International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 06 | June - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

A Detailed Review on the SARS-CoV-2 (COVID-19).

Shanu Magotra and Ayush Rajput

ABSTRACT:

A new pathogenic and transmittable virus was discovered late in December, 2019 in the Wuhan City, Hubei Province, China and named as SARS-CoV-2 (COVID-19).With its high transmission rate virus spreads all over the world and caused "pandemic" situation. Research finding concluded that SARS-CoV-2 originated from bats than to human with unknown intermediate source. After analyzing patients it was observe the symptoms of infection are fever, cough, sore throat, breathlessness and it may progress to pneumonia, ARDS and multi-organ dysfunction. Pathogenesis of COVID-19 shows that it recognizes ACE2 receptors present in lungs, heart, kidney, liver etc. in humans. Diagnosis of infection can be done by RT-PCR, CT scan findings and other methods too. Scientists all over the globe are racing to find COVID-19 vaccine and its potential treatment. In this review we try to cover all aspects of COVID-19 and provide all its necessary details.

COVID 19: Introduction

SARS-CoV-2 famously known as corona virus has bought human life to a standstill .This virus was reported to originate from Wuhan City ,China, in late December, 2019.It belongs to the order Nidovirales in Coronaviridae family [1]. Coronaviruses (CoVs) have been accounted for with extensive illness episodes in the previous decades, significantly influencing Asian nations. The severe acute respiratory syndrome (SARS) and the Middle East respiratory syndromes (MERS) emerge in 2002-2003 and 2011-2012, respectively [2]. On 31stDecember 2019,27 cases were reported with pneumonia in Wuhan city China [3]. Dry cough, dyspnea, fever and shortness off breath with other mild symptoms were observed initially along with multiple comorbidities including respiratory, endocrine, digestive disease with cardiovascular, cerebrovascular diseases also[4]. Chinese Centre for Disease Control and Prevention, first recognized the contributory agent using swab samples from patients and most of them had visited the Huanan South China Seafood Market in Wuhan, China [5].

In January, 2020 WHO (world health organization) mentioned this diseases as "Novel corona virus" (2019-nCoV). The COVID-19 outbreak was not only limited to China but spread to other countries of the world also [6]. WHO, on 31stof January, 2020 declared it as "global health emergency and PHEIC (public health emergency of international concern) announced it as "pandemic"[7].

On February 11,2020 WHO officially called this novel disease as COVID-19[8] and International Committee on Taxonomy of Viruses (ICTV) with the corona virus group study (CSG) called this disease as " Severe Acute Respiratory Syndrome Corona Virus 2" (SARS-Cov2) since its homology and sequence similarity with SARS-CoV and MERS-CoV[9].

Global outbreak of SARS-CoV-2 not only threatened the human life but according to study of World Organization For Animal Health certain pets which are having close contact with positive patient have also been tested positive for COVID 19.The Egyptian fruit bats also tested positive for SARS-CoV2 but did not show any clinical symptoms[10]. As per the information Wuhan city, China acted as the epicenter of disease and was spread to more than 210 countries with 20,745,29 confirmed cases and 139,378 confirmed deaths worldwide as on 17th of April ,2020[11]. In order to control the increasing number of affected people has solution social distancing has been recommended and there is a complete lockdown all over the world severely affecting the world economy. The scientific community is continuously working for the production of antiviral drugs and vaccines for COVID19. In this review article we are trying to bring all the information available related to this virus in one single document which can further add to the knowledge bases and help scientists to work more effectively in this direction.

Origin, Spread and Transmission of COVID 19

27 patients with pneumonia like symptoms were hospitalized in China and were found to be suffering from a new type of respiratory disease ,which is know as Severe Acute respiratory syndrome-CoV-2 (SARS-CoV-2) [12]. Majorly this disease spreads from infected patient to others by large droplets during sneezing and coughing. Other ways of viral transmission majorly include direct contact, by direct contact with contaminated surfaces or by shaking contaminated hands [13]. This viral strain can survive on a surface for several week [14]. In comparison to SARS-CoV-2, other viral

diseases including Avian H7N9, SARS-CoV, Ebola virus and MERS-CoV were with less pathogenesity ,transmission and reproduction rate (Ro) was also low. According to one report by WHO reproduction rate of SARS-Cov-2 is 1.4 to 2.5 [15] and studies suggest that Ro for SARS-coV-2 lies between 2.2-3.58 [16]. The higher Ro esteem shows more noteworthy transmission of infection among the population subsequently more prominent dangers. According to a report epidemic's doubling time is 1.8 days but the latency period of the SARS-CoV-2 with SARS-CoV was concluded to be3-7 days on an average [17].According to China and WHO's collaborative report, the transmission of COVID-19 from Wuhan to different spots in China was significantly through individuals and also the infection was communicated into the whole world [18].The spread of this disease in India ,has also been mainly through the infected travelers from other parts of the world which resulted in large outbreak of this disease and cases immediately rose from hundreds to thousands. As per the information, there are 24,71,136 confirmed case and 1,69,006 deaths with COVID -19 on 22nd April,2020. According to WHO and other reports it has been found that animals may also suffer from COVID-19 if they are in contact with the infected patients . In New York two cats were tested positive with weak COVID-19 infection and four in New York's Bronx zoo four Tigers and 3 Lions also been tested positive[19].

Epidemiology:

Beginning of 22 January, 2020, with a complete number of 571 instances of the2019-new (COVID-19) were accounted for in China. The China National Health Commission reported that 17 deaths were recorded up to January 22,2020 [20] According to next report On January 24, 2020, 1975 new cases are there infected with COVID-19, China itself with 56 deaths [21]. Another report on January25, 2020 in China gives the figure of about 5502 cases. January 30, 2020 cases reach up to 7734 in China [22]. In next month of February 22, 2020, count increases to 77,794 cases(with 2,359 and 357 deaths) have been reported from 29 countries worldwide [23]. According to the statistic The affected Countries with COVID-19 include Republic of Korea (346), Japan (105), Singapore (86) Sri Lanka(1), United States of America (35), Thailand (35), Malaysia (22), Australia (21), Iran (18), Viet Nam (16),Germany (16), France (12), United Arab Emirates (11), Italy (9), Canada (8), The United Kingdom (9), Philippines (3), India (3), Russian Federation (2), Spain (2), Cambodia (1), Nepal (1), Finland (1), Belgium (1), Israel (1), Lebanon (1) Sweden (1), Egypt (1) [23]. Recent increment in number of COVID19 patients might be because of festivity of the Spring Festival in China, an acclaimed customary celebration , from that point pretty much 3 billion individuals travel countrywide.

