IJPSR (2021), Volume 12, Issue 3 (Review Article)

INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES AND RESEARCH

Received on 07 July 2020; received in revised form, 19 February 2021; accepted, 22 February 2021; published 01 March 2021

CORONAVIRUS TO COVID-19 PANDEMIC: AN OVERVIEW

Mandeep Rana, Simran Singla, Priya Jaswal and Gurfateh Singh *

Department of Pharmacology, University School of Pharmaceutical Sciences, Rayat Bahra University, Saharuan, Kharar, Mohali - 140104, Punjab, India.

Keywords:

Coronaviruses, MERS-CoV and COVID-19

Correspondence to Author:
Dr. Gurfateh Singh

Head,
University School of Pharmaceutical Sciences, Rayat Bahra University, Saharuan, Kharar, Mohali - 140104, Punjab, India.

E-mail: dr_sugga@yahoo.co.in

ABSTRACT: Coronaviruses wrapped with the layers of positive-sense RNA viruses specified by the club-like projections from their surface responsible for a variety of diseases in the animal kingdom. After the two historical episodes of coronaviruses *i.e.*, severe acute respiratory syndrome coronavirus (SARS-CoV) in 2002 and Middle East respiratory syndrome coronavirus (MERS-CoV) in 2012, this time world strike with its highly pathogenic form which is severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Coronavirus disease (COVID-19) is a viral cascade event that starts from Wuhan in December 2019 and becomes a public health emergency of global interest as declared by the World Health Organization. Primarily, bats became an identifiable source of SARS-CoV-2 and their transmission to humans has occured through an unknown intermediate source. Present situation depicts that more than 200^{+} countries are suffering from the deadly attack of SARS-CoV-2. This virus is dangerous for every age group because of its asymptomatic carrier state that results in acute respiratory diseases. Escalation of this virus occurs very easily through human-to-human transmission *via* droplets or direct contact, with an estimated incubation period of 7-14 days. Fever is the ubiquitous symptom of SARS-CoV-2 followed by a dry cough. After completing more than a 1-year journey with SARS-CoV-2, now the countries are able to fight pharmacologically with this virus. Prevention strategies recommended by WHO and AYUSH include isolation of suspected and confirmed cases with personal hygiene and immunity enhancing measures. This review enlightened on the epidemiology, history of coronavirus, pathogenesis, comparative analysis, clinical features, recent possible pharmacological and non-pharmacological approaches for COVID-19.

INTRODUCTION: Coronavirus (CoVs) comes under the category of zoonotic disease associated with the family coronavirinae and characterized by the jacketed positive-sense RNA viruses with club-like spikes or thorny projection from its surface resulted in numerous pathological conditions in the human and animal world [1, 2].

QUICK RESPONSE CODE

DOI: 10.13040/IJPSR.0975-8232.12(3).1332-41

This article can be accessed online on www.ijpsr.com

DOI link: http://dx.doi.org/10.13040/IJPSR.0975-8232.12(3).1332-41

On the basis of serological studies [3, 4] CoVs are segregated into three genera such as Genera I CoVs (animal pathogens) like feline infectious peritonitis virus (FIPV), porcine epidemic diarrhea virus (PEDV), human CoVs HCoV-229E, Transmissible gastroenteritis virus (TGEV) of the pig leads to respiratory infections.

Genera II (veterinary pathogens) such as porcine hemagglutinating encephalomyelitis virus, BCoV, human CoVs, OC43 equine coronavirus and NL63, also developed respiratory infections just like HCoV-229E [5, 6]. A genus III (avian CoVs) covers Infectious bronchitis virus (IBV), turkey CoVs, and pheasant CoVs [7] **Fig. 1**. On the basis of historical

expertise, CoVs tragedies were very fateful such as in South China in November 2002, the first outbreak of Severe Acute Respiratory Syndrome (SARS-CoV) collectively touched 8096 people with 774 deaths (mortality rate, 9.6%) [8, 9]. After that, in September 2012, Saudi Arabia becomes the centralized point for the second outbreak of CoVs, *i.e.,* Middle East Respiratory Syndrome Corona-virus (MERS-CoV), with 2494 confirmed cases and 858 deaths (mortality rate, 34.4%) [10, 11]. Once again, in December 2019, the world strikes with the third outbreak of CoVs entitled Severe Acute Respiratory Syndrome Corona Virus 2 (SARS-CoV-2) emerged from the Wuhan City of China and rapidly spread across the world [12, 13, 14]. Novel coronavirus with the asymptomatic features induces pneumonia and designated as coronavirus disease 2019 (COVID-19) as per WHO on 11th February 2020 [15]. This COVID outbreak is subdivided into four platforms, namely, Platform 1 without the local spread of infection. The cases of infection are limited to those people only who have a travel history from a COVID-19 affected country. Platform 2: deals with the stage of local transmission from any contact with the infected peoples. Finally, platform 3 is the last stage of community spread [16]. It is observed that CoVs attack the human body cells by membrane angiotensin-converting enzyme-2 exopeptidase receptor [17] and associated with symptomatic and asymptomatic states which require immediate hospitalization in the intensive care unit (ICU) due to the virulent and fatal health conditions. Non-Pharmacological approaches such as social distancing, personal hygiene, quarantine, and immunity-boosting measures recommended by WHO and AYUSH become the backbone of this pandemic to fight against this deadly virus.

However, few broad-spectrum antiviral drugs and vaccines have been evaluated against COVID-19 and are under clinical trial [18, 19]. This overview showed the connectivity between the SARS-CoV, MERS-CoV, and SARS-CoV-2, which may become a milestone creature about the progression history of COVID-19 globally.

