

SARS-CoV-2: IS HUMAN RACE UNDER THREAT?

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Abstract :

Across the world, the COVID-19 pandemic has brought life to a standstill. Human activities are restricted by the medical advisory released by the government as mandatory guidelines to be followed strictly. Medical experts themselves are perplexed by the degree of complexity in dealing with novel strain of the virus. As the pandemic is spreading at a steadfast pace, vigorous researches are underway world over to understand the nature of the virus, its transmissibility, the genetic code hidden inside it and methods to exploit those links that can lead to its termination. The present study is based on reviewing major breakthrough researches on the COVID-19 pandemic. Prominent studies on modes transmission of the disease and some interesting preventive measures are covered.

Keywords: COVID-19, pandemic, 2019-nCoV, SARS-CoV-2, fomite, aerosols, MERS-CoV codon usage bias,

I. INTRODUCTION

Human race is facing unprecedented, unheard of threat under the clutches of a microscopic virus. Though corona virus infecting humans was first identified in 1965, the chronology of corona virus inflicting death dates back to the onset of the present century. In 2002, Severe Acute Respiratory Syndrome (SARS-CoV) infected approximately 8000 people with nearly 10% mortality rate [1]. Middle East Respiratory Syndrome (MERS-CoV) infected nearly 1700 people since 2012, killing 36% of them [2]. With 100% fatality rate in pigs, Porcine epidemic diarrhoea Corona Virus (PEDV) is creating havoc in the US since 2013 [3]. Coronavirus disease (COVID-19) is a highly pestilential infection caused by novel corona virus first detected in the city of Wuhan in China's Hubei Province. WHO named it as 2019-nCoV on 10 January, 2020 after the disease was found to be caused by new version of Coronaviridae family [4]. This novel corona virus was rechristened as SARS-CoV-2 as investigators have found it to be closely related to the predecessor SARS-CoV [5][6].

The novel corona virus appears to be originated by permutation and combination of genetic strain between two or more species. Results of several analyses suggest that 2019-nCoV has similar genetic information with bat corona virus and has a similarity in codon usage bias with snake. The putative recombination of virial material might have resulted in a strain, capable of cross species transmission [7].

2019-nCoV is enveloped, single strand RNA of zoonotic origin, spherical to pleomorphic in shape, containing four structural proteins- envelope (E), spike (S), membrane (M), and nucleocapsid (N). These pleomorphic RNA virus with crown shaped peplomers are app. 80-160 nm in size and 27-32 kb positive polarity [8]. The surface protein spike glycoprotein (S) facilitates interaction of the virus with surface receptor ACE2. After the membrane glycoprotein (M) binds with the receptor, envelope (E) of the virus fuses with the cell membrane, thus releasing the viral genome into the target cell [9].

II. TRANSMISSION

World Health Organisation in its scientific brief provides an overview of modes of transmission of SARS-CoV-2 [10]. Referred article elaborates possible modes of transmission for COVID-19- physical contact, aerosol borne, blood borne, fomite, mother to child (vertical transmission), animal to human, faeces etc.

SARS-CoV-2 is found to spread through direct or indirect contact with the infected person. The transmission occurs via secretions like saliva, respiratory droplets ejected when the infected person sneezes, coughs or talks, vomits or breathes [11]-[14]. The virus laden respiratory droplets and droplet nuclei contaminate the air around the infected person and become carrier of the deadly disease.

Respiratory droplets that contain the virus can transmit infection to a person within 1 metre proximity from the infected person who coughs, sneezes or talks. Indirect transmission occurs when respiratory secretions of infected person contaminate surfaces by contact, creating fomites and transferring the viable SARS-CoV-2 virus to the person touching the contaminated surface (fomite), followed by touching the mouth, nose or eyes.

2.1 Airborne transmission

Airborne transmission is technically defined as the dissemination of aerosols as infection transmitting agents by remaining suspended in the atmosphere for a long time. A team from John Hopkins University published their work about the generation and propagation of virus laden respiratory droplets and inhalation of these droplets by people coming across them [15]. Fluid Dynamics is the study of movement of fluid particles on different surfaces, atmosphere and their sustainability depending on their size. These studies are important in understanding the transmissibility of virus and degree of pandemic spread as a consequence.

Respiratory droplets of varying size are formed in respiratory passage when friction caused by air flow partially corrodes mucus lining of the air passage. These droplets contain virus if the person is infected with the virion. The bigger droplets containing more virions, move through air after being exhaled by the infected person, descend along a trajectory and set down on the surface they find in their path. These droplets become potential carrier of indirect transmission of infection by creating fomites.

