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Article

Ethnological aspects of COVID-19

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Within recent past, coronavirus has shaken the whole world. The world faced a new pandemic of novel coronavirus 2019 (SARS-CoV-2/ COVID-19).It has socioeconomically impacted world population a lot in terms of education, economy as well as physical and mental health. This novel coronavirus is notorious enough that put human health at a great risk. Currently, researchers all over the world aretrying hard to develop a new drug/vaccine for its treatment. In past decades, the world population has faced various viral infectious illness outbreaks. Influenza A, Ebola, Zika, SARS and MERS viruses had whacked public health and economy. Medical science technology achieved the landmark in developing coronavirus (SARS-CoV-2) vaccines that are approved currently for emergency use. Some of the recently approved vaccines are developed by Pfizer and Moderna, Johnson and Johnson, Gam-COVID-vac (Sputnik V), Bharat Biotech (covaxin) andOxford-AstraZeneca vaccines (covishield) (Baden*et al.*, 2021). Here, a short review is drafted focusingon infection, immune system, pathogenesis, phylogenesis, mode of transmission and impact of coronavirus on health and economy and recent developments in treating COVID-19.

Keywords: Coronavirus. COVID-19. Immune system. MERS. SARS.

INTRODUCTION

COVID-19, corona virus, quarantine, lockdown and social distancing; these words are now known to everyone.Viral infection is not a novel term. It is so much popularin public domain that even a layman interprets any infection as a viral infection even without knowing its cause. Viruses are defined as very small (10-250µm), intracellular parasites containing only one type of nucleic acid (RNA/DNA) that can grow only in living cells (like whole organism/fertile eggs/tissue culture etc.) but not in ordinary bacteriologicalculture media and are mostly insensitive to antibiotics (Cooper, Gunn, Carter, 1972). This coronavirus belongs to a family of viruses that causes various respiratory symptoms such as pneumonia, fever, breathing difficulty and lung infection. The present outbreak of coronavirusassociated acute respiratory disease called coronavirus disease-19 (COVID-19), is the third documented spillover, after SARS and MERS.Going back to December 2019, a group of patients of an unknown etiology was admitted to hospitals in Wuhan, Hubei Province, People's Republic of China with early findings of pneumonia. Early five patients suffering from acute respiratory syndrome, later termed as COVID-19, were reported in the month of December 2019 and out of these, one patient died (Lu, Stratton, Tang, 2020). Till 30 Jan-2020, 7734 confirmed cases of COVID-19 were reported in China and 90 cases of COVID-19 were reported from the rest of countries (Wang, Tang, Wei, 2020). All this raised the eyebrows of rest of the world. On March 11, 2020, WHO(World Health Organization) declared it as a pandemic(Cucinotta, Vanelli, 2020). The virus spread mainly due to direct contact or by droplets owing to close contact during coughing, sneezing, and talking. From the laboratory tests it was observed that the signs and symptoms of COVID-19 emerge after a time period of average 5.2 days. The time from the onset of COVID-19 symptoms to death vary from 6-41 days with an average of 14 days (Bassetti, Vena, Giacobbe, 2020). Considering its speedy and massive spread the governments of different countries have put the countries in complete lockdown

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state thereby jamming any movement of persons or goods to prevent the spread of virus or to break the chain of infection.

In order to understand how our immune system work to fight against infection, pathogenicity, transmission of infection and prevention and understanding of spread of diseases specifically covid-19, a brief discussion is dispensed here.

Defence mechanism of our body

The sweat, hair on skin, mucus in nose/throat forms the first line of defence that restricts the entry of any foreign particles in the body. If any foreign particles (virus/bacteria/parasite/allergen/toxicant etc.) got entry into the body and try to threaten the normal homeostasis of the body; an immune response is generated.To combat any mutilation, body's own immune system reacts against invaded foreign particles (whereas immunity is defined as capacity of the body to resist infection) (Figure 1). The main character of the immune system is white blood cells (WBCs)/leucocytes, containing phagocytes (breakdown pathogens and swallow them) and lymphocytes (memorize previous invaders and discern them if they encounter again). The phagocytes and lymphocytes perform different functions *viz.* attacking invaders, patrolling for pathogens, removing dead and destroying the infected cells, repairing wounds, destroying compromised cells, producing antibodies or immune-globulins and also alerting other cells involved in defence (Figure 2).Sometimes,natural immunity is not enough for protection against certain diseases, therefore, additional immunity is acquired via passive and active immunization process during life time by administering antigen or antibody containing preparations (Turvey, Broide, 2010; Schroeder, Cavacini, 2010). But as and when a novel infection outbreak occursto which immunity is not acquired then immune system of host cell is compromised and it becomes really important to establish the cause of infection and its control.