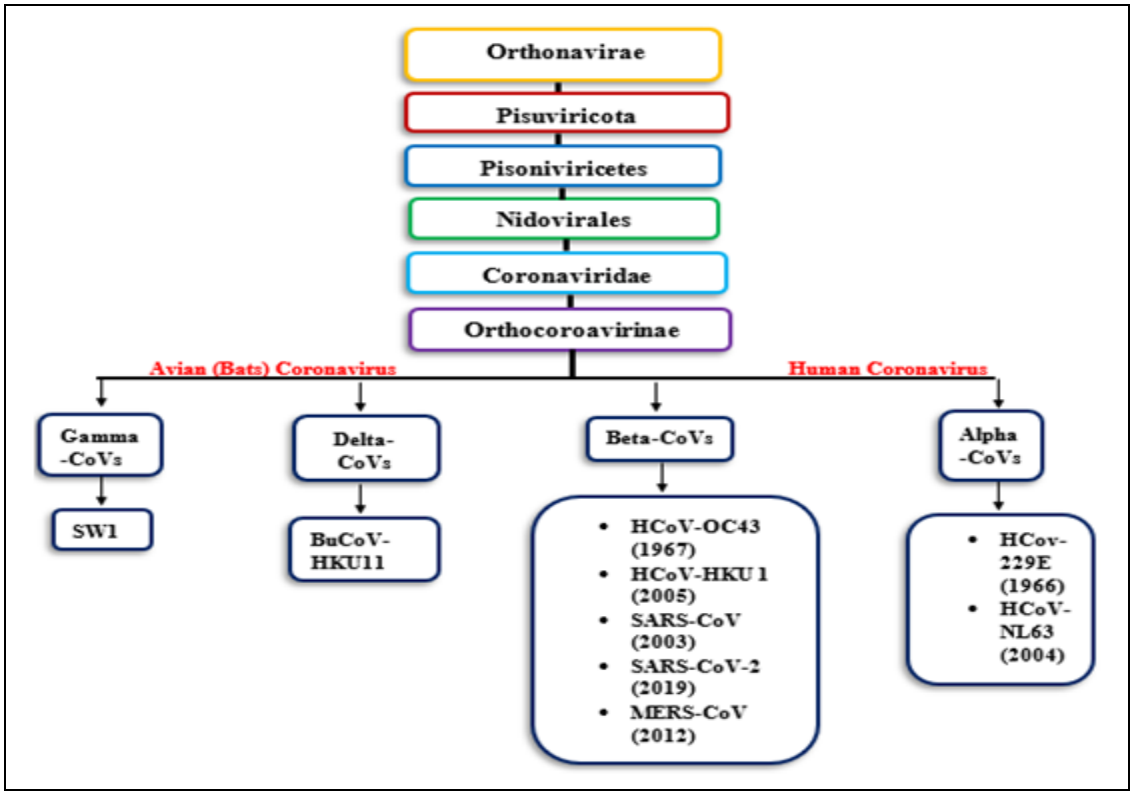

FIG. 1: TAXONOMICAL CLASSIFICATION OF CORONA VIRUSES

2. Epidemology: COVID-19 pandemic has shown devastating results, and it has affected 107,184,736 million people around the globe, with 2,341,576 reported deaths. On the same side, India has 10,847,790 positive cases followed by 155,195 deaths as cited by WHO as of 10/02/2021 [20]. It has not spared anyone, neither the immunosuppressed nor the healthy ones of the population [21, 22]. As per

the data of Chinese Health Authorities, COVID-19 has an incubation period of 7 days that ranges from 2-14 days [23, 24]. Similarly, SARS and MERS CoV incubation period remains commensurate to SARS-CoV-2 *i.e.*, 2-7 days and 2-14 days, respectively. However, the incubation period is smaller in the case of Swine flu and seasonal influenza (1-4 days) [25, 26, 27]. WHO states that COVID-19 reproductive number (R_0) estimates to be between 1.4-3.5 that makes it highly infectious, and it was observed that lower effective reproductive number (R_0) of SARS (1.77) has led to less spreading and lower pandemic risk [28, 29]. Moreover, various environmental and physical factors like the type of surface, temperature, and humidity affect its persistence on a variety of surfaces [30].

3. Life Cycle of SARS-CoV-2 Virus inside Human Body: Majorly, the constituents for virus structure is proteins especially known as S (spike), E (envelope), M (membrane), and N (nucleocapsid), out of which N protein is involved in the holding of RNA genome while the rest of proteins in combination form the viral envelope [31, 32]. The S protein namely spike glycoprotein found its role in attaching the virus to the ACE2 enzyme receptor, and ultimately it fuses with the host cell membrane [33]. The TMPRSS2 (transmembrane protease serine 2) is used by SARS CoV-2 to promote priming of S protein and infecting the target cells. Further, the S cleavage site in S protein divides into two subunits *i.e.*, S1 (receptor binding subunit) and S2 (fusion subunit), which facilitates virion attachment and fusion with the cell membrane [31]. However, this cleaving property of S protein is not observed in other species of coronavirus during the molecular analysis, and it is hypothesized that this can be a reason behind more infection power and efficient spreading of the SARS CoV-2 than SARS-CoV [34, 35].

Afterward, post membrane fusion, the genetic material of virus (RNA) enters the alveolar epithelial cells and takes over the control of host cell machinery in order to promote viral genome replication and synthesis of polypeptide chains [36] which leads to the formation of RCT (Replication-Transcription Complex) which proves to be crucial during the formation of subgenomic RNA as well as structural proteins [37, 38]. A very important role has been played by the viral envelope in the viral release, its assembly and promotion of viral pathogenesis [39]. All this has given a brief introduction, but more research is required to understand the role of various smaller viral peptides and subunits which are yet to be described and may prove crucial in better understanding of pathogenic mechanism **Fig. 2**.