On 27thmarch,2020 WHO release a new report regarding the cases of SARS-Cov-2 that is 6,34813people were confirmed and tested positive with around 29,891 deaths world wild [23]. According to updated report by WHO on 19th april,2020 total number of cases are 22,413,59 which tested positive and are confirmed and total no. of confirmed deaths are 15,255,1 worldwide and around 6,045,96 people were recovered [23]. If we talk individually about India last updated record on 19th April total coronavirus confirmed cases are 16,365 with 521 deaths and around 2,466 recoveries.

To get COVID-19 circumstances leveled out, utmost prevention measures , awareness and control estimation are required, Also insuring early detection, proper diagnosis, effective treatments, successful medicines, quarantine and isolate to forestall man-to-man transmission just as adapting to optional diseases.

THE VIRUS

SARS-CoV-2 principally belongs to family *Coronaviridae,* sub-family *Orthocoronavirinae* along with order *Nidovirales* [24]. The subfamily is further divided into four genera which are *Alphacoronavirus*, *Betacoronavirus*, *Gammacoronavirus*, and *Deltacoronavirus* (α, β, γ, δ). Until 2020, six coronaviruses were known which have potential to cause infection in humans including, NL63, 229E, HKU1, OC43, SARS-CoV, and MERS-CoV and now SARS-CoV-2 seventh coronavirus [25].The strain that infects humans, also known as Human Coronavirus (HCoVs). *Alphacoronavirus* genera includesHCoV-229E and NL63 and MERS-CoV, HCoV-OC43, SARS-CoV and HCoV-HKU1 falls in *Betacoronavirus* genera. Amongst them 229E, HKU1,NL63, OC43, cause mild respiratory diseases in humans while MERS-CoV, SARS-CoV cause severe and lethal respiratory track disorders [26].Genera *Alphacoronavirus* and *Betacoronavirus* has been found to be originated from bats, while researches concludes the *Gammacoronavirus* evolved from the birds where as *Deltacoronavirus* have evolved from swine gene pools [27].

SARS-CoV-2 is a new type of Betacoronavirus which relatively large viruses having a diameter varying from60 to 140 nm. It is a single-stranded positive-sense RNA virus of 30kb that lacks segments rapped within a membrane envelope [28]. According to the reports the Novel CoV (nCoV) is 29.89 kb in size with 38% of G+C content [29]. When the virus

is observed under electron microscope, a spherical structure with unique symmetry of spikes around the membrane 9-12nm long gives the virus a crown like appearance. The sequence homology between SARS-CoV and SARS-CoV-2 is about 79.5% and with MERS-CoV it is 55% indicating the evolutionary relatedness to SARS-CoV-2.CoVs (MERS-related-CoV and SARS-related-CoV) have been reported to originate from bats but for MERS and SARS, camels and civet cat act as intermediate hosts, respectively. It has also been reported that there is 96.2% similarity between SARS-CoV-2 and bat CoV RaTG13 [30].

Genome analysis of SARS-CoV-2 with its structure:

The genome is linearly arranged, having 3a/b, 4a/b as accessory genes but lacks HE gene (hemagglutinin- Esterase) which usually found with in structural genes [31]. These HE-genes can be seen in other *Betacoronavirus* as well .The positive sense strand gets translated into polyproteins due to absence of structural genes, the non structural genes helps in the formation of replication transcription complex (RTC). Thus with the help of RTC complex and discontinuous transcription, sub genomic RNAs are synthesized. Viral polymerase (RdRp) encodes two-third of viral RNA. CoV is having variable numbers of open reading frames around (6-10). Two- third of viral RNA is encoded by the open reading frame mainly, ORF1a/b , majority of ORF1a/b are occupied their place on the 5' end of the RNA. These ORFs get translated into polyproteins pp1ab and pp1a which further encodes 16 non structural genes and proceeds further for the formation of replication-transcription complex [32]. Viral structure comprise of different structural proteins that are four in number namely Spike (S), Membrane (M), Envelope (E), and Nucleocapsid (N) and also include other accessory proteins [33].

Spike protein(glycoprotein) : It is basically a large multifunctional protein with 1160-1400 amino acids residues [34]. It gives the virus a crown like appearance and also help to invade in host cell. The ectodomain part of this protein is divides in two domains S1 and S2 where S1 helps in host receptor binding and S2 helps in fusion. The (S1) is further categorized in two sub domains, namely the C- terminal domain (CTD) and N- terminal domain (NTD).These are actually receptor-binding domains thus interacts proficiently with a variety of host receptors.

On the S1 CTD terminal site, receptor binding motifs (RBM) is present where enzyme Angiotensin converting enzyme-2 (ACE2) binds to these receptors present on the membrane basically on surface of the host cell, thus entering the cell and cycle of replication start onwards [35].

M protein : Most abundant protein in virus particles which help in providing structural support to envelope for definite shape of virus .Overall the virus structure is maintained by M-M interaction[36].

E protein : It is smallest protein of virus which is integral part of the membrane made up of polypeptide. This protein plays role in pathogenesis and absence of this protein may reverse its virulence [37].

N protein : It basically helps in complex formation, also regulates the function of M protein, helps in RNA interaction and cell signaling. .One of the main function is to opposes the host cell response to viral genome [38].

Non structural proteins and Accessory proteins: Majorly present for providing structural support. Around 15 NSPs are there nsp12-16 and nsp1-nsp10 , 8 accessory proteins 7a,7b,3a, orf14,8b , p6 and 3b. SARS-CoV-2 specifically lacks 8a protein with shorter 3b and longer 8b.