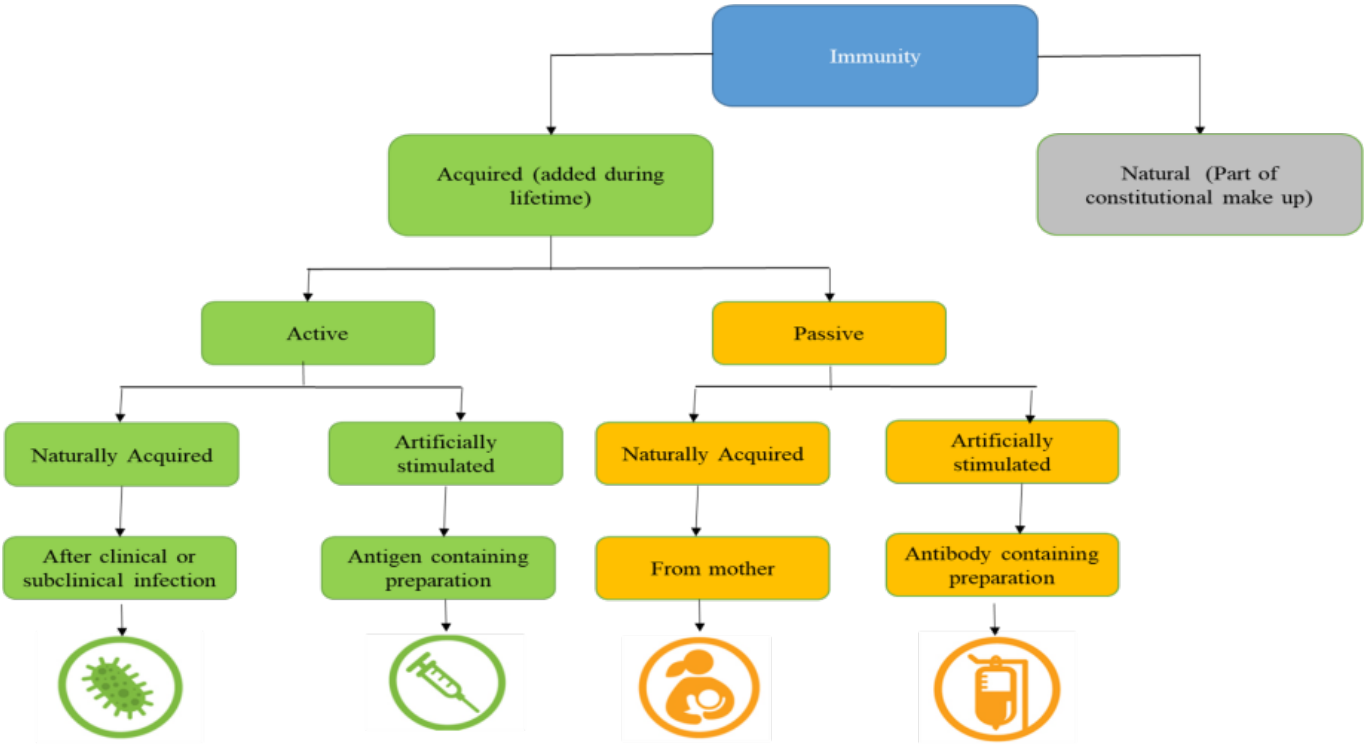

FIGURE 1 - Different types of immunity.

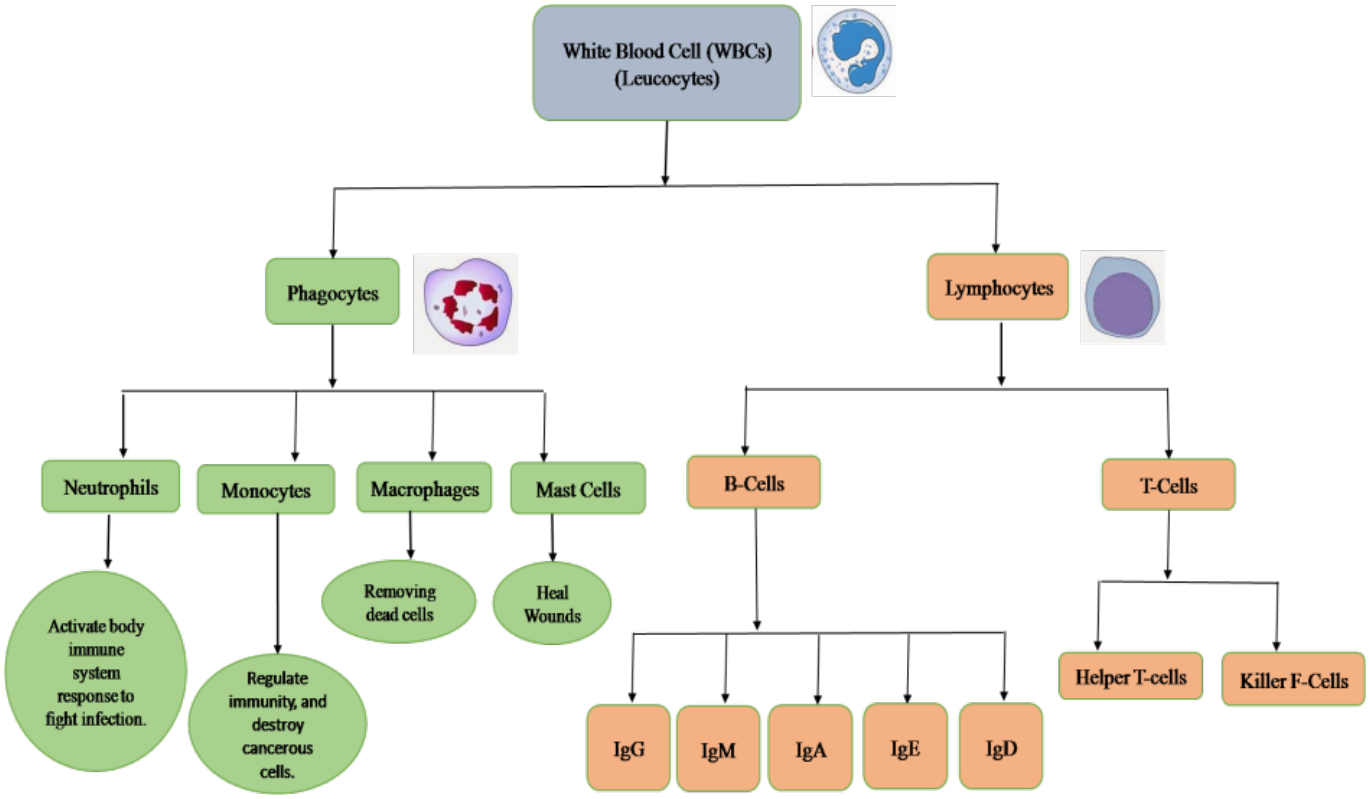

FIGURE 2 - Immune system of human body.