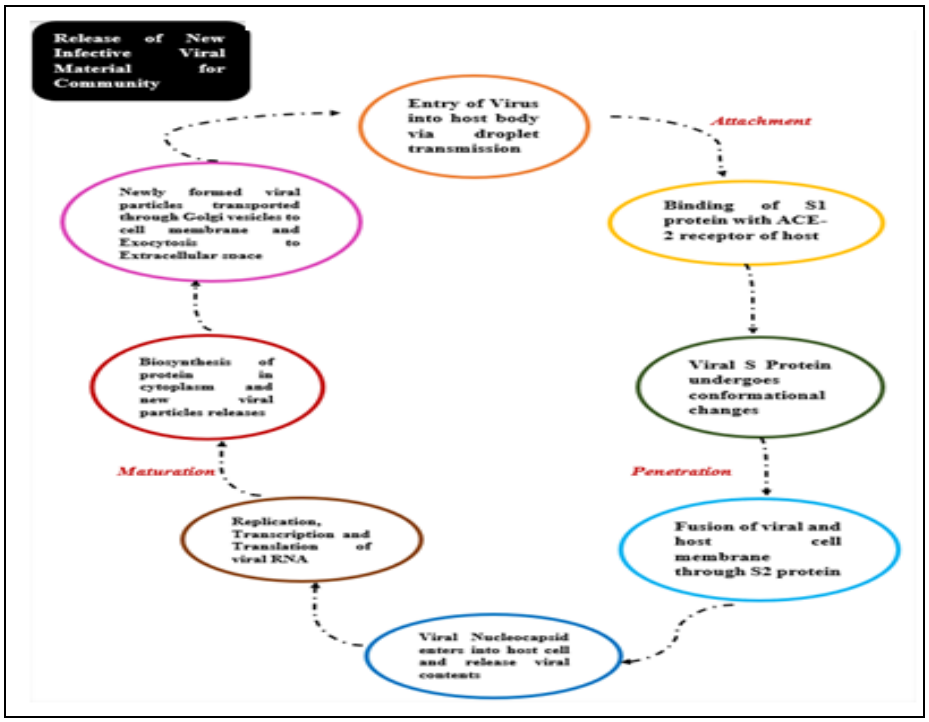

FIG. 2: LIFE CYCLE OF SARS-CoVs-2 VIRUS

4. Disease Pathophysiology: The disease progression can be classified into three phases such as: Phase I (Asymptomatic phase) is the primary stage of infection where virus just enters the human body through a suitable route of transmission but majorly it is through infected aerosols [40]. Virus enters through the nose and infects the nasal epithelial cells where it undergoes replication and propagation followed by infecting ciliated cells in the airways [41]. This stage is highly infectious although viral load is less but it can be detected through nasal swabs. The early symptoms are rarely found in this stage and may prove as silent killers [42]. Phase II (Infection of the upper respiratory tract) is the symptomatic stage where symptoms like dry cough, high fever, malaise *etc*. starts appearing. In this stage, virus has reached the upper respiratory tract owing to which immune response has been generated by the body against the virus particles [43]. The virus infected cells start releasing C-X-C motif chemokine ligand 10 and interferon mainly IFN-beta and IFN-alpha. This immune response is capable of preventing further replication of virus in four-fifth of the population [44]. Phase III (Infection in lower respiratory tract) is the critical stage and progression is seen in only one-fifth of the patients and patients start developing severe symptoms. This is recognized by the invasion of viral particles into the type 2 alveolar epithelial cells and undergoes replication over there so as to produce the large amount of viral nucleocapsids [45]. Pneumocytes got fully filled with virus copies and starts releasing a good amount of pro-inflammatory cytokines like IFN-α, IFN-γ, IL-1β, IL-6, IL-12, IL-18, IL-33, TNF-α, TGF-β, etc. and chemokines CCL2, CCL3, CCL5, CXCL8, CXCL9, CXCL10, etc. which looks like a storm of cytokines. Further, these attract some neutrophils mainly CD4 and CD8 T cells which starts sequestering in the tissues of lungs [46]. They try to fight with the virus but in that action, they harm lung tissues that further results in apoptosis of the cells and release of new viral cells, which further starts infecting surrounding epithelial cells [47]. Due to the autoimmune action of sequestered inflammatory cells, there is an injury at the gas exchange surfaces of the alveoli that leads to ARDS (Acute Respiratory Distress Syndrome) [48].

5. Transmission and Clinical Features: The transmission for COVID19 can be categorized into three general routes: Droplet transmission which is P2P (person to person) transmission in which infected person who is constantly coughing and sneezing produces droplets full of viral load and which came in close proximity of the mucosal surface (eyes, nose, mouth) of the healthy person [49]. Contact transmission occurs by sharing of fomites like clothes, utensils, furniture, medical equipment like thermometer with the infected person [50]. Lastly, Air borne transmission or aerosol transmission is the one in which various aerosol generating operations like bronchoscopy, nebulization with oxygen, endotracheal incubations, CPR *etc*., are performed for or by an infected person without taking preventive measures [51]. COVID-19 generally infects people of all age groups but people of age 40-70 years are more prone to it [11, 26]. The early and common symptoms are high fever, dry cough, severe body ache, difficulty in breathing, malaise, vomiting, disturbed abdomen [52]. In the mild condition, pneumonia starts developing with excessive coughing and breathlessness. However, in severe cases symptoms are severe pneumonia followed by hypoxia, acute kidney injuries, ARDS along with shock, encephalopathy, cardiac failure *etc*. can be noted down [53]. Rhabdomyolysis, aspergillosis, pancreatitis, neurological complications are some of the rare complications involved in COVID-19 [54]. Various diagnostic tests based upon epidemiological history, auxiliary examination and clinical manifestation are designed in order to have the early detection and further spreading can be prevented. RT-PCR (rapid test polymerase chain reaction) testing detects the nucleic acid of the viruses [55], ELISA test is based upon antigen antibody reaction which is used for confirmatory purposes, Point-of-care testing (POCT) is done for identification of IgG/IgM [56], CT scan and X Rays are to detect the presence of glass opacities and bilateral patches of cough and blood test can also be performed which shows lower white blood cell count and increased level of creatine protein, aspartate, aminotransferase, creatine kinase *etc*. [57]

6. Corona Virology from Sars to Mers: The CoVs comes in limelight in 1968, fabricated from the crown like morphology [58]. They are sorted into four sister branches: α-coronavirus (α-CoV), β-coronavirus (β-CoV), δ-coronavirus (δ-CoV) and γ - coronavirus (γ- CoV) [59, 60]. Targeting towards its

pathogenicity, CoVs are of two types [61] *i.e.* Low pathogenic (229E, HKU1, OC43, NL63) and high pathogenic (SARS and MERS) that cause multiple human diseases in the upper and lower respiratory tract respectively [62, 63]. Basically, the SARS-CoV-2 is layered with single positive-stranded RNA with its genomic range from 26 to 32 kilobase pair in length [58, 64]. As per genetic screening, SARS-CoV-2 is closely related with (88–89% similarity) two bat-derived SARS-like CoVs species, namely bat-SL-CoVZC45 (Gen Bank accession no. MG772933.1) and bat-SL-CoVZXC21 (Gen Ban accession no. MG772934.1), and it is clearly segregated from SARS-CoV (~79% similarity) and middle east respiratory syndrome coronavirus (MERS-CoV) (~50% similarity) [65, 66]. From asymptomatic to symptomatic state, the SARS-CoVs is a life- threatening condition that resulted in acute respiratory distress syndrome, multisystem organ failure and finally death [67]. The severity outcomes of SARS-CoV-2 are much more than SARS-CoVs [68] because of the length of (S) proteins, therefore its receptor-binding compatibility is totally different and modified from SARS-CoV [69]. Moreover, the nucleocapsid (N) protein in SARS-CoV helps to neutralize the immunological responses of the host and showed the antagonistic activity against interferon-gamma (IFN-g), basically a cytokine that triggers macrophages but still suspense should be there in the case of SARS-CoV-2 *i.e.,* its N proteins shows this ability or not [70]. Meanwhile, SARS-CoV-2 stands with 2 to 3-time higher R trough value (R_0) in comparison with SARS- CoV (<1). So, it become highly diffusible form of infection with a long incubation period associated with mild-to-moderate symptoms of infection with low mortality rate [71]. SARS-CoV and MERS-CoV both belongs from the zoonotic class of virus with their possible roots of origination in bats and camels [72, 73]. The intensity of spreadability of CoVs differs in every age group like SARS-CoV affects the young population whereas MERS-CoV affects the people above 50 years of age, however, SARS-CoV-2 touched with their harmful effects to people of every ages [74, 75].

