years of age while majority was 35 to 55 years old, some infants and children contracted virus too. Median age was determined as 59 years and majority were male patients (59%). [32]. [33].

Chinese Health Authorities described incubation period of CoV-2 virus is 7 days, extending from two to fourteen days. Symptoms include fever, nonproductive cough, myalgia, shortness of breath, decreased leukocyte counts. Severe cases found to experience severe acute respiratory syndrome, pneumonia, kidney failure and death [34] [35].

Demography
The onset and progression of COVID-19 can be visualized in Table-1 and 2, indicates the deaths rate has been increasing in different countries. The higher deaths have been reported in America (305,285 deaths) and Europe (206,965 deaths), followed by Eastern Mediterranean countries (34,226 deaths), South East Asia (33,543 deaths), Africa (9,546 deaths) and Western pacific (8005 deaths) by late June, 2020. [36].

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Country Name</th>
<th>Total Cases</th>
<th>Active Cases</th>
<th>Deaths</th>
<th>Recovered Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>USA</td>
<td>2,726,723</td>
<td>1,429,664</td>
<td>130,085</td>
<td>1,166,974</td>
</tr>
<tr>
<td>2</td>
<td>Brazil</td>
<td>1,408,485</td>
<td>558,789</td>
<td>59656</td>
<td>790,040</td>
</tr>
<tr>
<td>3</td>
<td>Russia</td>
<td>647,849</td>
<td>225,879</td>
<td>9,320</td>
<td>412,650</td>
</tr>
<tr>
<td>4</td>
<td>India</td>
<td>585,792</td>
<td>220,546</td>
<td>17,410</td>
<td>347,836</td>
</tr>
<tr>
<td>5</td>
<td>Spain</td>
<td>296,351</td>
<td>71,038</td>
<td>28,355</td>
<td>196,958</td>
</tr>
<tr>
<td>6</td>
<td>Peru</td>
<td>285,213</td>
<td>101,001</td>
<td>9,677</td>
<td>174,535</td>
</tr>
<tr>
<td>7</td>
<td>UK</td>
<td>282,432</td>
<td>NA</td>
<td>43,730</td>
<td>NA</td>
</tr>
<tr>
<td>8</td>
<td>Chile</td>
<td>279,393</td>
<td>32,476</td>
<td>5,688</td>
<td>241,229</td>
</tr>
<tr>
<td>9</td>
<td>Italy</td>
<td>240,578</td>
<td>15,563</td>
<td>34,767</td>
<td>190,248</td>
</tr>
<tr>
<td>10</td>
<td>Iran</td>
<td>227,662</td>
<td>28,087</td>
<td>10,817</td>
<td>188,758</td>
</tr>
<tr>
<td>11</td>
<td>Mexico</td>
<td>220,657</td>
<td>62,272</td>
<td>27,121</td>
<td>131,264</td>
</tr>
<tr>
<td>12</td>
<td>Pakistan</td>
<td>209,337</td>
<td>106,530</td>
<td>4,304</td>
<td>98,503</td>
</tr>
<tr>
<td>13</td>
<td>Turkey</td>
<td>199,906</td>
<td>21,664</td>
<td>5,131</td>
<td>173,111</td>
</tr>
<tr>
<td>14</td>
<td>Germany</td>
<td>195,832</td>
<td>7,680</td>
<td>9,052</td>
<td>179,100</td>
</tr>
<tr>
<td>15</td>
<td>Saudi Arabia</td>
<td>190,823</td>
<td>58,408</td>
<td>1,649</td>
<td>130,766</td>
</tr>
<tr>
<td>16</td>
<td>France</td>
<td>164,801</td>
<td>58,684</td>
<td>29,843</td>
<td>76,274</td>
</tr>
</tbody>
</table>
Table 2. Top 13 countries reported with highest and lowest deaths due to COVID-19 (WHO Health Emergency Dashboard (Data: July 19, 2020) [36].