How SARS-CoV-2 replicates inside Human:

The replication of SARS-CoV-2 shows resemblance with MERS-CoV and SARS-CoV replication inside human body [39].The process of infection takes place when the viral cell comes into contact with the host cells .The spike proteins which act as medium that binds with host cell . The membrane of the cell posses certain receptors Angiotensin converting enzyme-2 (ACE2) which acts as a binding site for virus [40].When Virus binds to these receptors it causes changes in the membrane functionality and allows viral genome to enter in the host cell. ACE2 is largely expressed as in lungs, nasal mucosa heart, stomach, bladder , kidney, bronchus, esophagus, ileum, and all these human organs are all susceptible to SARS-CoV-2.The virus enters in the cell and express all the genes and encodes all the accessory proteins need by virus, thereby making the environment favorable for its own survival inside the host cells [41]. For MERS-CoV and SARS-CoV they also attaches host cellular receptors, angiotensin-convertingenzyme 2 is activated (SARS-CoV associated) and cellular receptor of dipeptidylpeptidase 4 (MERS-CoV associated) [42].

Viral genome (RNA) reaches the cytoplasm here genomic RNA is polyadenylated and encapsulated , which encodes various non-structural polypeptide or proteins and structural proteins which thus helps in formation of receptor binding motifs (RBM) that is polyproteins are split by proteases that exhibit chymotrypsin [43].

Basically polyproteins takes up the host translational machinery for proteins thus this regulate the viral protease to suppress the antiviral response from host cell and further leads to replication and transcription (Discontinuous) simultaneously. During replication, full-length (-) RNA copies are produced and simultaneously full-length (+) RNA genomes as a template all Viral nucleocapsids got united and from genomic RNA like a recombinant cell and R protein in the cytoplasm [44]. The virus replicates in the lumen of endoplasmic reticulum, forms multiple copies of viral cells in the host cell and thereby bursting the host cell or by exocytosis gets out from the cell. Actually according to recent studies Angiotensin-converting enzyme 2 is present on the membrane of type 1and 2 alveolar epithelial cells also in the cells of liver , heart etc. Among them, 83% of the sort II alveolar cells have ACE2 expression thus virus directly damages the alveolar cell [45]. According to literature women have lower ACE2 level in their alveolar cells as compared to men which have higher. Additionally the white and African populaces have a lower level of ACE2 articulation in their alveolar cells than contrasting with Asians, thus making Asians more prone to this COVID-19 infection [46].

Reproduction rate of SARS-Cov-2

Reproduction rate basically represents the ability of a virus to get transmitted of a virus, also be define as the average viral infection population generated by an infectious person to the naïve population. Studies suggest that if reproduction rate is greater than 1 it surely is transferrable to others and if it is less than 1 then it will not be transfer. According to the reports, 12 different studies were conducted to determine the reproduction rate of SARS-CoV-2. This examination utilize stochastic techniques to assess Ro and report a scope of 2.2-2.68 with a normal value 2.44. Another six investigations utilized numerical techniques to assess Ro created a range from 1.5 to 6.49, with a normal value 4.2. Based upon the studies the average R0 is 3.28and median is 2.79 but according to WHO, SARS-Cov-2 reproduction rate is 1.4 to 2.5 [11]. According to another study of infection, man-to-man transmission, with a preliminary Ro estimate of 1.4 to 2.5 but a recent study has shown it to be 2.24 to 3.58 [47].

PATHOGENESIS OF COVID-19

Due to lack of proper knowledge about the virus pathogenesis the mode of infection is considered to be similar to *Betacoronavirus* due to its genomic similarity with MERS-CoV and SARS-CoV. The primary symptoms of COVID-19 include are fever, coughing, respiration issues etc.

VIRAL ENTRY AND SPREAD:

The virus is majorly transmitted from the large droplets by sneezing, coughing through direct contact and through eyes. The virus is mainly recognized by ACE2 binding sites present in is broadly expressed in lungs, nasal mucosa, heart ,kidney bronchus ,esophagus, stomach [48]. Virus primary replicates in mucosal epithelium of upper respiratory tract (nasal cavity and pharynx), with rest multiplication occurs in lower respiratory tract and gastrointestinal mucosa [49]. The patients may suffer primary symptoms in kidney, liver, stomach and may involve multiple organ problems etc. but major symptoms and effects of virus can be seen in respiratory system. The virus specifically attacks the lungs both alveolar type 1and 2 cells and also replicates inside host cell and produces progenies [50].

ANTIGEN PRESENTATION OF COVID-19:

Ones the virus enters in the body it exposes its antigen presenting sites (APS) to the immune system were it interacts to the major histocompatibility complex (MHC) further activating the T-lymphocytes that are recognized by virus-specific cytotoxic T lymphocytes (CTLs). MHC I molecules and MHC II molecule both contribute in the antigen presentation of COVID-19 but major role is played by MHC I molecule [51].

HUMORAL AND CELLULAR IMMUNITY:

Antigen presentation directly hits the cellular and humoral immunity where mainly B and T lymphocytes get activated to fight back against the virus. The lymphocytes further lead to

production of antibodies primarily IgM and IgG. The action of IgM lasts for some weeks against antigen whereas IgG acts for a much longer duration .This basically further activates more antibodies and it covers all the humoral responses by the body.

In case of cellular immunity it was reported that CD4+ T shows less frequent responses. Whereas CD8+ T cell responses are in greater magnitude and are more frequent. As per the latest report shows in the peripheral blood of SARS-CoV-2-infected patient the number of CD8+ T and CD4+ cells significantly get reduced [52].

ACUTE RESPIRATORY DISEASE SYNDROME (ARDS):

It is a condition in which lungs are not able to get enough oxygen for respiration and circulation which is basically a life threatening condition. In fatal cases severe respiratory distress occurs and require mechanical ventilation is seen in human beings [53]. Cytokines were firmly identified with the event of ARDS. Expanded degrees of plasma IL-8 and IL-6 were additionally exhibited to be identified with unfavorable results of ARDS. ARDS is the main cause of death in COVID-19patients. ARDS is the ordinary immunopathological result for MERS-CoV, SARS-CoV ,SARS-CoV-2 infections [54].

CYTOKINE STORM:

ARDS majorly cause cytokine storm. ARDS triggers systemic inflammatory response which is uncontrolled and deadly in nature which causes the arrival of large amounts of pro-inflammatory cytokines (IL-1β, IL-18, IFN-γ, IL-6, IL-33,IFN-α, IL-12 also TGF-β ,TNF-αm etc.) and chemokines (CXCL10, CCL3, CXCL9, CXCL8, CCL2, CCL5, etc.) [55]. The cytokine storm attack the immune system in a very violent way in the body resulting in ARDS, multiple organ failure, immune dysfunction and finally lead to death [56].