7. Preventive Approaches:

Pharmacological Approaches: Drugs, Vaccines.

Non-Pharmacological Approaches: Quarantine and Social Distancing, WHO preventive guidelines, Ayurvedic, Yoga and Naturopathy, Unani, Siddha and Homeopathy (AYUSH) guidelines.

7.1. Pharmacological Approaches:

7.1.1. Drugs: Yet now, there is no approved treatment for COVID-19 so based upon the previous experience with SARS-CoV and MERS-CoV, it gives us direction towards antiviral drugs such as Ribavirin, Lopinavir, and Ritonavir [76]. In recent times Chloroquine has been found to have *in-vitro* anti-COVID-19 activity by showing its action at both entry and post-entry stages of virus [77].

Chloroquine has been well illustrated with *in-vitro* effects on inhibition of uncoating or alteration of post-translational modifications of newly synthesized proteins, especially inhibition of glycosylation in numerous viruses [78]. Therefore, Chloroquine and Hydroxychloroquine may be the future drug for treating COVID-19 infection, although many clinical trials with these drugs are already underway [79]. However, Remdesivir only and along with Chloroquine or interferon beta, significantly blocked the SARS-CoV-2 replication, and patients were declared as clinically recovered [80, 81].

A short while ago, Physicians isolated the blood plasma from clinically recovered patients of COVID-19 and injected it in the infected patients who showed positive results with rapid recovery [82]. Plasma therapy may be good futuristic potential candidates for COVID 19 patients after repeatedly clinical successful outcomes.

7.1.2. Vaccine: After the advent of coronavirus, a huge competition was noticed among various institutes in the search of suitable vaccine candidate for this deadly virus. Maximum of them targets the S glycoprotein of SARS-CoV-2 [78, 80]. During December 2020 and January of 2021, various nations started the vaccination drive at a large scale after the successful testing of vaccines and taking approval from the drug regulatory authorities.

Out of hundreds of candidates, some of them, like Comirnaty, Moderna COVID19 vaccine, Corona-vac, Astra Zeneca, SputnikV, Covaxin, EpiVac Corona have shown excellent results during preclinical as well as clinical trials and are now used by various nations **Table 1** [58].

TABLE 1: VARIOUS POTENTIAL CANDIDATES OF COVID-19 VACCINE

S. no.	Category	Name of Vaccine	Manufactured by	Chief point
1	Protein sub unit vaccine	NVX-CoV2973	Emergent BioSolutions, Novax, Inc	Based upon the recombinant expressions of the stable pre-fusion, coronavirus S. Protein
		Molecular Clamp Stabilised spike protein vaccine	University of Queensland in collaboration with GSK and Dynavax	Based upon the Molecular Clamp technology
		PittCovace	University of Pittsburgh	Micro-Needle Array (MNA) based recombinant SAR-CoV-2 vaccine
		Triple Antigen Vaccine	Premas Biotech, India	Multi-antigenic VI.P vaccine prototype
2	Viral Vectored vaccines	AdS-nCoV	CanSino Biologic Inc, Beijing Institute of Biotechnology	Constructed using the Admax system from the Microbix Biosystem
		Coroflu	University of Wisconsin Madison, FluGen, Bharat Biotech	The vaccine express the hemagglutinin protein of the influenza virus
		ChAdOx1	University of Oxford	Recombinant adenovirus vaccine
3	mRNA Vaccine	mRNA-1273	Moderna TX, Inc	mRNA encapsulated in Lip[id nanoparticle
		BNT162b1	Biotech FosunPharma Pfizer	mRNA encapsulated in 80nm ionizable cationic lipid nanoparticles
4	DNA Vaccine	INO-4800	Inovia Pharmaceuticals	Use codon optimized S protein sequence of SARA-CoV-2
		ZyCoV-D	Zydus Cadila	Genetically engineered DNA plasmid-based vaccine encoding for the membrane proteins of the virus
5	Live Attenuated Vaccine	DeINSI-SARA-CoV-2-RBD	University of Hong Kong	Re-organized to express the RBD domain of SARA-CoV-2
6	Others	BBV152 (A-C)	Bharat Biotech, ICMR, NIV	Inactivated whole virion vaccine

7.2. Non-Pharmacological Approaches:

7.2.1. WHO Quarantine Guidelines and Social Distancing: The ultimate goal of quarantine is to restrict the movement or separate the rest of the population from the healthy persons who may have been exposed to the virus and to monitoring their symptoms and ensure early detection of cases [83]. Quarantine differs from isolation as it separates ill or infected persons from others to prevent the spread of infection or contamination. Persons who are in quarantine must be placed inappropriately ventilated, the spacious room having the provision of adequate food, water, and hygiene facilities [84]. Social distancing (at least a distance of 1 meter) must be followed; along with this, medical assistance and psychosocial support must be there. According to WHO, the quarantine period for COVID-19 cases should be 14 days [85]. Ministry of Health and Family Welfare, Government of India and other countries have published travel advisories from time to time respectively which focus on the people with travel history from China, and other affected countries will be quarantined on arrival [86]. Diamond Princess, a cruise ship docked off Yokohama in Japan was quarantined for two weeks after a tourist who stepped out at Hong Kong tested positive for SARS-CoV-2 [87, 88]. The cruise ship had over 3,700 passengers and crew, of whom 705 were tested positive for SARS-CoV-2 [89].