<table>
<thead>
<tr>
<th>S.NO</th>
<th>Country</th>
<th>Maximum Cumulative Deaths</th>
<th>Country</th>
<th>Minimum Cumulative Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>United States of America</td>
<td>138591</td>
<td>Brunei Darussalam</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Brazil</td>
<td>78772</td>
<td>Namibia</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Mexico</td>
<td>38888</td>
<td>RA@union</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>India</td>
<td>27497</td>
<td>Saint Martin</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Iran (Islamic Republic of)</td>
<td>14188</td>
<td>Belize</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>Peru</td>
<td>12998</td>
<td>Northern Mariana Islands (Commonwealth of the)</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>Canada</td>
<td>8848</td>
<td>Turks and Caicos Islands</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>Chile</td>
<td>8503</td>
<td>Botswana</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>Colombia</td>
<td>6516</td>
<td>British Virgin Islands</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>Pakistan</td>
<td>5599</td>
<td>Burundi</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>Ecuador</td>
<td>5313</td>
<td>Cayman Islands</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>South Africa</td>
<td>5033</td>
<td>Curacao</td>
<td>1</td>
</tr>
<tr>
<td>13</td>
<td>China</td>
<td>4653</td>
<td>Montserrat</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 3. The top ten countries in this region with a maximum number of cases July 22,2020 [39].

<table>
<thead>
<tr>
<th>Region</th>
<th>Countries</th>
<th>Maximum Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asia</td>
<td>India</td>
<td>1,194,085</td>
</tr>
<tr>
<td></td>
<td>Iran</td>
<td>278,827</td>
</tr>
<tr>
<td></td>
<td>Pakistan</td>
<td>278,827</td>
</tr>
<tr>
<td></td>
<td>Saudi Arabia</td>
<td>255,825</td>
</tr>
<tr>
<td></td>
<td>Turkey</td>
<td>221,500</td>
</tr>
<tr>
<td></td>
<td>Bangladesh</td>
<td>210,510</td>
</tr>
<tr>
<td></td>
<td>Qatar</td>
<td>107,430</td>
</tr>
<tr>
<td></td>
<td>Iraq</td>
<td>97,159</td>
</tr>
<tr>
<td></td>
<td>Indonesia</td>
<td>89,869</td>
</tr>
<tr>
<td></td>
<td>China</td>
<td>83,693</td>
</tr>
<tr>
<td>Europe</td>
<td>Russia</td>
<td>783,328</td>
</tr>
<tr>
<td></td>
<td>Spain</td>
<td>783,328</td>
</tr>
<tr>
<td></td>
<td>UK</td>
<td>295,817</td>
</tr>
<tr>
<td></td>
<td>Italy</td>
<td>244,752</td>
</tr>
<tr>
<td></td>
<td>Germany</td>
<td>203,890</td>
</tr>
<tr>
<td></td>
<td>France</td>
<td>177,338</td>
</tr>
<tr>
<td></td>
<td>Sweden</td>
<td>78,166</td>
</tr>
</tbody>
</table>
Geography
The pandemic started with the Asian region, Wuhan city, China [38]. Later spread throughout the continent. Later the pandemic developed in Europe, North America, South America region, Africa, Australia Refer Table 3 to find The top ten countries region wise [39].

Diagnosis
The diagnosis of COVID-19 is based on the clinical symptoms, epidemiological history and some supporting clinical testing are like ELISA, Detection of nucleic acid, blood cultures, CT scan, Point of care testing POCT of Immunoglobulins (IgM/IgG), etc.

Technology based on detection of nucleic acid
Technologies of detection of nucleic acid are used to detect COVID-19, high-throughput sequencing (HTp-S) and are real-time quantitative polymerase chain reaction (RT-qPCR). [5]. The HTp-S technology has high cost and dependency on equipment while the, RT-qPCR offers simplicity, efficacy, and direct method for detection of the virus in blood and secretions of the respiratory tract [40]. It has high specificity and sensitivity against SARS-CoV and MERS-CoV infection [41]. Research showed RT-qPCR tests were highly reliable for COVID-19 patients [42]. The sensitivity of the RT-qPCR method is about 50%–79% which depends upon the type of sample and the number of samples which are collected [43]. The rate of detection, biological safety issues by the retained samples and delayed results are some drawbacks of this technique.