Transmission of infection

Pathogen is a biological agent (bacteria, fungi, protozoa, virus etc.) which causes the damage during the host-microorganism interaction. The capability of pathogen to cause infection is called pathogenicity and microorganisms communicate pathogenicity through their virulence i.e. a quantitative/relative degree of pathogenicity. The microorganisms cause physiological damage and areclassified as obligate, opportunistic and facultative pathogens affecting wide range of living host, specifically immune compromised, and may be able to harass aggressively and progressively (Brooke, 2012; Casadevall, Pirofski, 2014; Casadevall, Pirofski, 2015). Infection spreads by special transferring agents, known as indirect mode of transmission (Figure 3). The animatetransmission mediators/vectors (insects, fleas, mites and rodents), air, water,foodand even the inanimate mediators consisting of fomites (such as toys, clothes bedding and surgical equipments etc.) on which the pathogen deposited are disease carrying vehicles. Indirect pathogentransmission may be spread by air *(Bacillusanthraces)* or water (*Vibrio cholera) etc.*(Cortez, Weitz, 2013); whereasdirect transmission includesthe diseases transmitted by means of semen, blood and saliva.The direct transmission may occur asleptospirosis (through urine of rats/rodents), faecal-oral infections (through contaminated fingers, food, soil, domesticflies and drinking water) andinfections outspread via direct contact (due to contaminated clothes, hands, domestic flies and other types of infected substances infecting mainly eyes or skin) etc. (Hoglund, 2001).In COVID-19 the receptor binding by host cells expressed the first step of viral infection followed by fusion with the cell membrane and found that the lung epithelial cells are the prime target of the virus. Hence, it has been observed that human-to-human transmissions of coronavirus take place by the receptor-binding domain of virus spikes and the cellular receptors i.e. angiotensin-converting enzyme -2 receptor (Wan *et al*., 2020).

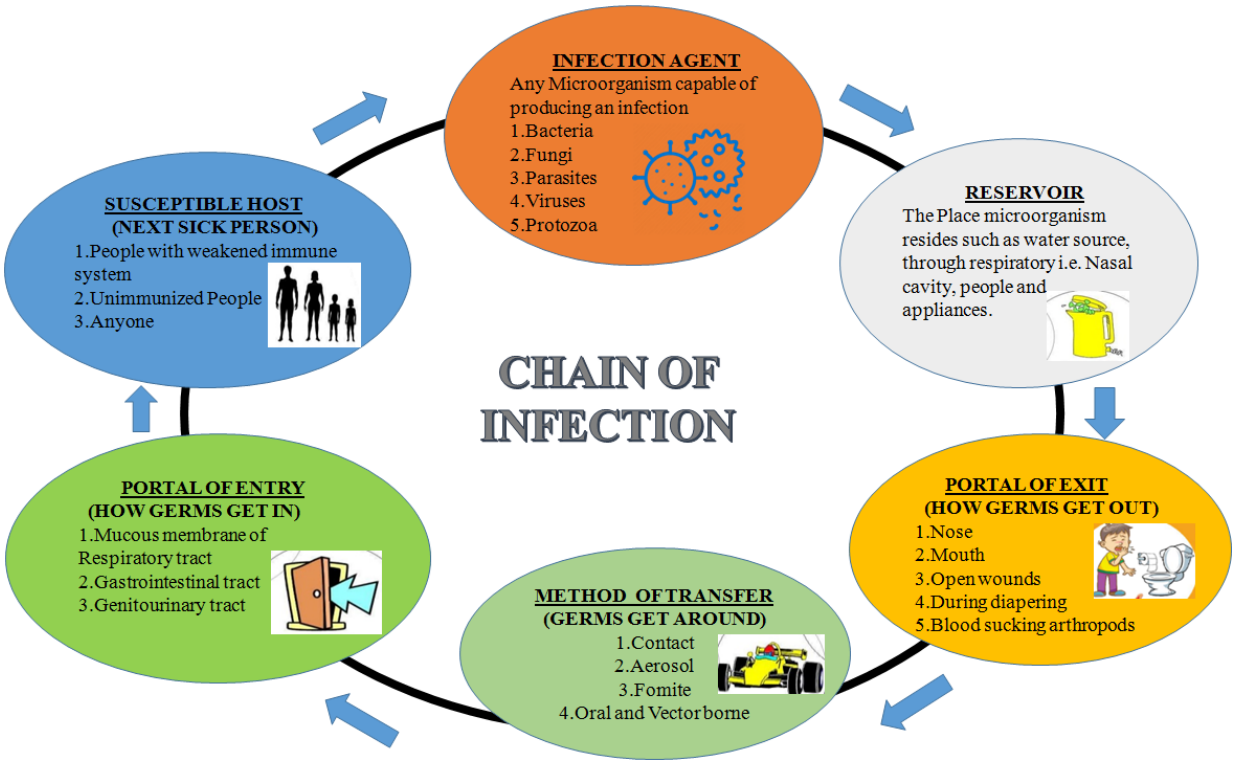

FIGURE 3 - Chain of infection.