7.2.2. WHO Guidelines for Prevention of Covid-19: A string of measures has been suggested to diminish nosocomial infection, including training for prevention and control, isolation, disinfection, classified protections at different degrees in infected areas and protection of confirmed cases [90, 91]. Personal hygiene, a healthy lifestyle, and adequate nutritional intake are the main ways to boost up immunity [92, 93]. According to studies, vitamin C may hinder the susceptibility of lower respiratory tract infection under certain conditions in COVID-19 [94]. For SARS-CoV-2 infection protective measures include improving personal hygiene, wearing medical masks, proper rest, and good ventilation [95, 96]. Health care workers are endorsing to use of particulate respirators such as those certified N95 or FFP2 while performing aerosol-generating procedures as per WHO guidelines [97]. From the experience of management of MERS-CoV and SARS-CoV infections, the WHO recommended infection control interventions to reduce the general risk of transmission of acute respiratory infections by avoiding close contact with infected people, practicing cough etiquette and frequent hand washing along with sanitization [98, 99].

7.2.3. Ayush Guidelines: Ministry of AYUSH guidelines gives the green light to the following self-care guidelines for preventive health measures

and boosting immunity with special reference to respiratory health [19]. As there is no medicine for COVID-19, so it will be advisable to take preventive measures because prevention is better than cure.

7.2.3.1. General Measures: Drink warm water throughout the day. Daily practice of Yogasana, Pranayama and meditation required for at least 30 minutes. Spices like Turmeric (*Curcuma longa*, Family *Zingiberaceae*), Cumin *(Cuminum cyminum*, Family *Apiaceae*), Coriander (*Coriandrum sativum*, Family *Apiaceae*), and Garlic (*Allium sativum*, Family *Amaryllidaceae*) are recommended in cooking [19].

7.2.3.2. Ayurvedic Immunity Promoting Measures: Take Chyavanprash 10gm in the morning. Diabetics should take sugar-free Chyavanprash. Following are the major ingredients of Chyavanprash: Amla (*Phyllanthus emblica*, Family *Phyllanthaceae*), Sesame oil (*Sesamum indicum*, Family *Pedaliaceae*), Cow's ghee (Clarified butter), Sugar, Honey, Agarwood (*Aquilaria malaccensis*, Family *Thymelaeaceae*), Bael (*Aegle marmelos*, Family *Rutaceae*), Dry grapes (Vitaceae), Long pepper (*Piper longum*, Family *Piperaceae*), Red sandalwood *(Pterocarpus santalinus*, Family *Fabaceae*), White sandalwood (*Santalum album*, Family *Fabaceae*), Cardamom *(Elettaria cardamomum*, Family *Zingiberaceae*), Tejpata (*Cinnamomum tamala*, Family *Lauraceae*), Guduchi (*Tinospora cardifolia*, Family *Menispermaceae*), *etc*. Drink herbal tea/decoction (Kadha) made from Basil (*Ocimum sanctum*, Family *Lamiaceae*), Cinnamon (*Cinnamomum verum*, Family *Lauraceae*), Black pepper *(Piper nigrum*, Family *Piperaceae*), Dry Ginger (*Zingiber officinale*, Family *Zingiberaceae*) and Munakka (Raisin) - once or twice a day. Add jaggery (natural sugar) or fresh lemon juice to your taste, if needed. The Golden Milk- Half teaspoon turmeric (*Curcuma longa*, Family Zingiberaceae) powder in 150 ml hot milk may be taken once or twice a day [19].

CONCLUSION: Worldwide, this pandemic year 2020 becomes familiar to everyone as a year of COVID-19 or coronavirus. Every day of this year starts with the new outcomes of this deadly virus on human health and becomes an invisible health blackmailer to all ages in the existing universal population. Although, the countries with outstanding health care facilities and infrastructures are break down with the footprints of COVID-19. So, our first priority is to stop the progression or transmission of this deadly virus with the use of very familiar coronavirus terminologies such as isolation, quarantine, immunity, and personal hygiene maintains. This review enlightens coronavirus's life story, including its complicated pathogenicity to genomic similarities with other forms of CoVs and the newly discovered vaccines. Therefore, it's fascinating to gather knowledge about the linkage of these trios of CoVs, *i.e.*, SARS-CoV, MERS CoV, and SARS-CoV-2, and that may also become the ray of hope for designing new antiviral therapies. This present overview also focused on the currently used pharmacological and non-pharmacological criteria's in India or worldwide as well as on the active, recovered, or death cases of coronavirus. On behalf of gathered information, it's clear that for eradicating this corona term, we should work on a ground level, develop an advance or scheduled framework in our health care system to stop the progression or control of this virus. This present eugenically framed molecular level study of CoV to COVID -19 may act as good potential candidates for futuristic researchers in the field of corona virology worldwide.

ACKNOWLEDGEMENT: We wish to express our gratefulness to Prof. Parvinder Singh, Worthy Vice-Chancellor, and S. Gurinder Singh Bahra (Honourable Chancellor), Rayat-Bahra University, Mohali (Punjab), for their praiseworthy inspiration, platform, and constant support for the completion of this study.

CONFLICTS OF INTEREST: The author has no conflicts of interest in the present review.

REFERENCES:

1. Li G, Fan Y and Lai Y: Coronavirus infections and immune responses. J Med Virol 2020; 92: 424-32.
2. Cui J, Li F and Shi ZL: Origin and evolution of pathogenic coronaviruses. Nat Rev Microbiol 2019; 17: 181-92.
3. McIntosh K: Coronaviruses: a comparative review. Curr Top Microbiol Immunol 1974; 63: 85129.
4. JM Gonzalez, Gomez-Puertas P, Cavanagh D, Gorbalenya AE and Enjuanes L: A comparative sequence analysis to revise the current taxonomy of the family Coronaviridae. Arch Virol 2003; 148: 2207-35.
5. Goebel SJ, Taylor J and Masters PS: The 3 cis-acting genomic replication element of the severe acute respiratory