CT scan and diagnostic methods
To avoid the false detection of the virus by RT-qPCR technique, clinicians have proposed CT scans as a supplementary test. The patients are suggested to have repeated tests of RT-qPCR and CT-scan of chest. A High-resolution CT scan is necessary for earlier diagnosis of COVID-19 [44]. The CT scans has drawback of distinguishing between different
respiratory diseases like other viral pneumonia. It is necessary to develop kits that detect immunologically the presence of antibodies or antigens. [45, 46]. COVID-19 serological test can detect antibodies of SARS-CoV-2in a human body. Antibodies presence indicate that person has been infected and recovered from SARS-CoV-2infection. There are various antibodies test however FDA has not authorized and evaluated all the antibody tests available in the market [47]. To perform antibody test, in-vitro diagnostic (IVD) devices are designed to perform on samples collected from patients such as swab mucus either from inside the nose or back of the throat, or blood collected from a vein or taken from the human body by pricking finger [48]. The test kit is called the CDC 2019 Novel Coronavirus (2019-nCoV) Real-Time Reverse Transcriptase (RT)–PCR Diagnostic Panel. This was the first laboratory test kit designed in early 2020 by the CDC for the testing of SARS-CoV-2specimens. These kits were then available for consumers. Some laboratories identify an issue with one of the testing reagents while performing validation of the SARS-CoV-2test. The problematic reagent was excluded without affecting the accuracy of the test results. This technique was time-saving as it can be used without the addition of a reagent. This was authorized by the FDA and new test kits are available in the market [49].

**Clinical features**

COVID-19 patients can be classified into mild, moderate, severe and critical stage. While reported studies show 70% of patients suffer mild symptoms or remain asymptomatic and 30% may suffer severe illness [50]. Symptoms in mild stage are dry cough, mild fever, nasal congestion, sore throat, headache, muscle pain, malaise along with vomiting, diarrhea and loss of taste or smell. In moderate stage cough, dyspnea, and tachypnea. In severe stage pneumonia, acute respiratory distress syndrome (ARDS), sepsis, severe dyspnea, tachypnea (respiratory rate > 30 breath/minute), respiratory distress, SpO2 ≤ 93%, PaO2/FiO2 < 300, and/or > 50% lung infiltrates with the virus within 24 to 48 hours. Sometimes in severe cases, fever is not present [51]. In critical stage system or respiratory failure, septic shock, cardiac injury, or multiple organ dysfunction resulting in the death of patients. 5% patients face this stage [50].

<table>
<thead>
<tr>
<th>DISCUSSION</th>
</tr>
</thead>
</table>

**Proposed therapies**

In absence of treatment preventive and supportive measure are adopted to reduce complications. Along with monitoring of vital signs, bed rest and energy intake are encouraged. Antipyretic like acetaminophen and oxygen saturation, Antibiotics such as neuraminidase inhibitors, intravenous fluid resuscitation or vasopressor (norepinephrine for the regulating of persistent shock), Dobutamine (a beta-1 agonist in management of cardiac shock or severe heart failure) and systemic steroids (hydrocortisone for the reduction of COPD exacerbation) are recommended as supportive therapies [52], [53, 54], [55-57]. NSAIDS especially ibuprofen is prohibited as it could exacerbate the COVID-19 infection instead paracetamol can be used. [58]. Some Chinese medicines including Shuanghuanglian oral liquid and Lianhua Qingwen capsule are used as supportive therapy. As they can reduce inflammatory responses developed in human body as a result of viruses and bacteria. [59, 60]. Early blood purification can reduce renal workload, as ACE-2 receptors are concentrated in kidneys, this process can decrease immune damage as a result of pro-inflammatory and anti-inflammatory factors as well as it maintains electrolytes and acid-base balance [61, 62]. Vitamin C plus vitamin D and vitamin E are also recommended in some studies. These vitamins build resistance towards nCoV [63].

