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Possible strategies and treatments of SARS-CoV-2 outbreak

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Abstract

December 2019 in Wuhan, Hubei, China, pneumonia-like cases with unexplored cause appeared, after sequence analysis named as SARS-COV-2. WHO reported the prevalence of tobacco addiction were 19.33%, with 23.29% male and 15.35% female adolescents in 133 countries of the world. History revealed it is a type of common virus spreading epidemic in animals: people, birds, bats mostly harbor these viruses. Bats, pigs, civets, and pangolins are to be intermediate species for the new coronavirus. Coronaviruses cause long term and constant effect due to their ability to adapt the new environment and host by mutation; recombination as dependent RNA polymerase and error-prone RNA. Four genera of Coronaviruses are Alpha, Beta, Gamma, and Delta coronaviruses respectively. HCOV-NL63, TGEV, PEDV are alpha coronaviruses. SARS-CoV, MERS-CoV, OC43 are beta coronaviruses. IBV, PdCoV are gamma and delta coronaviruses, respectively. This outbreak would be controlled under the guideline of prevention and maintain hygienic conditions.

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Introduction

Coronavirus is commonly known as the common cold, fever, nose infection, throat infection, headache, breathlessness, myalgia, and sinuses in humans [1]. Virus can be transmitted through aerosolization, contacting infectious surfaces, and through feco-oral routes [2]. These viruses have long term affect due to environmental adaptation, mutations and dependent RNA polymerase, error-prone, and RNA. Coronavirus belongs to family *Coronaviridae* and order *Nidovirales* [3, 4]. Four genera of coronaviruses are Alpha, Beta, Gamma, and Delta. Alpha and beta coronaviruses cause infection in mammals while gamma in birds and delta coronavirus causes infection in both mammals and birds [5, 6]. Human coronavirus NL63 (HCoV-NL63), Porcine transmissible gastroenteritis coronavirus (TGEV), Porcine epidemic diarrhea virus (PEDV) and Porcine respiratory coronavirus are included alpha coronaviruses. SARS-CoV (severe acute respiratory syndrome corona virus), MERS-CoV (middle east respiratory syndrome), Bat coronavirus, HKU4, Mouse hepatitis corona virus (MHV), Bovine corona virus (BCoV) and human coronavirus OC43 are included beta coronaviruses. Avian infectious bronchitis corona virus (IBV) and porcine delta corona virus (PdCoV) are in gamma and delta corona viruses respectively [7, 8]. Corona viruses mostly cause respiratory illness which ranges from moderate to severe [9].

31st of December 2019 in Wuhan, Hubei, China, pneumonia cases with unexplored causes appeared named as SARS-CoV-2 [10]. According to the World Health Organization (WHO) report of 22nd of May 2020, about 4,993,470 people were affected worldwide and 327,738 people were dead due to deadliest SARS-CoV-2 [11]. According to the [New York City Health](#) report of April 14 sex ratio in coronavirus patient is 61.8% male and 38.2% female [12]. Smoking is considered as the leading cause of respiratory disorders results that males have more chances of SARS-CoV-2 infection as compared to females. Patients having pre-existing conditions as cardiovascular diseases, diabetes, chronic respiratory diseases, hypertension, cancer, and aging experienced more deaths [12-14].

Coronaviruses have a genome ranging from 27-32 kb, the largest genome among all RNA viruses [7]. Four different structural proteins as spike (S) protein, Nucleocapsid (N) protein, membrane (M) protein, and envelop (E) protein are involved to complete the

replication cycle of coronavirus. N form helical capsid and E surrounds the capsid. S helps to anchor the virus into the target cell to determine the host range and tissue tropism of the virus. It also helps the virus to shape like a crown. E and M proteins play a key role in virus assembly [8, 15]. The spike protein of SARS-CoV-2 has showing resemblance with the 3D structure of SARS-CoV spike protein, share nearly about 76% amino acid similarity [16, 17]. The structural analysis predicts that the spike protein of SARS-CoV-2 interacts with the putative binding domain site in human angiotensin-converting enzyme 2 (ACE2), receptor present in heart, lungs, kidneys, and gastrointestinal tract, facilitate the entry of virus in target cells (**Fig. 1**). The viral proteins interact with the ACE2 receptor and start its replication cycle [18, 19].