DAIGNOSIS

When primary cases of pneumonia with unknown cause were admitted to the hospitals their swab samples were taken by CCDC to identify the causative agents. The primary symptoms were cough, fever and respiratory issues. For proper diagnoses of the disease different tpes of testing kits,techniques and practices were adopted.

Nucleic acid detection techniques falls under most significant technique for diagnosis of SARS-COV-2 which includes reverse transcription-polymerase chain reaction (RT-PCR) [57]. For determining of COVID-19 nucleic acid samples are taken from throat swab, sputum, lower respiratory secretion, sputum along with blood. N-gene-specific quantitative RT-PCR helps in estimation of viral load [58]. According to finding virus on 5^{th} or 6^{th} day in the body had reached the peak, following with the beginning of symptoms and found out 104 to 107 copies/mL of infection during this restricted time. In one of the examination it was discovered that that the viral load concentration is more in nasal region than in throat region [59].

From reports it was seen that during the initial screening, negative results obtain from RT-PCR at the same time chest CT findings suggest positive [60]. Henceforth, for the precise analysis of COVID-19, a blend of rehashed test CT filtering and PR-PCR is needed to get exact data.It was found out that the sensitivity of CT scan is more superior than RT-PCR. Other preferable techniques used to diagnose COVID19 are high-throughput sequencing and real-time quantitative polymerase chain reaction (RT-qPCR).High-throughput sequencing technology require great equipment utilization , high cost and dependency on equipments for clinical diagnosis thus its application is limited [61] whereas RT-qPCR is straight method ,common and effective method for detecting the viral load from blood and respiratory secretions. RT-qPCR has some drawbacks, including certain biological safety hazards, low sensitivity and also take a bit long time for results.

Other diagnosis methods include Xrays and Chest CT for identifying COVID-19 or pneuminia. Superiority and affectability of the chest CT is far more compare to the x-ray.

Sometimes result obtained from RT-qPCR can be wrong and efficiently corrected with CT findings. Chest CT findings comprise posterior part or lower lobe, predilection multifocal bilateral GGOs with patchy consolidations, prominent peripherally sub pleural distribution [62]. Findings concluded that CT findings are more prominent in diagnosis SARS-CoV-2 compared to other techniques yet, CT scans also have some drawbacks, sometimes it is difficult to differentiate which type of viral pneumonia is their , negative predictive value in early symptoms onset and the abnormal CT imaging. According to one CT scan findings of 1014 patients, it is found out 59% (601/1014) of individual tested positive when RT-PCR results came, whereas with chest CT scan findings 88% (888/1014) of individual tested positive. According to results sensitivity of chest CT of is more compare to RT-PCR results that is 97% (95%CI, 95-98%, 580/601 patients) this directly shows that CT scan findings give more of the prominent results [63].

SYMPTOMS AND SUFFERING

Based upon the research carried out this disease almost affects ever individual including every age group. After analyzing reports on children, adults ,teens ,old and pregnant women there is almost cascade mechanism of symptoms and sufferings [64]. On the vary initial days patients usually suffer from high chills, headaches and coughing, which is further followed by sputum production fatigue and in some cases it strikes minor respiratory infection. When this viral infection further grows up it leads to more coughing, dysponea and fatigue. Other symptoms of an upper respiratory tract infection were also
observed, some had myalgia, a sore throat, indicated malaise and some shows gastrointestinal symptoms at the same time antiviral drugs and medication to the patient is going on but these primary majors on the virus if not successful the patient bear further pains. Leucocytes count will go lower , as this virus directly hits the alveolar cells in the lungs both type 1 and 2 respiratory issues further will be increased that is shortness of breath occurs and ultimately patient needs external primary oxygen supports [65].

If condition is still not in recovering the patient needs the mechanical ventilation support other wise patient will unable to breath. Some patient also suffers from claustrophobia so they refuse ventilation support so they received(HFNC) which is high-flow nasal cannula an oxygen therapy [66]. At this time viral cells may reach other organs like heart, kidney, liver, spleen etc. and may cause multiple organ failure also. If still patient is not recovering and still the oxygen saturation level above 90% patient will able to survive but it not get stabilize and oxygen level reach below 60%.In this condition patient got uncertain cardiac arrest and He was promptly given chest compression, adrenaline injection and invasive ventilation but due to high damage to the body patient will die on the same day.

Biopsy samples of patient from heart tissue, lung and liver gone for Histological examination and it indicated cell fibromyxoid exudates with bilateral diffuse alveolar harm .The right lung demonstrated extraordinary harm clear desquamation of pneumocytes and development of hyaline film , connoting ARDS which is acute respiratory distress syndrome [66]. Careful examination lung tissue displayed formation of hyaline membrane , pulmonary oedema indicating of early-phase ARDS.Both lungs shows Interstitial mononuclear inflammatory infiltrates, dominated by lymphocytes. Amphophilic granular cytoplasm with multinucleated syncytial cells with atypical enlarged pneumocytes characterized by large nuclei.In the intraalveolar spaces prominent nucleoli were identified [67]. Not apparently any intracytoplasmic or intranuclear viral inclusions were seen or identified. The patient which falls below the age group of 12-15 and above 55-60 are the most sensitive to the COVID-19 and those who is suffering from already with any kind of disease like chronic hypertension ,diabetes , cardiovascular disease , asthma etc. deals with the disease more painfully.

TREATMENT:

After the outbreak of COVID-19, worldwide scientists are working 24/7 to find the cure of this disease. Attempts have been made to develop vaccines and antiviral drug for coronavirus (SARS-CoV and MERs-CoV) and still much success is not gained . SARS-Cov-2 possessing new traits with high reproduction rate and mutation efficiency compared to other coronavirus there is urgent need of cure because death count increasing day by day.

The essential helpful medications that have potential in overseeing or treating COVID-19 incorporate remdesivir indicated extraordinary outcomes, lopinavir/ritonavir taken alone or by 23 mix with interferon-β, mAbs andconvalescent plasma , before using these medications legitimately for COVID-19 patients, adequacy and security of the medication ought to be led by further clinical preliminaries so no significant mischief happens to patients [68]. Although a controlled preliminary has been directed on ritonavir-helped interferon-alpha 2b and lopinavir treatment and effectively has been enlisted for hospitalized use and treatment of COVID-19 patients.