**Proposed drugs**

It is believed that the drugs targeting the SARS-CoV-2 main protease (Mpro), an enzyme which is important viral replication and transcription, could play a key role in COVID-19 treatment [64]. The Table 4 shows common therapies investigated for COVID-19 disease but none of these have been approved by Food and Drug Administration (FDA) so far. However, FDA recommended administering COVID-19 convalescent plasma based on the fact that it contains antibodies against SARS-CoV-2on April 8, 2020 [65].
Table 4. Proposed therapies against COVID-19 infection.

<table>
<thead>
<tr>
<th>THERAPIES</th>
<th>DRUG TYPES</th>
<th>CLINICAL TRIALS</th>
<th>DOSE</th>
<th>FINDINGS</th>
<th>REFERENCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Azithromycin</td>
<td>Antibacterial (Macrolide antibiotic)</td>
<td>8 clinical trials and 6 review articles</td>
<td>500 mg day 1 and 250 mg days 2 to 5, 500mg once daily for 5 days, 500 mg orally in one dose followed by 250 mg in one dose for a total of 5 days, 500 mg day 1-3 followed by 250mg day 4-15</td>
<td>3 of the clinical trials and 3 of the review articles favor clinical benefits of the drug</td>
<td>[66-79]</td>
</tr>
<tr>
<td>Chloroquine (CQ) and Hydroxychloroquine (HCQ)</td>
<td>Antiprotozoals</td>
<td>6 clinical trials and 22 review articles</td>
<td>600 mg/d for 10 days (HCQ), 600mg CQ twice daily for 10 days (CQ) 450mg twice daily on day 1 and once daily for 4 days (CQ), 600mg of hydroxychloroquine daily (HCQ), 800 mg orally in two doses followed by 400 mg daily in two doses for 5 days (HCQ), 1200 mg daily for three days followed by a maintenance dose of 800 mg daily for two or three weeks depending upon severity (HCQ)</td>
<td>2 of the clinical trials and 5 of the review articles favor clinical benefits of the drug while 2 of the review articles suggest further evaluation of the drugs for the final conclusion</td>
<td>[12, 52, 66-72, 74, 77-95]</td>
</tr>
<tr>
<td>Remdesivir</td>
<td>Antiviral (Nucleoside analogue)</td>
<td>2 clinical trials and 13 review articles</td>
<td>200 mg on day 1 followed by 100 mg on days 2–10 in single daily infusions for 10 days</td>
<td>1 of the clinical trials and 5 of the review articles favor clinical benefits of the drug while 8 of the review articles suggest further evaluation of the drugs for the final conclusion</td>
<td>[28, 96-109]</td>
</tr>
<tr>
<td>Drug</td>
<td>Category</td>
<td>Trials and Articles</td>
<td>Dosing Details</td>
<td>Clinical Benefits</td>
<td></td>
</tr>
<tr>
<td>----------------------</td>
<td>---------------------------------</td>
<td>---------------------</td>
<td>--------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Lopinavir/Ritonavir</td>
<td>Antiviral (Protease inhibitor)</td>
<td>4 clinical trials</td>
<td>200/50 mg P.O.; two tablets QID for 5 days, (400 mg and 100 mg, respectively) twice a day for 14 days</td>
<td>3 of the clinical trials and 3 of the review articles favor clinical benefits of the drug</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>and 5 review</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>articles</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dexamethasone</td>
<td>Corticosteroid (Immunosuppressant)</td>
<td>4 clinical trials</td>
<td>6 mg once daily (either by mouth or by intravenous injection) for 10 days</td>
<td>All of the clinical trials and review articles favor clinical benefits of the drug</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>and 2 review</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>articles</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Convalsescent Plasma</td>
<td>Immunomodulator</td>
<td>5 clinical trials</td>
<td>200 - 250 mL or based on the clinical condition of each patient</td>
<td>3 of the clinical trials and 12 of the review articles favor clinical benefits of the drug</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>and 15 review</td>
<td></td>
<td>while 1 of the clinical trials and 2 of the review articles show uncertainty or suggest further evaluation</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>articles</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Vaccine**

Among all the isolated proteins of SARS-CoV-2, the key target for COVID-19 vaccine development is the S-protein, based on the evocation of neutralizing antibodies of virus as the immune associates to vaccine defense. The COVID-19 vaccine progress is currently in three different stages. Refer Table 5 [147] [148].