Discussion

The past two decades, >10,000 cases were reported for severe acute respiratory syndrome coronavirus (SARS-CoV) and Middle East respiratory syndrome corona virus (MERS-CoV) and the death rate was 9.6% for SARS-CoV and 40% for MERS-CoV [20]. It is observed that SARS-CoV and MERS-CoV were originated from bats. It has been discovered that SARS-CoV and MERS-CoV were found in bats leads to move in human from market civets and dromedary camels (one-humped camel of Arabia and North Africa) [21]. SARS was first observed in the Guangdong province of China in November 2002. The symptoms of SARS include cold, high fever, headache, body ache, discomfort, mild respiratory problems as cough after 2-7 days of attack, and diarrhea (10-20% patients). The incubation period of SARS-CoV is usually 2-7 days however can be up to 14 days. The old age people (above 65%) were most likely to die and males were dominant than females. Civets cats infected through bats were the possible intermediate species for SARS-CoV. SARS-CoV can be transmitted to another person by contact with infected respiratory droplets and personal contacts. The reported death rate was approximately 774 people out of 8000 patients [22]. MERS-CoV was first appeared in Saudi Arabia and spread to the other 27 countries [23]. The symptoms of MERS-CoV include fever, influenza, mild cough, breathing disorders as dyspnea (shortness of breath), and diarrhea. Numerous patients have severe respiratory disorders including adult respiratory distress syndromes (ARDS). MERS-CoV can be transmitted by person to person contact and infected