Viruses acting on the respiratory tract

"Common cold" and "flu" are the most common ailmentsof the upper respiratory tract caused by viral infection. Of all colds, rhinoviruses,coronaviruses and influenza viruses account for 30–50%, 10–15% and 5–15% of colds; respectively.In the last century, the world has looked over five pandemic viral respiratory disorders. In 1918, Spanish flu (H1N1) killed approximately 50 million, 1957 Asian flu (H2N2) killed about 4 million, Hong Kong flu (H3N2) killed 1 millionpeople worldwide. In 2005 and 2009, Bird flu (H5N1) and Swine flu (H1N1) that affected more birds and pigs and caused around18,000 human deaths. The pandemic originated from the family of coronavirus, usually infect epithelial cells of the gastroenteric or respiratory tract includingSARS and MERS,with symptoms of cough, fever, runny nose, sore throat, difficulty in breathing, dyspnea and hypoxemia (Holmes, Behnke; 1981; Eccles, 2005; Huang *et al.*, 2020;Boopathi, Poma, Kolandaivel, 2020). Luckily, it has been observed that the SARS patients are not found infectious throughout the incubation period. Several studies showed that SARS-CoV RNA strands mainly found in the plasma of SARS patients, even if it is a respiratory infection. MERS-CoV was the first very much lethal respiratory infectious disease and had high rate of fatality than SARS. The spreading of virus from the blood was rare and the MERS viral load was quite low. In 2020, this novel corona virus disease known as COVID-19 has spread its wings all over the world. A total of 145,426,232coronavirus cases have been reported with 3,087,633deaths, although 123,430,858 cases have been recovered all over world till 23rd April 2021. COVID-19 is unfurling and affecting a large no. of population but alsohave a high recovery rate. The symptoms (Figure 4) appear after some days of incubation period and this period is totally dependent upon the immunity and age of the patient. Other clinical features revealed by chest CT scan were RNAaemia, acute cardiac injury, acute respiratory distress syndrome and occurrence of ground-glass opacities causing death (Wang *et al.*, 2020b; Ren *et al.*, 2020; Yang *et al.*, 2020).

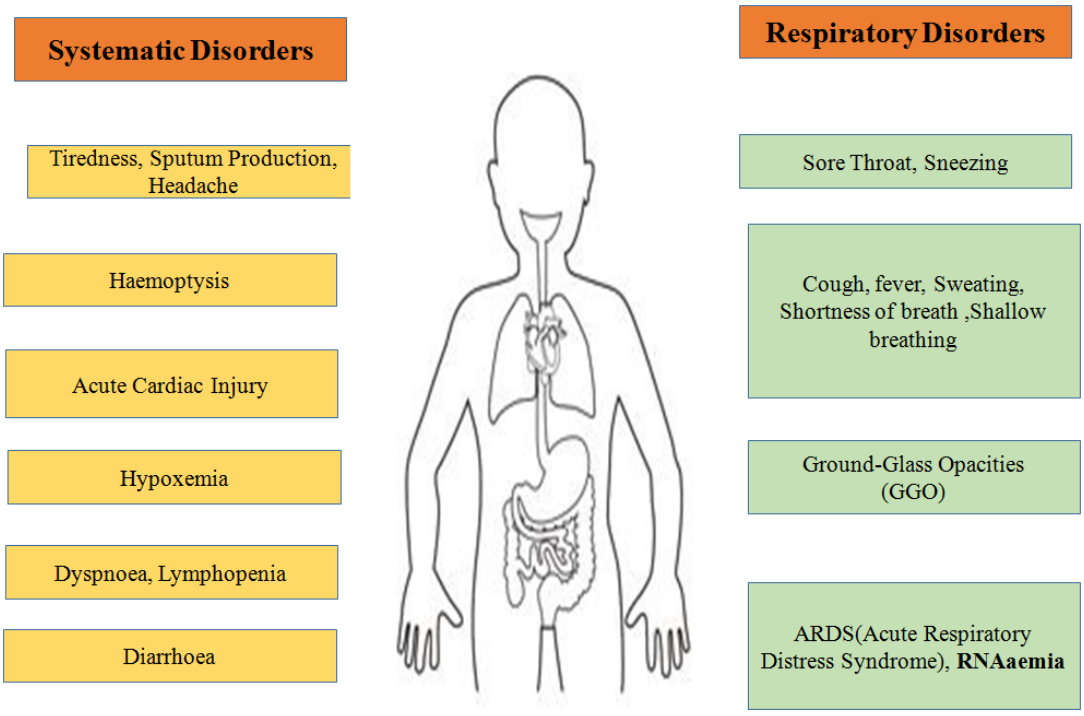

FIGURE 4 - Common symptoms associated with coronavirus infectionsStructure of coronavirus.

Generally, a virus consists of a central core containing single nucleic acid (RNA/DNA) that is surrounded by a protein shell known as capsid. Some viruses (influenza & measles) are surrounded by a lipid envelope that is very sensitive to ether or alcohol and is fragile enough to be washed off even with soap solution. Occasionally, there are spikes containing haemagglutinin on the surface that may probably assist absorption on to the host cells. Coronavirus is also enveloped virus with spikes on the surface (Figure 5) (Boopathi, Poma, Kolandaivel, 2020).