Four patients tainted with COVID-19 went for clinical investigations where they given with mix treatment utilizing arbidol , ritonavi/ lopinavir, and ShufengJiedu Capsule (Traditional Chinese medication) and discovered to be successful treatment for COVID-19 [58].

One research suggested that Chinese traditional medicine such as ShuFengJieDu Capsules and Lianhuaqingwen, remdesivir, neuraminidase inhibitors, RNA synthesis inhibitors (like 3TC), anti-inflammatory drugs abidol , peptide (EK1) , could work with great efficacy and are promising drug for treating COVID-19 but needs to undergo various

studies and clinical trails. The existing drugs which has potential effect on COVID-19 are baricitinib , Lopinavir , ritonavir , darunavir , favipiravir , remdesivir, ribavirin, galidesivir, BCX-4430 , arbidol, chloroquine, nitaxoxanide [69].

In China oral organization of asoseltamivir which is neuraminidase inhibitors has been extensively utilized . It is a test drug for COVID-19 utilized by a few emergency clinics of China despite the fact that there is no check about its viability. Medications, for example, chloroquine , ribavirin, nafamostat , nitazoxanide, , and penciclovir were contrasted and two expansive range antiviral medications favipiravir and remdesivir against the treatment of SARS-CoV-2 (2019-nCoV), FAD had directed in vitro preliminaries on them and affirmed them and choloquine recommended to be best worked.
Chloroquine is an anti-malarial and anti viral drug thus holds antiviral activity. This medication block infection cell fusion by expanding the endosomal pH imperative for combination ,consequently quells infection cell combination. Too known actuality that COVID-19 receptors are ACE2 so Chloroquine meddles with the infection receptor official by meddling with the terminal glycosylation of COVID-19 cell receptors andangiotensin-converting enzyme 2.
In China multicenter trails were conducted on drugs and found out chloroquine phosphate is best therapeutic management of SARS-CoV-2 (2019nCoV) drug exhibit both efficacy and safety [70]. As this drug is highly effective and the production of chloroquine is large in India thus it is transported worldwide from India only.
In one studies it is found out that monoclonal antibodies have potential to treat COVID-19. Human specific monoclonal antibody named CR3033 bind to the SARS0-CoV-2 RBD abd obstruct its path thus able to fight SARS-CoV-2. Monoclonal antibodies either alone given to patients or with combination of neutralizing antibodies makes it more effective treatment and prevention of COVID-19. One of the best approach to treat COVID-19 is passive immunotherapy using convalescent plasma came out to be one of the best solution. Convalescent plasma or application of immunoglobulins have been utilized seriously to improve the endurance pace of patients and restoring condition of patient with SARS whose condition continued to deteriorate despite using pulsed methyl prednisolone and other treatments also. This above study concluded out when 10 severe patients of SARS-CoV-2 were cured by convalescent therapy (CP) [71]. Other treatment using convalescent plasma comes out best treatment, where 200mL of convalescent plasma (CP) resultant from recently recovered patients from COVID-19 .These patients actually develop antibodies against COVID-19 and thus these people serve as donors. With the blend of convalescent plasma, neutralizing antibody titers above 1:640 was transfused to the COVID-19 patients as an expansion to maximal supportive care also giving antiviral agents. These therapies show best result in treatment of COVID-19. Post treatment reports recommend side effects were essentially improved alongside increment of oxyhemoglobin saturation. A considerable amount of boundaries would in general improve when contrasted with pretransfusion by CP, including expanding lymphocyte counts and decreased C-reactive protein. When seven patients were analyzed who has previous viremia , viral load in them was untraceable. [72]. This study revealed CP therapy was well tolerated without having any severe side effects to the patients and could potentially a treatment for COVID-19,Thus this therapy may be the possible cure of COVID-19.

CONCLUSION:

After research, findings and analyzing microorganisms some are great threat to living population especially humans, lead to severe public health crises and hits economy. Global outbreak of coronavirus (SARS and MERs) in past decades challenges many lives and also economy. The year 2019 known for outbreak of SARS-Cov-2 (Novel corona virus) from china cause's standstill to human life and eventually locking down all over the world. While corona virus is spreading, research and findings on this virus is gearing up simultaneously. All over the world doctors, nurses, scientists and all other warriors putting their enormous effort to fight back against this virus. Proceeding research helps us to find out viral characterization, virology, pathogenesis and finding a cure to kill the virus from the core. Knowing about virus mechanism (virology), replication put our steps ahead for making vaccine for the virus. Many vaccines, drugs and therapies which were known have been used to treat corona virus patients. All over the biotechnologist (scientists) are working 24/7 to find a cure. Therapies like plasma therapy had shown great results in treatment of patients. Scientists are also working with immunoglobulins, combination of drugs and are full focused to develop vaccine. Genomic approach is also been followed and techniques involving CRISPR may be the future for development of vaccine. According to scientist by the end of 2020 or in the initial months of 2021 they are ready with SARS-CoV-2 vaccine. Thus in this pandemic situation various control and preventive measures should be followed and key solutions today for us is following social distancing, wearing masks and regular hands washing with soap or by using sanitizers.

Reference

[1] M. S. Shahab, S. S. Imam, and M. A. Jahangir, "A review on the contemporary status of mutating coronavirus and comparative literature study of current COVID-19 vaccines," *Int J Pharm Pharmacol 2021; 5: 153. doi: 10.31531/2581*, vol. 3080, no. 2, 2021.

[2] P. Dawson, M. R. Malik, F. Parvez, and S. S. Morse, "What have we learned about Middle East respiratory syndrome coronavirus emergence in humans? A systematic literature review," *Vector-Borne and Zoonotic Diseases*, vol. 19, no. 3, pp. 174–192, 2019.

[3] L. Chen *et al.*, "RNA based mNGS approach identifies a novel human coronavirus from two individual pneumonia cases in 2019 Wuhan outbreak," *Emerg Microbes Infect*, vol. 9, no. 1, pp. 313–319, 2020.

[4] J. A. Malik *et al.*, "The impact of COVID-19 on comorbidities: a review of recent updates for combating it," *Saudi J Biol Sci*, vol. 29, no. 5, pp. 3586–3599, 2022.