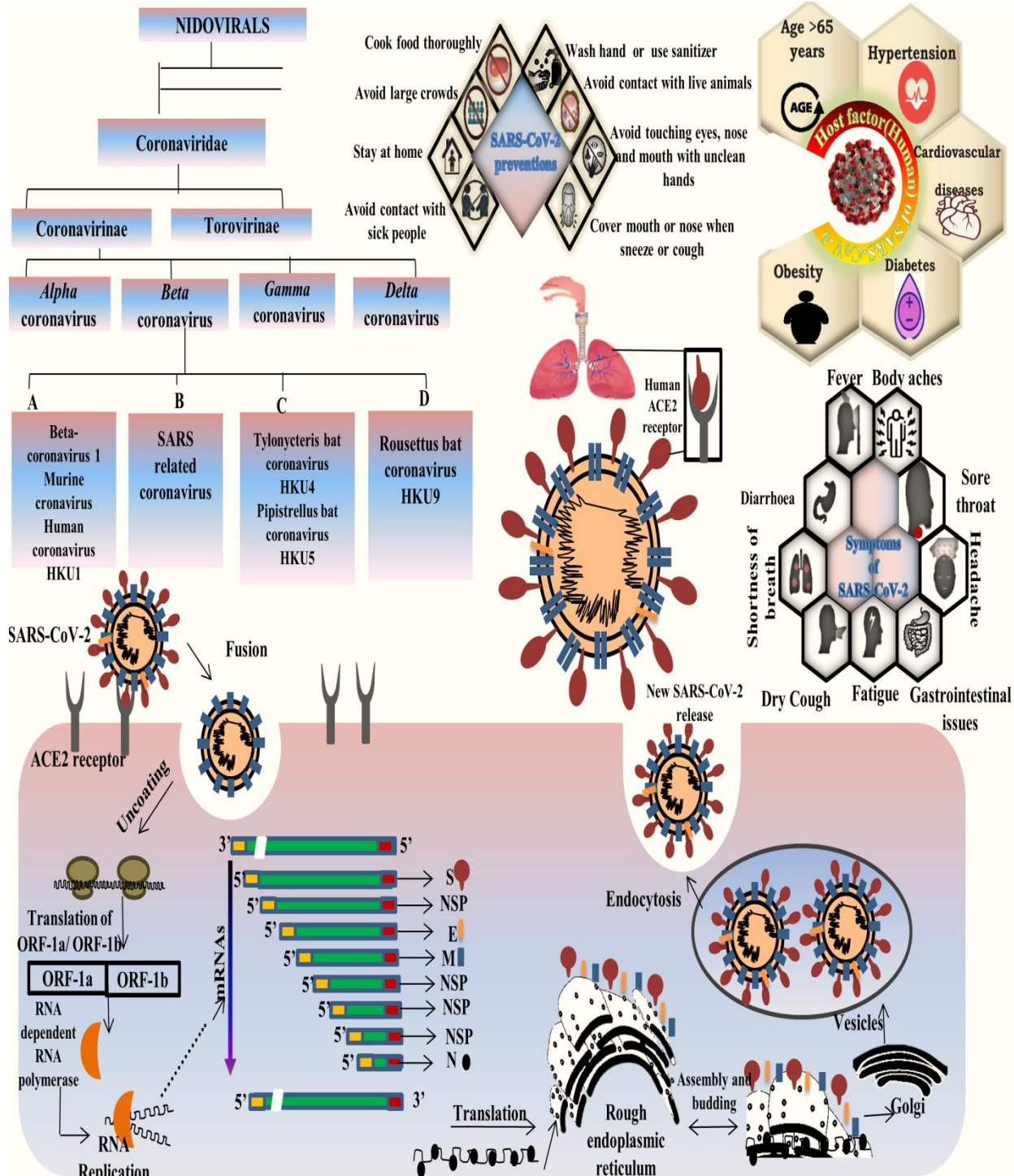


Fig. 1: Schematic representation of SARS-CoV-2.

respiratory droplets (greater than 5 μm). MERS-CoV was also originated in bats though there is no contact between the humans and bats in Saudi Arabia where more cases were observed (Table 1) [24-26]. Dromedary camels were considered to be the

reservoir species for coronavirus because of the presence of MERS-CoV specific antibodies in dromedary camels and the diagnosis of two patients who were linked to dromedary farms in Qatar [21]. In 2012 MERS-CoV, there is almost 858 deaths out

Table 1: SARS, MERS and SARS-CoV-2 outbreak summary during 2000-2019.

| Parameters | SARS-CoV | MERS-CoV | SARS-CoV-2 |
|-----------------|------------------|----------------------|----------------|
| Detection date | November, 2002 | June, 2012 | December, 2019 |
| Detection place | Guangdong, China | Jeddah, Saudi Arabia | Wuhan, China |
| Age average | 39.9 | 56 | 49 |

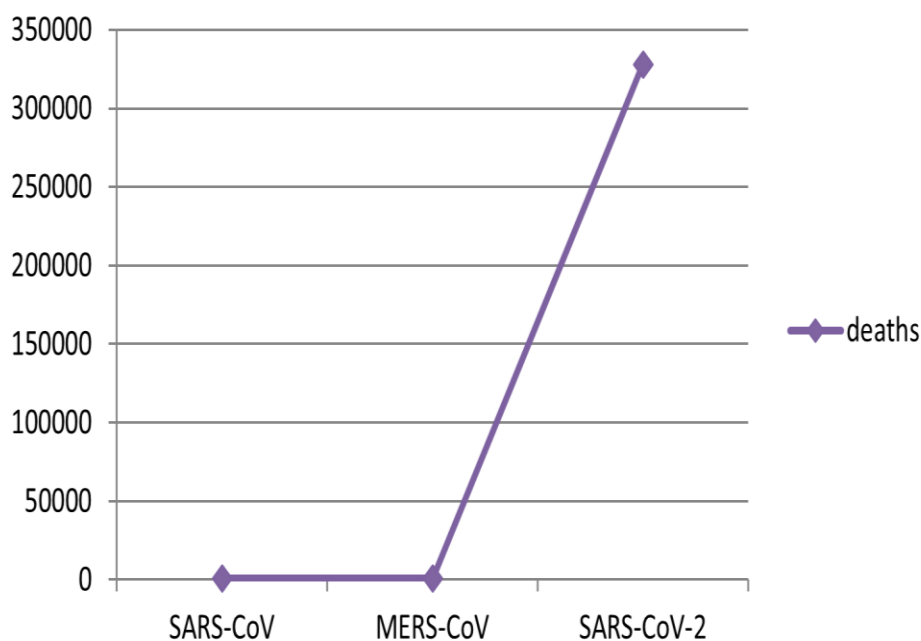
of 2442 cases worldwide [20]. Males were more affected than females. People with cardiovascular diseases, diabetes, and renal problems were more prone to MERS-CoV infection. The incubation period for MERS-CoV is about 5 days [27].