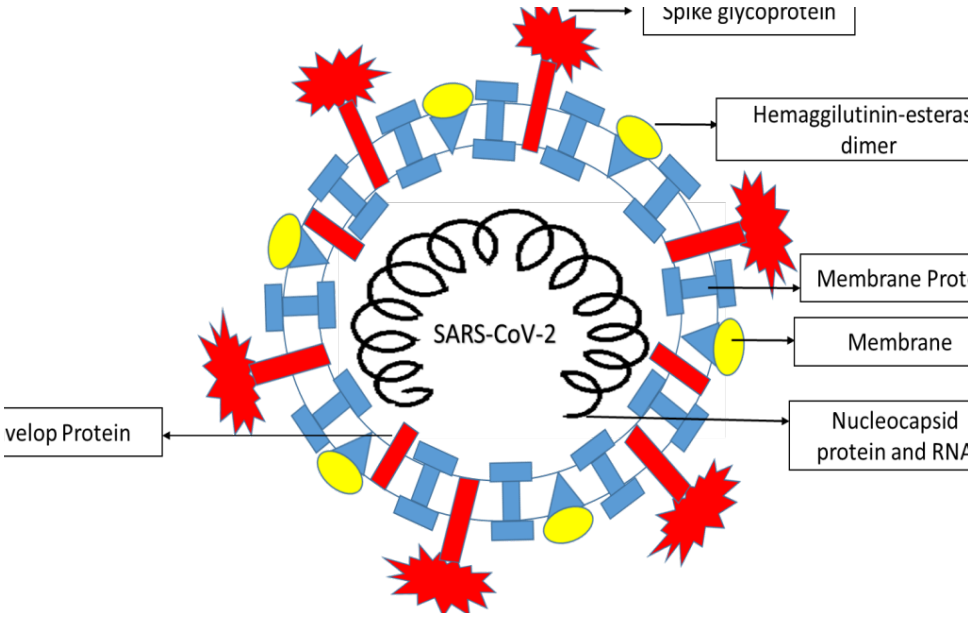

FIGURE 5 -Diagrammatic representation of structure of Coronavirus.

Diversity and classification of coronavirus

Coronavirus is the largest single-stranded RNA virus that belongs to the Nidovirales order. The order includes Roniviridae, Arteriviridae, and Coronaviridae families. The Coronaviridae family is subdivided into Torovirinae and Coronavirinae subfamilies and classified into four genera such as alpha, beta, gamma and delta-CoVs. The alpha and beta-CoVs have ability to infect different human beings whereas the other genera may infect birds and vertebrates. Up to now, seven coronaviruses have been found out that infect humans and leads to respiratory diseases. Four out of seven (HCoV-OC43, HCoV-229E, HCoV-HKU1 and HCoV-NL63.) are ordinary human CoVs (HCoVs) which leads to upper respiratory disease and cause serious illness in young, elderly or immune compromised person (Chen, Liu, Guo, 2020).

Pathogenesis and Phylogenetic of Coronavirus

The person infected with COVID-19 revealed leucopenia (2.91×10^9 cells/l), abnormal respiratory observations, fever, cough, uncouth breathing sounds of the lungs, high erythrocyte sedimentation rate, elevated body temperature, the high level of plasma cytokines (Lei *et al.*, 2020) and also with high blood plasma levels of chemokines and cytokines in infected patients which include IL1-β, IL1RA, IL7, IL8, IL9, IL10, basic FGF2, GCSF, GMCSF, IFNγ, IP10, MCP1, MIP1α, MIP1β, PDGFB, TNFα, and VEGFA. Most of the severe cases which were noted with the high level of pro-inflammatory cytokines such as IL2, IL7, IL10, GCSF, IP10, MCP1, MIP1α, and TNFα and encourage disease severity (Huang *et al.*, 2020). The phylogenetic study of COVID-19 patients showed that 99.8 to 99.9% nucleotide genome sequences were identical to new beta-CoVstrain. Another genome sequencing study of COVID-19 patients exhibited 99.98% sequence identity (Lu*et al.*, 2020).The genetic sequence study of COVID- 19 exhibited approximately 50% to the MERS-CoV and 80% identity to the SARS-CoV, both the infections were (SARS-CoV and MERS-CoV) originated from the bats. Thus, confirming COVID-19 to be a member of the genus beta-coronavirus and infects bats, humans and wild animals.The genetic sequence study and analysis of phylogenetic reports verified that COVID-19 is amply different from SARS-CoV and it considered as a novel beta-coronavirus which mainly cause infections in humans. Furthermore, the virus having single intact open reading frame on gene 8 and this is directly indicator for the bat-origin CoVs. Though, the amino acid sequence and receptor-binding domain of COVID-19 is similar to that of SARS-CoV which indicates that the virus might use the same receptor (Cui, Li, Shi, 2019).