syndrome coronavirus can function in the murine coronavirus genome. J Virol 2004; 78: 7846-51.
6. Gorbalenya AE, Snijder EJ and Spaan WJ: Severe acute respiratory syndrome coronavirus phylogeny: toward consensus. J Virol 2004; 78: 7863-66.
7. Cavanagh D, Mawditt K, Welchman Dde B, Britton P and Gough RE: Coronaviruses from pheasants (*Phasianus colchicus*) are genetically closely related to coronaviruses of domestic fowl (infectious bronchitis virus) and turkeys. Avian Pathol 2002; 31: 81-93.
8. Drosten C, Günther S and Preiser W: Identification of a novel coronavirus in patients with severe acute respiratory syndrome. N Engl J Med 2003; 348: 1967-76.
9. Ksiazek TG, Erdman D and Goldsmith CS: A novel coronavirus associated with severe acute respiratory syndrome. N Engl J Med 2003; 348: 1953-66.
10. Middle East Respiratory Syndrome Coronavirus (MERS-CoV): World Health Organisation. 2020. https://www. who.int/csr/don/mers-saudi-arabia/en/.
11. Coronavirus disease (COVID-19) outbreak: World Health Organisation. 2020. https://www.who.in.
12. Wang C, Horby PW, Hayden FG and Gao GF: A novel coronavirus outbreak of global health concern. Lancet. 2020; https://doi.org/10.1016/S0140-6736(20)30185-9.
13. Ramadan N and Shaib H: Middle East respiratory syndrome coronavirus (MERS-CoV): A review. Germs. 2019; 9: 35-42.
14. Zhong NS, Zheng BJ, Li YM, Poon, Xie ZH and Chan KH: Epidemiology and cause of severe acute respiratory syndrome (SARS) in Guangdong, People's Republic of China, in February, 2003. Lancet 2003; 362: 1353-58.
15. Zhou P, Yang XL and Wang XG: A pneumonia outbreak associated with a new coronavirus of probable bat origin. Nature. 2020; https://doi.org/10.1038/s41586-020-2012
16. Rana M, Singla S, Jaswal P and Singh G: Historical Journey of Coronavirus to COVID-19 pandemic: an overview. Innov Pharm Pharmacother 2020; 8(4): 1-7.
17. Yin, Y and Wunderink RG: MERS, SARS and other coronaviruses as causes of pneumonia. Respirology 2018; 23(2): 130-37.
18. Key considerations: quarantine in the context of COVID-19. In: Social Science in Humanitarian Action: A Communication for Development Platform. New York: UNICEF, Institute of Development Studies; 2020. https://www.socialscienceinaction.org/resources.
19. Ayurveda's immunity boosting measures for self-care during COVID 19 crisis. https://www.ayush.gov.in.
20. Kim JY, Choe PG, Oh Y, Oh KJ, Kim J and Park SJ: The first case of 2019 novel coronavirus pneumonia imported into Korea from Wuhan, China: Implication for infection prevention and control measures. J Korean Med Sci 2020; 35: e61.
21. Coronavirus disease 2019 (COVID-19) Situation Report - 87. World HealthOrganization.2020. https://who.int/docs/ defult-source/coronaviruse/situation reports/20200416-sitrep-87 covid.pdf.
22. Medicine JHUa. Coronavirus Resource Centre. 2020. https://coronavirus.jhu.edu.in.
23. Medical expert group of Tongji hospital. Quick guide to the diagnosis and treatment of pneumonia for novel coronavirus infections. Herald Med. 2020. http://kns.cnki. net/kcms/detail/42.1293.r.20200 30.1803.002.html.
24. Wang C and Wang X: Prevalence, nosocomial infection and psychological prevention of novel coronavirus infection. Chin General Pract Nurs 2020; 18: 2-3.
25. National Health Commission of People's Republic of China. Prevent guideline of 2019nCoV.2020.http://www. nhc.gov.cn/xcs/yqfkdt/202001/bc661e49b5bc487dba182f5 c49ac445shtml.
26. World Health Organization. Preliminary clinical description of severe acute respiratory syndrome.2020. https://www.who.int/csr/sars/clinical/en/.
27. Centers for Disease Control and Prevention. MERS clinical features. Atlanta, USA; CDC; 2019. https://www. cdc.gov/coronavirus/mers/clinicalfeatures.html.Accessed 16 Feb 2020.
28. Jilani TN, Jamil RT and Siddiqui AH: H1N1 influenza (swine flu). Stat Pearls Treasure Island, FL: Stat Pearls Publishing 2020.
29. World Health Organization. Situation report-24. Geneva: WHO. 2020. https://who.int/docs/default-source/ corona-viruse/situation-reports/20200213-sitrep-24-covid19.pdf.
30. Li Q, Guan X, Wu P, Wang X, Zhou L and Tong Y: Early transmission dynamics in Wuhan, China, of novel coronavirus-infected pneumonia. N Engl J Med 2020; https://doi.org/10.1056/NEJMoa2001316.
31. Cascella M, Rajnik M and Cuomo A: Features, evaluation and treatment coronavirus (COVID-19). Stat pearls [internet]. Treasure Island (FL): Stat Pearls Publishing, Jan 2020.
32. Bosch BJ, van der Zee R and de Haan CA: The coronavirus spike protein is a class I virus fusion protein: structural and functional characterization of the fusion core complex. J Virol 2003; 77: 8801-11.
33. Li W, Moore MJ and Vasilieva N: Angiotensin-converting enzyme 2 is a functional receptor for the SARS coronavirus. Nature 2003; 426: 450-4.
34. Chen Y, Guo Y and Pan Y: Structure analysis of the receptor binding of 2019-nCoV [published online ahead of print, 2020 Feb 17]. Biochem Biophys Res Commun 2020; 525: 135-40.
35. Walls AC, Park YJ and Tortorici MA: Structure, function, and antigenicity of the SARS-CoV-2 spike glycoprotein. Cell 2020; 181: 281-92.
36. Letko M, Marzi A and Munster V: Functional assessment of cell entry and receptor usage for SARS-CoV-2 and other lineage B beta coronaviruses. Nat Microbiol 2020; 5: 562-9.
37. Ou X, Liu Y and Lei X: Characterization of spike glycoprotein of SARS-CoV-2 on virus entry and its immune cross-reactivity with SARS-CoV. Nat Commun 2020; 11: 1620.
38. Li T, Zhang Y and Fu L: siRNA targeting the leader sequence of SARS-CoV inhibits virus replication. Gene Ther 2005; 12: 751-61.
39. Li W, Moore MJ and Vasilieva N: Angiotensin-converting enzyme 2 is a functional receptor for the SARS coronavirus. Nature 2003; 426: 450-4.
40. Yang N and Shen HM: Targeting the endocytic pathway and autophagy process as a novel therapeutic strategy in COVID-19. Int J Biol Sci 2020; 16: 1724-31.
41. Mason RJ: Pathogenesis of COVID-19 from a cell biology perspective. Eur Respir J 2020; 55: 2000607.
42. Wu Z and McGoogan JM: Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72314 cases from the Chinese centre for disease control and prevention. JAMA 2020; 323: 1239.
43. Wan Y, Shang J and Graham R: Receptor recognition by novel coronavirus from Wuhan: an analysis based on decade-long structural studies of SARS. J Virol 2020; 94: e00127-20.
44. Hoffmann M, Kleine-Weber H and Schroeder S: SARS-CoV-2 cell entry depends on ACE2 and TMPRSS2 and is