Both SARS-CoV and SARS-CoV-2 have similar cellular pathways. Moreover, there is a difference in the sequence of amino acid of SARS CoV and SARS-CoV-2 as 8a (accessory protein) is absent in SARS-CoV-2 [28]. In SARS-CoV-2, 8b(accessory proteins) is 37 amino acids longer and 3b is 132 amino acids shorter than SARS-CoV [29]. SARS-CoV-2 showed more resemblance to bat like SARS than SARS-CoV which evolved from coronavirus and is more similar to SARS-CoV than MERS-CoV [30] (**Fig. 2**).

The outbreak of SARS-CoV in 2003 is compared with SARS-CoV while it has a short incubation period (2-7 days) as compared to SARS-CoV-2 (2-14 days) [31]. There is no specific vaccine and drug for the treatment of SARS-CoV-2. Anti-inflammatory drugs [32], Arbidol [33], Peptide (EK1) [34], Remdesivir [35], Lopinavir\Ritonavir [36], Lopinavir\Ritonavir combined with Interferon-B, Nucleoside analogues, RNA synthesis inhibitors

[34], monoclonal antibodies, convalescent plasma [37], combination of Ribavirin and Interferon α , Systemic Glucocorticosteroid [38], Oligonucleotide(ON) Strategy [39], Favipiravir (T705) [40], Oseltamivir [41], Chloroquine [42], Corticosteroid (Methylprednisolone) [43], Antibiotics combination (Amoxicillin, Azithromycin, Fluoroquinolones) [44], Chinese traditional medicine (CTM) [45], Oxygen therapy [46] and Nanotechnology [47] could be the possible treatment options for corona virus although their safety and efficacy need more research.

The use of nanotechnology to develop nanoparticles (Gold Nanoparticles, Carbon quantum dots, Magnetic Nanoparticles, Lipid Nanoparticles, Graphene oxide, Silica, and Polystyrene Nanoparticles) could be an effective option for the treatment of SARS-CoV-2. The objects of different nano-size contact with biological fluid are to become new biological identity known as protein corona. Protein corona changes the properties of nanoparticles such as changes in physiochemical properties which in turn affect the biological properties of nanoparticles as changes in cell uptake behavior to reduce the infection rate [47].

**Fig. 2:** Mortality rate of SARS-CoV, MERS-CoV and SARS-CoV-2.

The confirmed cases of SARS-CoV-2 who are critically ill, having infection require critical management and modification of intensive care to reduce the risk of transmission. In addition to standard precautions which include hand hygiene, use of personal protective equipment, respiratory hygiene, cleaning and disinfectant, cough etiquette, and waste management, patients with confirmed SARS-CoV-2 also need the precautions of airborne, droplet and contact. To lessen the chances of transmission, patients should not share personal equipment with others and should wear a mask to reduce the airborne transmission of the virus. The Aerosol generating procedures (AGP) such as noninvasive ventilation, tracheal intubation, airway suctioning, manual ventilation, and bronchoscopy must be carried out in AIIR (Airborne infection isolation Room) and fit-tested N95 respirators, gloves, gowns, and eye protection are necessary for AGP to avoid risk of exposure. The movement of the patients must be limited outside the AIIR. After removal of personal equipment, hand must wash with hand sanitizer. The healthy people should improve hygiene conditions and should avoid social contact to avoid SARS-CoV-2 pandemic [48-50].

Conclusion

The past two-decades, beta coronavirus has caused severe diseases, but mortality rate was lower than SARS-CoV-2. The outbreak of SARS-CoV-2 has largely burdened health and economy of world comprehensive measures should be adopted to prevent this outbreak.

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Conflict of Interest

The authors declare no conflict of interest.

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