Diagnosis of COVID-19 Infection

The National Health Commission of China gave diagnosis and treatment program for COVID-19 patients based on the recommendations/ guidelines of the WHO on MERS and SARS. According to WHO the final identification test for COVID-19 is confirmed by RT-PCR assay using blood and respiratory samples and studying the viral gene sequencing of the samples which are highly similar with the coronavirus and accordingly patients are classified into low, moderate, severe and serious types (Yang, Yan, 2020; Siordia, 2020).The identification testing method consists of two categories i.e. serological and nucleic-acid. The serological tests confirm the antibodies (IgG and IgM) present in the patient's serum while the nucleic-acid testing method include the probe for RNA of virus swabbed from the throat and nasal passage of the patient. During early stage of infection, the patient viral titres are so much high and a single patient swab nasopharyngeal sample may carry 1 million SARS CoV-2 viralparticles. Thus, nucleic acid tests provide the earliest and sensitive detection of the SARSCOV-2. The RT-PCR analysis test was initiated by the Centre for Disease Control and Prevention 2020 (CDC) and termed as the "gold standard" for clinical identification (Wolfel *et al.*, 2020). The general RT-PCR test includes the three steps that are samplecollection, lysis/RNA purification andamplification from the nasopharyngeal swab sample.The RNA strand of the inactivated virus is purified by using column-based RNA purification kit. The purified and amplified RNA can be detected through Taqman probefluorescence or DNA-intercalating dyes and a threshold cycle of amplification is set to distinguishpositive and negative results. The test result is considered positive if amplification is foundfor two or

more viral targets, while the test is negative if amplification is measured for the controlRNA but for none of the viral targets (Shen *et al*., 2020).

Therapeutics treatment

Upon a viral endemic, knowing the cause (whether the outbreak is caused by a new or a previously known virus) is highly important so as to rapidly establishwhich approachesand actions are most appropriate to detect the genesis, controlits spread and also to curb potential consequences of the outbreak.When there are no specific vaccination and antiviral drugs are available against coronavirus disease for potential treatment of humans then the only alternative is using antiviral drugs (broad spectrum) such as nucleoside analogues and HIV-protease inhibitors which could assuage viral infection until the vaccination and a specific viral drug becomes obtainable (Jin*et al*., 2020). Theoptional treatment of Coronavirus included oral administration of lopinavir (500 mg), oseltamivir (75 mg), ritonavir (500 mg) twice a day and i.v. administration of ganciclovir (0·25 g) for 3 to 14 days. On the other hand, the broad spectrum anti-viral drug such aschloroquine andremdesivirare very much effective against the control of coronavirus. The CPAM (China International Exchange and Promotive Association for Medical and Health Care) recommends chloroquine, (500 mg) and hydroxychloroquine (400 mg) for older patients and patients with underlying disorders (Wang*et al*., 2020). More recently, favipiravir is portrayed as a potential oral medicament for mild to moderate cases of COVID-19. These all anti-viral drugs have been effectively used in patients with a safety record. In addition, several other compounds such as EIDD-2801 compound which have been used against influenza virus and this is the otherpossible drug to be counted for the coronavirus treatment (Toots *et al*.,2019). In the present circumstances, where COVID-19 is proving to be hazardous to mankind, more and more research is immediatelyrequired to develop novel chemotherapeutic agent for the treatment of COVID-19 infections. Presently, plasma therapy is also showing good results (Koenig, 2015; Mair-Jenkins *et al*., 2015). The recombinant monoclonal antibody is a directly onward path to counteractthe viral infection for example CR3022 is a coronavirus human monoclonal antibody which is able to bind the receptor-binding domain of coronavirus (Tian *et al*., 2020).

Vaccine development

The origin of various new strains from zoonotic hosts provides a very complex structure and very tricky to identified them. Previously, the coronavirus were known as a weak pathogen and causing mild flu-like illness but with repeated transmission and consistent outbreaks threaten economic losses globally (Jeyanathan *et al*., 2020). The development of vaccine depends upon the selection of antigen, adjuvant, manufacturing system and the delivery process. The quick development of vaccines is possible only when the structural information and genome sequence of SARS-CoV-2 are available. Different areas were explored for the development of vaccines includes live attenuated vaccines, inactivated virus vaccines, recombinant protein based viral vaccines, subunit vaccine and DNA vaccines (Shereen*et al*., 2020) discussed in Table I.

TABLE I - Different types of vaccines, their mechanism of action and development process

Vaccine type	Mechanism of action	Production and development features
Live-attenuated vaccines	These types of vaccine bring out very strong immune response, protection is for longer period and causes reactogenicity.	The development and manufacturing procedure is highly established and handling live virus properly.
Inactivated vaccines	These types of vaccines generates weaker immune response than live-attenuated vaccines,less reactogenicity, also, requiring multiple dosages and adjuvants.	Product development and manufacturing process is highly established but requires handling live virus.

TABLE I - Different types of vaccines, their mechanism of action and development process

Vaccine type	Mechanism of action	Production and development features
Recombinant protein-based and vector-based vaccines	Safe, induce a precise immune response, weak immunogenicity and may require the addition of adjuvants.	The development and manufacturing process of vaccine on large scale includes some steps such asepitope selection, design of antigen and vehicle development.
Trained immunity-vaccine	These vaccines boost innate immunity against a wide range of infections but the mechanisms are still unknown.	These vaccines are available across the world but each country has its own development process.

Vaccines are critical for the prevention and control of infectious-disease outbreaks. WHO possesses vaccines to prevent more than 20 life-threatening diseases that help people of all ages live longer and healthier lives. Immunization achieved through vaccines prevents 2-3 million deaths every year from diseases like diphtheria, tetanus, pertussis, influenza and measles etc. Various laboratories all around the world are going through different phase trials for the development of vaccine (Table II) to combat the deadly virus.