Different types of vaccines are prepared on basis of S-antigen, such as viral vectored vaccines, subunit vaccines, inactivated vaccines, nucleic acid DNA or mRNA-based vaccines. The Partnership for Epidemic Alertness Innovations [149] has provided funding (Table 6). On the contrary, those companies who arenot involved in the drug development and vaccine have simultaneously appeared. It includes US-based companies such as NanoViricides, Novavax, Vir Biotechnology and Johnson & Johnson,. These companies have declared collective strategies to develop vaccine. Currently, the COVID-19 vaccine is in the Phase-1 clinical trial assessment and will register 45 healthy adult volunteers 18 to 55 years of ages for a period of approximately 6 weeks[149].

<table>
<thead>
<tr>
<th>Investigator</th>
<th>Vaccine applicant</th>
<th>Clinical Trial Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderna</td>
<td>mRNA-1273</td>
<td>Phase I</td>
</tr>
<tr>
<td>Casino Biologics</td>
<td>Ad5-nCoV</td>
<td>Phase I</td>
</tr>
<tr>
<td>Inovio</td>
<td>INO-4800 [150]</td>
<td>Phase I</td>
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<tr>
<td>Pfizer and BioNTech</td>
<td>BNT162(mRNA)</td>
<td>Pre-Clinical</td>
</tr>
<tr>
<td>Novavax</td>
<td>Recombinant nanoparticle vaccine</td>
<td>Pre-Clinical</td>
</tr>
<tr>
<td>Curevac</td>
<td>mRNA-based vaccine</td>
<td>Pre-Clinical</td>
</tr>
<tr>
<td>Generex</td>
<td>Li-key peptide vaccine</td>
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</tr>
<tr>
<td>Vaxart</td>
<td>Oral recombinant vaccine</td>
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<tr>
<td>Sanofi</td>
<td>Not revealed</td>
<td>Research</td>
</tr>
<tr>
<td>Epivax</td>
<td>Li-key peptide vaccine</td>
<td>Research</td>
</tr>
<tr>
<td>Clover and GSK</td>
<td>S-Trimer</td>
<td>Research</td>
</tr>
<tr>
<td>iBio</td>
<td>Plant based vaccine</td>
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<tr>
<td>MIGAL</td>
<td>Modified avian coronavirus vaccine</td>
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</tr>
<tr>
<td>AJVaccine</td>
<td>Not revealed</td>
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<tr>
<td>Codagenix</td>
<td>Live attenuated vaccine</td>
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Table 6. Techniques funded by CEPI (From: https://cepi.net/covid-19/).

<table>
<thead>
<tr>
<th>S.no.</th>
<th>Research organization</th>
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<tbody>
<tr>
<td>1</td>
<td>Curevac Inc</td>
<td>mRNA</td>
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<td>2</td>
<td>Inovio Pharmaceuticals Inc.</td>
<td>DNA</td>
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<td>3</td>
<td>Moderna, Inc</td>
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<td>4</td>
<td>University of Queensland</td>
<td>Molecular calm</td>
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<td>5</td>
<td>Novavax</td>
<td>Nanoparticles</td>
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<td>6</td>
<td>University of Oxford</td>
<td>Adenovirus vector</td>
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<tr>
<td>7</td>
<td>University of Hong Kong</td>
<td>live-attenuated influenza virus</td>
</tr>
<tr>
<td>8</td>
<td>Institute of Pasteur</td>
<td>measles vector</td>
</tr>
</tbody>
</table>

Vaccine
Collaborative efforts of the public and government are required for the management and prevention of COVID-19 that is vital to control the spread of diseases. [151].

Outside hospital
Washing hands with soap, using sanitizer, wearing a mask especially if already coughing and sneezing. Taking precautions in house by using appropriate disinfectant. Avoiding public gatherings and transport.

Reducing interactions with those who are showing symptoms. Closure of offices and educational institutes for some time to flatten the curve. Drink lukewarm water approximately 5 litres/day. Installation of sanitizers in public places[151].