blocked by a clinically proven protease inhibitor. Cell 2020; 181: 271-280.
45. Sims AC, Baric RS and Yount B: Severe acute respiratory syndrome coronavirus infection of human ciliated airway epithelia: role of ciliated cells in viral spread in the conducting airways of the lungs. J Vir 2005; 79: 15511-24.
46. Tang NL, Chan PK and Wong CK: Early enhanced expression of interferon-inducible protein-10 (CXCL-10) and other chemokines predicts adverse outcome in severe acute respiratory syndrome. Clin Chem 2005; 51: 2333-40.
47. Xu Z, Shi L and Wang Y: Pathological findings of COVID-19 associated with acute respiratory distress syndrome. Lancet Respir Med 2020; 8: 420-2.
48. Channappanavar R and Perlman S: Pathogenic human coronavirus infections: causes and consequences of cytokine storm and immunopathology. Semin Immunopathol 2017; 39: 52939.
49. National Health Commission of People's Republic of China. Prevent guideline of 2019nCoV.2020. http://www.nhc.gov.cn/xcs/yqfkdt/202001/bc661e49b5bc487dba182f5c49ac445shtml.
50. Burke RM, Midgley CM and Dratch A: Active monitoring of persons exposed to patients with confirmed COVID-19: United States, January–February 2020. MMWR Morb Mortal Wkly Rep 2020.
51. Ong SW, Tan YK and Chia PY: Air, surface environmental, and personal protective equipment contamination by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) from a symptomatic patient. JAMA 2020; 323: 1610.
52. Huang C, Wang Y and Li X: Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet. 2020; https://doi.org/10.1016/s0140673620301835
53. Lauer SA, Grantz KH and Bi Q: The incubation period of coronavirus disease 2019 (COVID-19) from publicly reported confirmed cases: estimation and application. Ann Intern Med 2020; 172(9): 577-82.
54. GuanWJ, Ni ZY and Hu Y: China Medical Treatment Expert Group for Covid-19. Clinical characteristics of coronavirus disease 2019 in China. N Engl J Med. 2020; 382(18): 1708-20.
55. Gralinski LE and Menachery VD: Return of the Coronavirus: 2019-nCoV. Viruses 2020; 12(2): 135.
56. Xu Z, Shi L and Wang Y: Pathological findings of COVID-19 associated with acute respiratory distress syndrome. Lancet Resp Med 2020; https://doi.org/10.1016/s221326002037776
57. Anthony SJ, Gilardi K, Menachery VD, Goldstein T, Ssebide B, Mbabazi R, Navarrete Macias I, Liang E, Wells H and Hicks A: Further evidence for bats as the evolutionary source of Middle East respiratory syndrome coronavirus. mBio 2017; 8: 16.
58. Kaur SP and Gupta V: COVID-19 Vaccine: A comprehensive status report. Vir Res 2020; 288: 198114.
59. Azhar EI, El-Kafrawy SA, Farraj SA, Hassan AM, Al-Saeed MS, Hashem AM and Madani TA: Evidence for camel-to-human transmission of MERS coronavirus. N Engl J Med 2014; 370: 2499-2505.
60. Yin Y and Wunderink RG: MERS, SARS and other coronaviruses as causes of pneumonia. Respirology 2018; 23(2): 130-37.
61. Hui DS, Azhar EI, Madani TA, Ntoumi F, Kock R, Dar O, Ippolito G, Mchugh TD, Memish Z, Drosten C, Zumla A and Petersen E: The continuing 2019-nCoV epidemic threat of novel coronaviruses to global health-The latest 2019 novel coronavirus outbreak in Wuhan, China. Int J Infect Dis 2020; 91: 264-66.
62. Holshue M.L, DeBolt C, Lindquist S, Lofy KH, Wiesman J, Bruce H, Spitters C, Ericson K, Wilkerson S, Tural A, Diaz G and Cohn A: First Case of 2019 Novel Coronavirus in the United States the New England Journal of Medicine 2020.
63. Lau SK, Woo PC, Li KS, Huang Y, Tsoi HW and Wong BHL: Severe acute respiratory syndrome coronavirus-like virus in Chinese horseshoe bats. Proc Natl Acad Sci U S A 2005; 102: 14040-5.
64. Guo YR: The origin, transmission and clinical therapies on coronavirus disease 2019 (COVID-19) outbreak–an update on the status, Military Medical Research 2020; https://doi.org/10.1186/s407790200024007.
65. Fehr AR and Perlman S: Coronaviruses: an overview of their replication and pathogenesis. Methods Mol Biol. 2015; 1282: 1-23.
66. Lu R, Zhao X, Li J, Niu P, Yang B and Wu H: Genomic characterization and epidemiology of 2019 novel coronavirus: implications for virus origins and receptor binding. Lancet. 2020; https://doi.org/10.1016/S0140673620302518
67. Jiang S, Du L and Shi Z: An emerging coronavirus causing pneumonia outbreak in Wuhan, China: calling for developing therapeutic and prophylactic strategies. Emerg Microbes Infect 2020; https://doi.org/ 10.1080/22221751.20201723441
68. Ren LL, Wang YM, Wu ZQ, Xiang ZC, Guo L and Xu T: Identification of a novel coronavirus causing severe pneumonia in human: a descriptive study. Chin Med J Engl 2020; http://doi.org/10.1097/CM900000 00000722.
69. Rodriguez-Morales AJ, Cardona-Ospina JA and Gutiérrez-Ocampo E: Clinical, laboratory and imaging features of COVID-19: a systematic review and meta-analysis. Travel Med Infect Dis 2020; 34: 101623.
70. Wu C, Chen X and Cai Y: Risk factors associated with acute respiratory distress syndrome and death in patients with coronavirus disease 2019 pneumonia in Wuhan, China. JAMA Intern Med 2020; 58(4): 713-14.
71. Kan B, Wang M, Jing H, Xu H, Jiang X, Yan M, Liang W, Zheng H, Wan K and Liu Q: Molecular evolution analysis and geographic investigation of severe acute respiratory syndrome coronavirus-like virus in palm civets at an animal market and on farms. J Virol 2005; 79: 1189211900.
72. Lu R, Zhao X, Li J, Niu P, Yang B, Wu H, Wang W, Song H, Huang B, Zhu N, Bi Y, Ma X, Zhan F, Wang L, Hu T, Zhou H, Hu Z, Zhou W, Zhao L, Chen J, Meng Y, Wang J, Lin Y, Yuan J, Xie Z, Ma J, Liu WJ, Wang D, Xu W, Holmes EC, Gao GF, Wu G, Chen W, Shi W and Tan W: Genomic characterization and epidemiology of 2019 novel coronavirus: implications for virus origins and receptor binding. Lancet. 2020; 395: 565-74.
73. Tyrrel, DAJ, Almedia JD, Berry DM, Cunningham CH, Hamre D, Hofstad MS, Malluci L and McIntosh K: Coronavirus Nature 1968; 220: 650.
74. Chan JF, To KK, Tse H, Jin DY and Yuen KY: Interspecies transmission and emergence of Novel viruses: lessons from bats and birds. Trends Microbiol 2013; 21: 544-55.
75. Cowley JA, Dimmock CM, Spann KM and Walker PJ: Gill-associated virus of Penaeus monodon prawns: an invertebrate virus with ORF1a and ORF1b genes related to arteri- and coronaviruses. J Gen Virol 2000; 81: 1473-84.
76. Jin YH, Cai L and Cheng ZS: A rapid advice guideline for the diagnosis and treatment of 2019 novel coronavirus [2019-nCoV] infected pneumonia. Mil Med Res 2020; 7: 4.