[5] W. J. Liu *et al.*, "Surveillance of SARS-CoV-2 at the Huanan seafood market," *Nature*, vol. 631, no. 8020, pp. 402–408, 2024.

[6] P. S. Nannaware and S. D. Mankar, "REVIEW ON RECENT EMERGENCE OF NOVEL CORONA VIRUS," *World J Pharm Res*, vol. 9, no. 6, pp. 1–26, 2020.

[7] S. Rattan, A. Gupta, and G. A. Sharma, "COVID-19 Pandemic preparedness and response by India: did lockdown serve its purpose? a commentary," *J Public Health Policy Plann April 2020; 4 (4): 66-69. 67 J Public Health Policy Plann 2020 Volume 4 Issue*, vol. 4, 2020.

[8] P. Yang and X. Wang, "COVID-19: a new challenge for human beings," *Cell Mol Immunol*, vol. 17, no. 5, pp. 555–557, 2020.

[9] W. S. Al-Qahtani, L. M. Alneghery, A. Q. S. Alqahtani, M. D. ALKahtani, and S. Alkahtani, "A review of comparison study between corona viruses (Sars-cov, mers-cov) and novel corona virus (COVID-19)," *Rev Mex Ing Quim*, vol. 19, no. Sup. 1, pp. 201–212, 2020.

[10] A. K. SRIVASTAVA and R. BIMAL, "DEVLA, PARUL*, SNEHA SNIGDHA*, AMIT K. LOVELY".

[11] "WHO Namibia COVID-19 Bulletin - 17 April 2020 | WHO | Regional Office for Africa." Accessed: May 30, 2025. [Online]. Available: https://www.afro.who.int/publications/who-namibia-covid-19-bulletin-17-april-2020

[12] N. R. Alwaqfi and K. S. Ibrahim, "COVID-19: an update and cardiac involvement," *J Cardiothorac Surg*, vol. 15, no. 1, p. 239, 2020.

[13] R. Dhand and J. Li, "Coughs and sneezes: their role in transmission of respiratory viral infections, including SARS-CoV-2," *Am J Respir Crit Care Med*, vol. 202, no. 5, pp. 651–659, 2020.

[14] R. Suman, M. Javaid, A. Haleem, R. Vaishya, S. Bahl, and D. Nandan, "Sustainability of coronavirus on different surfaces," *J Clin Exp Hepatol*, vol. 10, no. 4, pp. 386–390, 2020.

[15] K. Diriba, E. Awulachew, and E. Getu, "The effect of coronavirus infection (SARS-CoV-2, MERS-CoV, and SARS-CoV) during pregnancy and the possibility of vertical maternal–fetal transmission: a systematic review and meta-analysis," *Eur J Med Res*, vol. 25, pp. 1–14, 2020.

[16] M. S. Fragala, Z. N. Goldberg, and S. E. Goldberg, "Return to work: managing employee population health during the COVID-19 pandemic," *Popul Health Manag*, vol. 24, no. S1, p. S-3, 2021.

[17] R. M. Anderson *et al.*, "The SARS-CoV-2 pandemic: Remaining uncertainties in our understanding of the epidemiology and transmission dynamics of the virus, and challenges to be overcome," *Interface Focus*, vol. 11, no. 6, p. 20210008, 2021.

[18] J. Liu *et al.*, "Excess mortality in Wuhan city and other parts of China during the three months of the covid-19 outbreak: findings from nationwide mortality registries," *BMJ*, vol. 372, Feb. 2021, doi: 10.1136/BMJ.N415.

[19] S. L. Bartlett *et al.*, "GLOBAL RETROSPECTIVE REVIEW OF SEVERE ACUTE RESPIRATORY SYNDROME SARS COV-2 INFECTIONS IN NONDOMESTIC FELIDS: MARCH 2020–FEBRUARY 2021," *https://doi.org/10.1638/2022-0141*, vol. 54, no. 3, pp. 607–616, Oct. 2023, doi: 10.1638/2022-0141.

[20] J. Liu *et al.*, "Excess mortality in Wuhan city and other parts of China during the three months of the covid-19 outbreak: findings from nationwide mortality registries," *BMJ*, vol. 372, Feb. 2021, doi: 10.1136/BMJ.N415.

[21] E. Gu and L. Li, "Crippled community governance and suppressed scientific/professional communities: a critical assessment of failed early warning for the COVID-19 outbreak in China," *Journal of Chinese Governance*, vol. 5, no. 2, pp. 160–177, Apr. 2020, doi: 10.1080/23812346.2020.1740468.

[22] "Coronavirus Disease-19 (COVID-19): A Perspective of New Scenario: Volume 1," *Coronavirus Disease-19 (COVID-19): A Perspective of New Scenario: Volume 1*, Sep. 2021, doi: 10.2174/9789814998932121010101.

[23] "COVID-19 cases | WHO COVID-19 dashboard." Accessed: May 31, 2025. [Online]. Available: https://data.who.int/dashboards/covid19/cases

[24] Kamal. Niaz, M. Sajjad. Khan, and Muhammad. Farrukh Nisar, "From SARS-CoV to MARS-CoV," p. 335, 2024.

[25] B. Chen *et al.*, "Overview of lethal human coronaviruses," *Signal Transduction and Targeted Therapy 2020 5:1*, vol. 5, no. 1, pp. 1–16, Jun. 2020, doi: 10.1038/s41392-020-0190-2.

[26] A. B. G. da Veiga, L. G. Martins, I. Riediger, A. Mazetto, M. do C. Debur, and T. S. Gregianini, "More than just a common cold: Endemic coronaviruses OC43, HKU1, NL63, and 229E associated with severe acute respiratory infection and fatality cases among healthy adults," *J Med Virol*, vol. 93, no. 2, pp. 1002–1007, Feb. 2021, doi: 10.1002/JMV.26362;PAGEGROUP:STRING:PUBLICATION.

[27] U. Poudel, D. Subedi, S. Pantha, and S. Dhakal, "Animal coronaviruses and coronavirus disease 2019: Lesson for One Health approach," *Open Vet J*, vol. 10, no. 3, pp. 239-251–239–251, Jul. 2020, doi: 10.4314/OVJ.V10I3.1.