TABLE II - Coronavirus vaccines which are under clinical trials currently

Trial number	Type of vaccine	Objective/aim	Clinical Phase	Developer/ Organization	References
NCT04327206	Live attenuated	Determination of impact of BCG vaccination for reduction of COVID-19 severity in pandemic.	Phase III	Murdoch Childrens Research Institute	https://clinicaltrials.gov/ct2/show/NCT04327206.
NCT04328441	Live attenuated	To investigate the influence of BCG vaccination on healthcare workers in order to get protection from COVID-19.	Phase III	UMC Utrecht	https://clinicaltrials.gov/ct2/show/NCT04328441
NCT04352608	Inactivated	To determine the safety and immunogenicity of trail inactivated COVID-19 vaccine in group of healthy peoples having age range of 18–59 years.	Phase I/II	Sinovac Research and Development Co., Ltd.	Wang*et al*., 2020b
NCT04383574	Inactivated	To assess safety as well as immunogenicity of inactivated COVID-19 vaccine	Phase I/II	Sinovac Research and Development Co., Ltd.	Wang*et al*., 2020b
NCT04276896	Non-replicating Vector	To study immunogenic response and safety concern of non-replicating vector COVID-19 vaccine.	Phase I/II	Shenzhen Geno-Immune Medical Institute	https://clinicaltrials.gov/ct2/show/record/NCT04276896

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Trial number	Type of vaccine	Objective/aim	Clinical Phase	Developer/ Organization	References
NCT04313127	Vector base	To develop Adenovirus Type 5 Vector base vaccine for study of safety, reacto-genesis and immune reactivity of COVID-19 vaccine.	Phase I	CanSino Biologics Inc.	https://clinicaltrials.gov/ct2/show/record/NCT04313127
NCT04341389	Vector base	To investigate the influence of Adenovirus Type 5 Vector base novel coronavirus vaccine in a group of healthy adults	Phase II	Insitute of Biotechnology, Academy of Military Medical Sciences, PLA of China	https://clinicaltrials.gov/ct2/show/NCT04341389
NCT04324606	Non-replicating vector	To investigate proficiency, safety and immunogenicity of COVID-19 vaccine in age group of 18–55 years.	Phase I/II	University of Oxford	Folegatti *et al*., 2020
ChiCTR2000031781	Vector base	To investigate the influence of Adenovirus Type 5 Vector base novel coronavirus vaccine in a group of healthy adults having age range 18–60 years.	Phase I/II	Insitute of Biotechnology, Academy of Military Medical Sciences, PLA of China	Smith *et al*., 2020
NCT04336410	Nucleic acid	To investigate the nucleic acid vaccine against COVID-19.	phase I	Inovio Pharmaceuticals	Smith *et al*., 2020
NCT04368728	Nucleic acid	To study safety and immunogenicity and efficiency of RNA vaccine against COVID-19.	phase I/II	Biontech SE	Mulligan *et al*., 2020
ChiCTR2000032459	Inactivated vaccine	Safety assessment and improve immunogenicity	Phase I/II	Beijing Institute of Biological Products, Sinopharm	Gao *et al*., 2020
ChiCTR2000031809	Inactivated vaccine	Safety and immunogenicity of inactivated COVID-19 vaccine	Phase I/II	Wuhan Institute of Biological Products, Sinopharm	http://www.chictr.org.cn/showprojen.aspx?proj=52227
NCT04368988	Subunit vaccine	Stable, pre-fusion S protein given with adjuvant, Matrix-M	Phase I/II	Novavax	Wang*et al*., 2020c

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Trial number	Type of vaccine	Objective/aim	Clinical Phase	Developer/ Organization	References
NCT04398147	Non-replicating viral vector vaccine	Incorporates the adenovirus type 5 vector (Ad5-nCoV)	Phase I/II	CanSino Biological Incorporation, Beijing Institute of Biotechnology, Canadian Center for Vaccinology	Wang *et al*., 2020c
NCT04400838	Non-replicating viral vector vaccine	Safety assessment and improve immunogenicity	Phase I/II	University of Oxford, AstraZeneca	Wang *et al*., 2020c
NCT04299724	Non-replicating viral vector vaccine	Modified dendritic cells expressing SARS-CoV-2 minigenes	Phase I/II	Shenzhen Geno-Immune Medical Institute	Badgujar, Badgujar, Badgujar, 2020
NCT04334980	DNA vaccine	Spike oral DNA vaccine encoding S of SARS-CoV-2	Phase I	Symvivo	Badgujar, Badgujar, Badgujar, 2020
NCT04405076	RNA vaccine	Stabilization of S protein mRNA vaccine	Phase II	Moderna	Corbett *et al*., 2020

Impact of COVID-19

The shutdown of financial markets affected the economy brutally in various sectors i.e. education, aviation, hotels, restaurants, tourism, entertainment, manufacturing, sports and IT sectors etc. (Ozili, Arun 2020). These restrictions cost the tourism sector a loss of $200 billion globally and GTBA reported the loss to the business travel sector would be $820 billion in revenue (Gaiotti, 2013).Shutdown of hotels in the United States, UK and in various Asian and European countries leads to the approximated 24.3 million losses of jobs globally, and 3.9 million losses in the US only.Oil-dependent countries encountered loss in oil revenue. In Italy, loss of 7.3 million Euros in film screening, 7.2 million Euros in theatre segment, and 4.1million Euros in the live music sector, 2.5 million Euros in the dance activities and 1.8 million Euros in the exhibition sector was estimated from February 23 to March 1, 2020 (Jagannathan, Kapoor, Schaumburg, 2013). UNESCO reported that the pandemic disturbed the education at least 290.5 million students globally. According to S&P Dow Jones, $6 trillion amount lost from 23-28 Feb, 20. From 20 Feb 2020 to 19 Mar 2020, the S&P 500 index fell by 28%, the FTSE 250 index fell by 41.3% and the Nikkei fell by 29% in the same time, large international banks recorded a fall in their share price (Ozili, 2019). In health Sector**,** China supplied about 60% of world's active pharmaceutical ingredients and during this shutdown severe supply issues are used as maximum pharma companies procure raw material from china that leads to shortage of drugs even for other diseases amid the crisis of COVID-19 (Allen, Carletti, 2010).