77. Wang M, Cao R, Zhang L, Yang X, Liu J and Xu M: Remdesivir and chloroquine effectively inhibit the recently emerged novel coronavirus (2019nCoV) *in-vitro*. Cell Res 2020; https://doi.org/10.1038/s142202002820
78. Rolain JM, Colson P and Raoult D: Recycling of chloroquine and its hydroxyl analogue to face bacterial, fungal and viral infections in the 21st century. Int J Antimicrob Agents 2007; https://doi.org/10.1016/j. ijantimicag.200705015
79. Zhu R, Gao R, Robert S-H, Gao J, Yang S and Zhu C: Systematic review of the registered clinical trials of Coronavirus Disease 2019 (COVID19). Med Rxiv 2020; https://doi.org/10.1101/2020030120029611
80. Sheahan TP, Sims AC, Leist SR, Schäfer A, Won J and Brown AJ: Comparative therapeutic efficacy of remdesivir and combination lopinavir, ritonavir, and interferon beta against MERS-CoV. Nature Communication 2020; 11(1): 1-14.
81. Holshue ML, DeBolt C, Lindquist S, Lofy KH, Wiesman J and Bruce H: First case of2019 novel coronavirus in the United States. New England Journal of Medicine 2020: 19.
82. Derebail VK and Falk RJ: ANCA-Associated Vasculitis-Refining therapy with plasma exchange and gluco-corticoids. Mass Medical Soc 2020; 382(7): 671-73.
83. Carlson R: INO4800 coronavirus vaccine. 2020. https://www.precisionvaccinations.com/vaccnes/ino-4800 coronavirus-vaccine.
84. Duddu P: Coronavirus outbreak: Top coronavirus drugs and vaccines in development. 2020. https://www.clinical trialsarena.com/analysis/coronavirus-mers-cov-drugs.
85. McKay BLP: Drugmakers rush to develop vaccines against china virus the wall street journal. 2020. https://www.wsj.com/articles/drugmakers-rushto-develop-vaccines-against chinavirus11579813026.
86. World Health Organization. Global Surveillance for human infection with coronavirus disease (COVID-19): Interim guidance. 2020. https://www.who.int/emergencies/ diseases/novel-coronavirus-2019.
87. Considerations for quarantine of individuals in the context of containment for coronavirus disease (COVID-19). World Health Association: Interim guidance. 2020. https:// www.who.int/emergencies/diseases/novel-corona-virus-2019/question-and-answershub/q-a-detail/q-a-corona-viruses.
88. Habibi R, Burci GL, de Campos TC, Chirwa D, Cinà M and Dagron S: Do not violate the International Health Regulations during the COVID-19 outbreak. Lancet 2020; 395: P664-6.
89. Diamond Princess Cruise Ship test positive for COVID-19. The Japan Times Online. 2020. https://www.japantimes. co.jp/news/2020/02/13/national/coronavirus-diamond-princess.
90. Dooley B and Rich M: Cruise ship's coronavirus outbreak leave screw nowhere to hide. The New York Times. 2020. https://www.nytimes.com/2020/02/10/business/coronaviru s-japan cruise-ship.html.
91. Normile D: Coronavirus infections keep mounting after cruise ship fiasco in Japan. 2020. https://www.sciencemag. org/news/2020/02/coronavirus-infections-keep-mounting after-cruiseship-fiasco-japan. Accessed 28 February 2020.
92. Wei Q and Ren Z: Disinfection measures for pneumonia foci infected by novel corona virus in 2019. Chin J Disinfect 2020; 37: 59-62.
93. Bin C, Fang X and Chen H: Application effect of disaster vulnerability analysis incoping with the transmission of new coronavirus in non-closed hematology ward. 2020. http://kns.cnki.net/kcms/detail/14.1272.R.20200131.1909. 002.html.
94. High KP: Nutritional strategies to boost immunity and prevent infection in elderly individuals. Clin Infect Dis 2001; 33: 1892-900.
95. Simpson RJ, Kunz H, Agha N and Graff R: Exercise and the regulation of Immune functions. Prog Mol Biol Transl Sci 2015; 135: 355-80.
96. Hemila H: Vitamin C intake and susceptibility to pneumonia. Pediatr Infect Dis J 1997; 16: 836-7.
97. Guan W, Ni Z, Hu Y, Liang W, Ou C and He J: Clinical characteristics of 2019 novel coronavirus infection in China 2020; 382: 1708-20.
98. WHO. Advice on the use of masks in the community, during home care and in health care settings in the context of the novel coronavirus 2019-nCoV outbreak (Interim guidance). 2020. WHO/nCov/IPC_Masks/2020.
99. World Health Organization (WHO). Novel coronavirus (2019-nCoV). Situation report.https://www.who.int/docs/ default-source/coronaviruse/situation-ports/20200207-sitrep-18 ncov.pdf.

How to cite this article:
Rana M, Singla S, Jaswal P and Singh G: Coronavirus to Covid-19 pandemic: an overview. Int J Pharm Sci & Res 2021; 12(3): 1332-41. doi: 10.13040/IJPSR.0975-8232.12(3).1332-41.