[28] R. N. Mingaleeva *et al.*, "Biology of the SARS-CoV-2 Coronavirus," *Biochemistry (Moscow)*, vol. 87, no. 12–13, pp. 1662–1678, Dec. 2022, doi: 10.1134/S0006297922120215/FIGURES/4.

[29] S. Sharma *et al.*, "Emergence and expansion of highly infectious spike protein D614G mutant SARS-CoV-2 in central India," *Sci Rep*, vol. 11, no. 1, pp. 1–8, Dec. 2021, doi: 10.1038/S41598-021-95822-W;SUBJMETA=181,326,4130,596,631,735;KWRD=MOLECULAR+EVOLUTION,SARS-COV-2.

[30] K. Liu *et al.*, "Binding and molecular basis of the bat coronavirus RaTG13 virus to ACE2 in humans and other species," *Cell*, vol. 184, no. 13, pp. 3438-3451.e10, Jun. 2021, doi: 10.1016/J.CELL.2021.05.031/ATTACHMENT/BDCF8CFB-C168-45D8-BF03-A4378618076E/MMC2.XLSX.

[31] K. Dhama *et al.*, "Coronavirus disease 2019–COVID-19," *Clin Microbiol Rev*, vol. 33, no. 4, pp. 1–48, Oct. 2020, doi: 10.1128/CMR.00028-20/ASSET/0028B4AE-8691-4088-B299-3B4D6CE2D693/ASSETS/GRAPHIC/CMR.00028-20-F0007.JPEG.

[32] Y. Liao *et al.*, "Classification, replication, and transcription of Nidovirales," *Front Microbiol*, vol. 14, p. 1291761, Jan. 2023, doi: 10.3389/FMICB.2023.1291761/XML/NLM.

[33] J. Louten, "Virus Structure and Classification," *Essential Human Virology*, p. 19, 2016, doi: 10.1016/B978-0-12-800947-5.00002-8.

[34] S. S. Solanki, P. Singh, P. Kashyap, M. S. Sansi, and S. A. Ali, "Promising role of defensins peptides as therapeutics to combat against viral infection," *Microb Pathog*, vol. 155, p. 104930, Jun. 2021, doi: 10.1016/J.MICPATH.2021.104930.

[35] A. C. Maheux, "The endothelium in COVID-19 complications and in the regulation of vascular tone," 2022, doi: 10.7939/R3-8G3K-1047.

[36] B. G. Hogue and C. E. Machamer, "Coronavirus Structural Proteins and Virus Assembly," *Nidoviruses*, pp. 179–200, Apr. 2014, doi: 10.1128/9781555815790.CH12.

[37] N. A. Wong and M. H. Saier, "The SARS-Coronavirus Infection Cycle: A Survey of Viral Membrane Proteins, Their Functional Interactions and Pathogenesis," *International Journal of Molecular Sciences 2021, Vol. 22, Page 1308*, vol. 22, no. 3, p. 1308, Jan. 2021, doi: 10.3390/IJMS22031308.

[38] U. C. Chaturvedi and R. Shrivastava, "Interaction of viral proteins with metal ions: role in maintaining the structure and functions of viruses," *FEMS Immunol Med Microbiol*, vol. 43, no. 2, pp. 105–114, Feb. 2005, doi: 10.1016/J.FEMSIM.2004.11.004.

[39] M. Fani, A. Teimoori, and S. Ghafari, "Comparison of the COVID-2019 (SARS-CoV-2) pathogenesis with SARS-CoV and MERS-CoV infections," *Future Virol*, vol. 15, no. 5, pp. 317–323, May 2020, doi: 10.2217/FVL-2020-0050;PAGE:STRING:ARTICLE/CHAPTER.

[40] J. H. Kuhn, W. Li, H. Choe, and M. Farzan, "Angiotensin-converting enzyme 2: A functional receptor for SARS coronavirus," *Cellular and Molecular Life Sciences*, vol. 61, no. 21, pp. 2738–2743, Nov. 2004, doi: 10.1007/s00018-004-4242-5.

[41] R. McBride and B. C. Fielding, "The Role of Severe Acute Respiratory Syndrome (SARS)-Coronavirus Accessory Proteins in Virus Pathogenesis," *Viruses 2012, Vol. 4, Pages 2902-2923*, vol. 4, no. 11, pp. 2902–2923, Nov. 2012, doi: 10.3390/V4112902.

[42] Y. J. Park *et al.*, "Fighting the War Against COVID-19 via Cell-Based Regenerative Medicine: Lessons Learned from 1918 Spanish Flu and Other Previous Pandemics," *Stem Cell Rev Rep*, vol. 17, no. 1, pp. 9–32, Feb. 2021, doi: 10.1007/S12015-020-10026-5/TABLES/1.

[43] J. M. Trigueiro *et al.*, "Universidade de Lisboa Faculdade de Farmácia CONSERVED PROTEINS OF INFLUENZA VIRUS AND CORONAVIRUS AS POTENTIAL NOVEL THERAPEUTIC TARGETS Doutoramento em Farmácia (Microbiologia)".

[44] A. R. Fehr and S. Perlman, "Coronaviruses: An overview of their replication and pathogenesis," *Coronaviruses: Methods and Protocols*, vol. 1282, pp. 1–23, Feb. 2015, doi: 10.1007/978-1-4939-2438-7_1/TABLES/2.

[45] J. P. Bridges, E. K. Vladar, H. Huang, and R. J. Mason, "Respiratory epithelial cell responses to SARS-CoV-2 in COVID-19," *Thorax*, vol. 77, no. 2, pp. 203–209, Feb. 2022, doi: 10.1136/THORAXJNL-2021-217561.

[46] M. Zheng, "ACE2 and COVID-19 Susceptibility and Severity," *Aging Dis*, vol. 13, no. 2, p. 360, Apr. 2022, doi: 10.14336/AD.2021.0805.

[47] S. Biswas1a, A. K. Paul2a, M. A.-A. Molla, and A. Kumar, "A Review of Reproductive Number of Pandemic Covid-19: Comparative Analysis of R Value," 2020.

[48] S. Beyerstedt, E. B. Casaro, and É. B. Rangel, "COVID-19: angiotensin-converting enzyme 2 (ACE2) expression and tissue susceptibility to SARS-CoV-2 infection," *European Journal of Clinical Microbiology & Infectious Diseases 2021 40:5*, vol. 40, no. 5, pp. 905–919, Jan. 2021, doi: 10.1007/S10096-020-04138-6.