Recent mutation of COVID-19

Currently, the scientists are trying to produce vaccines against SARS-CoV-2 globally. The protein-based type vaccines are more effective and the private based sectors are also focus on the development of this type of vaccines. But, unexpectedly the mutation speed of Coronaviridae (SARS-CoV-2) is reminding high and may be implicated the efficiency of therapeutic agents and vaccines. Moreover, the newest strain of SARS-CoV-2 lineage emerged mainly in UK, South Africa and

Brazil and this may enhance the number of the patients of COVID-19 in those countries. Scientists have expressed that the mutations occurred in the virus genome world-wide and reported that the new SARS-CoV-2 variant proposed by the alteration of nucleotide genome sequence (Nidom*et al.*, 2021). Formerly, Phan *et al.*,(2020)carried out a genetic analysis on 86 virus genomes and accounted many mutations. In the meantime, Yadav *et al.*, (2020) also analyzed the first two viruses which were isolated from India. The mutation frequency is found to be moderate in coronavirus. Some of the factors such as host and environmental factors which are mainly involves in the mutational events of SARS-CoV-2. Alteration at S protein could modify the pathogenesis of the virus and initiate the unambiguous host immune responses. Furthermore, the environmental factors like UV radiation, high temperature and humidity play a major role in the mutation of viruses. Some of the current studies suggest that the coronavirus variation arises at the point N501Y of the spike protein and engross 23 separate mutations on the spike protein out of which 17 are connected to the virus proteins and therefore offer specific features to the virus. The variants recently described in the UK will not hinder vaccine-induced immunity and will not break the vaccine although there may be chance of making it less effective (Tegally*et al.*, 2020).

Currently approved vaccines

It is nothing short of a medical surprise that vaccines have been produced for Coronavirus in the same year as the universal pandemic - itself. Due to an extraordinary achievement in medical science technology vaccines for coronavirus (SARS-CoV-2) are approved currently for emergency use. Some of the recently approved vaccines are developed by Pfizer and Moderna, Johnson and Johnson, Gam-COVID-vac (Sputnik V), Bharat Biotech (covaxin) and Oxford-AstraZeneca vaccines (covishield) (Baden*et al.*, 2021). The Pfizer and Moderna developed vaccines based on mRNA technology as well as lipid nanoparticles delivery system whereas the Johnson and Johnson, AstraZeneca and Gam-COVID-vac are based upon the DNA carrying non-replicating recombinant adenovirus (AdV) vector systems. The mRNA and AdV vaccines developed for SARS-CoV-2 primarily work to neutralize antibodies generated via natural infection and for therapeutic use based on monoclonal antibodies (Polack *et al.*, 2020). The phase III clinical trials study showed that the Pfizer/BioNTech and Moderna mRNA vaccines have 90–95% efficacy in protecting against coronavirus whereas the AdV vaccines and Gam-COVID-vac (Sputnik V) showed 92% efficacy (Voysey *et al.*, 2021). The mRNA based vaccine platform represents anoriginally new licensed formulationalthough the AdV vaccine platform has been licensed for Ebola (Logunov *et al.*, 2021). But, we still have much more to learn about how these vaccines mobilize the immune systems and increase the durability of protection and how to furthermore optimize them to prevent against new strains, variants and disease manifestations.

CONCLUSION

This novel coronavirus eruption has challenged the public health, medical, world economic and other necessary activities of the whole world. COVID-19has had a detrimental effect on global healthcare systems rippling to other sectors alsoincluding tourism, petroleum, aviation, e-commerce, sports, entertainment and IT sector etc. Some of the vaccines got approval for the treatment of coronavirus infection. To break the chain of infection, washing hands with soap for 30 sec and alcohol based sanitizers, wearing masks at public places, physical distancing and following the prevention protocols and advisories issued from various health organizations is quite enough to keep the virus at bay. The coronavirus pandemic caused a major reshuffle which includes public health emergency, economic shutdown and social isolation as well as physical distancing. This pandemic has critically affected many practices of consumption or socializing between individuals. Some of the foremost changes in terms of volume, content and procedures took place in these domains of practices. Moreover, social isolation and economic shutdown coupled by physical distancing policies has blocked the performance of both the activities. Likewise, stay-at-home significantly reduced social communication and inter-personal interactions. The pandemic may show a

two wave or three wave pattern that too with unpredicted degree of severity. In future government launch some advance programmes like case investigation and tracing programmes which helps to tackle public health equity and advance community resilience. Thus, apart from fighting back this outbreak, lots of efforts are needed for the prevention of future outbreaks of zoonotic origin.

CONFLICT OF INTEREST

The authors declared no competing conflicts of interest.

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There is no direct or indirect financial interest and funding.

ETHICAL APPROVAL

No human or animal studies are performed in this study.

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