Inside hospital
Overall safety
It is recommended for hospital emergency patients, physicians, and nursing staff. It is advisable to wear a
disposable/surgical face masks, protective clothing, and gloves [152].

**Level 1 safety**
It is applied for outpatient clinics, patients with fever, frontline healthcare workers, and staff in COVID wards. A disposable cap, medical mask (N95 mask is mandatory), and isolation clothing, latex gloves, as well as strict hand hygiene routine [152].

**Level 2 safety**
is applied to doctors and nurses working in close contact with confirmed COVID-19 patients and Level 3 safety is applied to aerosol operators for suspected or confirmed patients. Complete protective clothing including cap, goggles, face mask, disposable gloves, shoe covers, and strict adherence to hand sanitization [152].

**Global impact**
The impact of COVID-19 chaos on the world economy are summarize primarily focusing some main industries. It includes industries working in the mining of raw materials, production of finished products, education sector and health care industry. Some are discussed below [153].

**Impact on Agriculture**
The global demand for agricultural products from restaurants and hotels has dropped by around 20% [154]. Perishable goods like meat and vegetables are facing less demands as gatherings, travelling and transportation has been banned. Floor trading has stopped for companies like Chicago Mercantile Exchange [155].

**Impact on Petroleum & oil**
Organization of the Petroleum Exporting Countries (OPEC) held meeting in Vienna in March 2020, later that Saudi Arabia reduced oil prices (Reuters, 2020). Hence Saudi oil production rises by 25% as compared to February 2020. A day sharpest price crash was observed in almost 30 years. On March 23rd, 2020 Brent Crude fell by 24% from 3$ per barrel to stand at 25.70$ per barrel [156].

**Impact on the Manufacturing industry**
British Plastics Federation survey [157] revealed impact of COVID-19 on manufacturing businesses in UK, 98% observed negative impact whereas 80% predicted decline in turnover for next two quarters [157]. Distancing guidelines has been big concern for businesses as it impacts supply chain, import activities and staffing capability. Work from home option is inadequate for manufacturing industries. Chemical Industry projected 1.2% reduction in the global production which is lower than the 2008 financial crash (Industry week, 2020).

**Impact on Education**
COVID-19 pandemic has impacted schools and universities, leading to completely shut down in some countries like Germany and Italy.[158] United Kingdom has decided, targeted closure for those who have exposure to any major industry [159]. Moreover, greater than 100 countries closed educational institutes. UNESCO evaluated that 900 million students have been affected [160]. The closures will have extensive socioeconomic consequences (Ali and Alharbi, 2020).

**Impact on Healthcare and the Pharmaceutical Industry**
Global health care system witnessed two faced challenge, one maintaining health of patients and doing so protecting healthcare workers too as they are at great risk. Working remotely or implementation of viral testing all carry risk factor [161]. The Pandemic collapsed the health care system as the demand for personal protective equipment’s, masks, ventilators and beds skyrocketed, specifically to mention inflated costs. This has led uninsured individuals and frontline workers in USA mentally disturbed [162]. Nicola et al. has emphasized need of change in healthcare dynamics, by faster digitalization and big investment into infectious disease preventive organizations [153]. US import API from EU (26%), India (18%) and China (13%), along with medical equipment from China (39.3%), this trade has suffered decline [163].

**CONCLUSION**
The novel coronavirus 2019 or SARS-CoV-2 was first appeared on the December 2019 in the Wuhan, China. The virus subsequently effected almost every part of the world. Regrettably, no effective and safe treatment has been found against this deadly virus so far. However, several precautionary measures like wearing masks, making social distance, washing hands properly and many more have been exclusively suggested by the organizations including CDC, UNO and FDA for the better prevention of COVID-19 infection. Finally, vaccine is the only cure as suggested by several scientists and clinicians.
Fortunately, several companies have been developing vaccine against the virus and some have started clinical trials also.

**Ethical standards**

No human was involved in the current study. The already published data were reviewed and studied only.

**Funding**

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

**Conflict of interest**

There is no conflict of interest.

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