[49] E. Arruda, O. A. L. Cintra, and F. G. Hayden, "Respiratory Tract Viral Infections," *Tropical Infectious Diseases*, p. 637, Dec. 2009, doi: 10.1016/B978-0-443-06668-9.50064-8.

[50] N. Clementi *et al.*, "Viral respiratory pathogens and lung injury," *Clin Microbiol Rev*, vol. 34, no. 3, pp. 10–1128, 2021.

[51] I. A. Ishina, M. Y. Zakharova, I. N. Kurbatskaia, A. E. Mamedov, A. A. Belogurov, and A. G. Gabibov, "MHC Class II Presentation in Autoimmunity," *Cells 2023, Vol. 12, Page 314*, vol. 12, no. 2, p. 314, Jan. 2023, doi: 10.3390/CELLS12020314.

[52] M. Gao *et al.*, "Regulatory CD4+ and CD8+ T cells are negatively correlated with CD4+/CD8+ T cell ratios in patients acutely infected with SARS-CoV-2," *J Leukoc Biol*, vol. 109, no. 1, pp. 91–97, Jan. 2021, doi: 10.1002/JLB.5COVA0720-421RR.

[53] R. G. Brower and H. E. Fessler, "MECHANICAL VENTILATION IN ACUTE LUNG INJURY AND ACUTE RESPIRATORY DISTRESS SYNDROME," *Clin Chest Med*, vol. 21, no. 3, pp. 491–510, Sep. 2000, doi: 10.1016/S0272-5231(05)70161-1.

[54] A. Kosyreva, D. Dzhalilova, A. Lokhonina, P. Vishnyakova, and T. Fatkhudinov, "The Role of Macrophages in the Pathogenesis of SARS-CoV-2-Associated Acute Respiratory Distress Syndrome," *Front Immunol*, vol. 12, p. 682871, May 2021, doi: 10.3389/FIMMU.2021.682871/XML/NLM.

[55] R. El Baba and G. Herbein, "Management of epigenomic networks entailed in coronavirus infections and COVID-19," *Clin Epigenetics*, vol. 12, no. 1, pp. 1–12, Aug. 2020, doi: 10.1186/S13148-020-00912-7/FIGURES/2.

[56] P. Chen *et al.*, "Potential Pathophysiological Mechanisms Underlying Multiple Organ Dysfunction in Cytokine Release Syndrome," *Mediators Inflamm*, vol. 2022, no. 1, p. 7137900, Jan. 2022, doi: 10.1155/2022/7137900.

[57] H. M. Yoo, I. H. Kim, and S. Kim, "Nucleic acid testing of sars-cov-2," *Int J Mol Sci*, vol. 22, no. 11, p. 6150, Jun. 2021, doi: 10.3390/IJMS22116150/S1.

[58] K. Dhama *et al.*, "Coronavirus disease 2019–COVID-19," *Clin Microbiol Rev*, vol. 33, no. 4, pp. 10–1128, 2020.

[59] J. P. DeVincenzo *et al.*, "Viral load drives disease in humans experimentally infected with respiratory syncytial virus," *Am J Respir Crit Care Med*, vol. 182, no. 10, pp. 1305–1314, 2010.

[60] X. Xie, Z. Zhong, W. Zhao, C. Zheng, F. Wang, and J. Liu, "Chest CT for typical coronavirus disease 2019 (COVID-19) pneumonia: relationship to negative RT-PCR testing," *Radiology*, vol. 296, no. 2, pp. E41–E45, 2020.

[61] M. J. Pallen, N. J. Loman, and C. W. Penn, "High-throughput sequencing and clinical microbiology: progress, opportunities and challenges," *Curr Opin Microbiol*, vol. 13, no. 5, pp. 625–631, 2010.

[62] M. L. Rosado-de-Christenson and S. Martínez-Jiménez, *Diagnostic Imaging: Chest-E-Book: Diagnostic Imaging: Chest-E-Book*. Elsevier Health Sciences, 2022.

[63] T. Ai *et al.*, "Correlation of chest CT and RT-PCR testing for coronavirus disease 2019 (COVID-19) in China: a report of 1014 cases," *Radiology*, vol. 296, no. 2, pp. E32–E40, 2020.

[64] D.-G. Basaca *et al.*, "Long COVID in Children and Adolescents: Mechanisms, Symptoms, and Long-Term Impact on Health—A Comprehensive Review," *J Clin Med*, vol. 14, no. 2, p. 378, 2025.

[65] N. Clementi *et al.*, "Viral respiratory pathogens and lung injury," *Clin Microbiol Rev*, vol. 34, no. 3, pp. 10–1128, 2021.

[66] L. Spicuzza and M. Schisano, "High-flow nasal cannula oxygen therapy as an emerging option for respiratory failure: the present and the future," *Ther Adv Chronic Dis*, vol. 11, p. 2040622320920106, 2020.

[67] W. W. Johnston and C. E. Elson, "Cytology of Other Body Sites," *Comprehensive Cytopathology E-Book*, p. 303, 2008.

[68] R. F. Barghash *et al.*, "Navigating the COVID-19 Therapeutic Landscape: Unveiling Novel Perspectives on FDA-Approved Medications, Vaccination Targets, and Emerging Novel Strategies," *Molecules*, vol. 29, no. 23, p. 5564, 2024.

[69] R. P. Saha *et al.*, "Repurposing drugs, ongoing vaccine, and new therapeutic development initiatives against COVID-19," *Front Pharmacol*, vol. 11, p. 1258, 2020.

[70] J. Gao, Z. Tian, and X. Yang, "Breakthrough: Chloroquine phosphate has shown apparent efficacy in treatment of COVID-19 associated pneumonia in clinical studies," *Biosci Trends*, vol. 14, no. 1, pp. 72–73, 2020.

[71] D. J. Sullivan Jr, "Convalescent Plasma and Other Antibody Therapies for Infectious Diseases—Lessons Learned from COVID-19 and Future Prospects," Springer, 2024.

[72] F. Maggiolo *et al.*, "Ultrasensitive assessment of residual low-level HIV viremia in HAART-treated patients and risk of virological failure," *JAIDS Journal of Acquired Immune Deficiency Syndromes*, vol. 60, no. 5, pp. 473–482, 2012.