Apart from fomite transmission through larger droplets, aerosol transmission may occur at alarming rate under the condition of exposure to virus infested aerosols present in the atmosphere. Aerosols are condensed particles formed by soil, dust, pollutants, pollen grain etc. When a person coughs or sneezes or even breathes, tiny respiratory droplets are ejected and get embedded in a cloud of warm air exhaled by the person. If humidity is present in the atmosphere, the process of evaporation which otherwise quickly takes place in normal conditions, gets delayed giving extra life to the droplets. The droplets containing micro-organism exhaled by the infected person may dissolve with the aerosol and become potent enough to infect those who come in contact with virus infested aerosol (bio-aerosol). Researchers have found these bio-aerosols to spread in a space up to 2 m, not only this much, aerosols can travel hundreds of metres [16]. Major breakthrough in the management and control of COVID-19 is expected through the researches in the field of aerosol transmission [17].

2.2 Sustainability of SARS-CoV-2

Aerosol and surface stability of novel corona virus has been evaluated and its decay rate is estimated as a consequential study [18]. This study was carried out with two viruses: SARS-CoV-2 and SARS-CoV-1, in different environmental conditions. The comparative results are:

- SARS-CoV-2 as well as SARS-CoV-1 are more stable on plastic and stainless steel than on copper and cardboard.
- SARS-CoV-2 remains viable even after a pretty long time on plastic and stainless-steel surface. The virus titre was drastically reduced after 72 hours of its deposition on plastic and after 48 hours on stainless steel.
- On copper surface, no active SARS-CoV-2 virus was observed after 4 hours of its deposition whereas this duration was 8 hours for SARS-CoV-1.
- On cardboard, the active period was 24 hours for SARS-CoV-2 and 8 hours for SARS-CoV-1.
- Van Doremelan et.al. (2020) artificially generated aerosols containing SARS-CoV-2 strain, with the use of collision nebuliser and Goldberg drum. As per the observations of the experiment, SARS-CoV-2 remains viable in aerosol for 3 hours which was the duration of the experiment.

A great deal of research has been done to establish efficacy of different expiratory activities like talking, singing, coughing etc. to emit respiratory droplets potent to spread infection [19],[20].

- In the experiment related with talking, 93.7% of droplets were deposited on the ground. Ninety percent of droplets were lying within a range of 0.3 m. For coughing experiments, 80.9% of the droplets were deposited on the ground. Fifteen percent of total emitted droplets reached the wall 0.5 m away.

Similar researches reported some important observations in context with the outreach of virus during various expiratory activities.

- Percentage of droplet nuclei generated by singing is nearly six times greater than that produced by simple talking and almost equivalent to that emitted by coughing [21].
- There are strong evidences that loud talking involving vigorous vocal cord vibrations is capable of releasing copious quantity of virus laden droplets [22].

Bourouiba et.al. [23] have shown in their theoretical discussion and experimental data collection that respiratory jet suspended in the cloud expelled by sneezing or respiratory outward airflow takes a shape of turbulent cloud. Large droplets are not affected by the dynamics of cloud but small and medium size droplets remain suspended in the cloud for a longer time. This cloud containing virus laden droplets can move upwards due to buoyant forces and enter the ventilators to make the indoor atmosphere of the room potent to induce transmission of infection.

III. CONTACT KILLING

Frequently touched surfaces in busy places are spreading infection potentially at community level and putting a large section of population at risk of acquiring and propagating it by leaps and bounds. Various laboratory researches and consequent clinical trials are underway to understand the response of different surfaces after being inoculated with bacteria or virus. Copper was recognized by the United States Environmental Protection Agency as strong antimicrobial agent [24]. Contact killing experiments and investigations on different metallic surfaces contaminated by many bacterial species and viruses have led to some very interesting and encouraging results. Such experiments have revealed that metal-bacterial interface damages cell envelope thereby making them vulnerable to further damage due to attack by metallic ions [25]. From these studies, it was found that bacteria on copper surface suffer rapid decay, membrane damage and DNA degradation by copper ions. Researches from Southampton University show that millions of methicillin-resistant *Staphylococcus aureus* (MRSA) and methicillin-sensitive *Staphylococcus aureus* (MSSA) are rapidly killed on surface of copper or copper alloys but these micro-organisms remain alive for quite a longer time on non-antimicrobial surface such as stainless steel [26].

According to Professor Bill Keevil, University of Southampton, copper ion has the capability of targeting cellular sites in multidimensional manner, not only destroying bacterial and viral pathogens but destroying the genetic material contained in the pathogen, thereby ruling out further mutation in genetic code and preventing evolution of next generation superbug. Keevil studied the antimicrobial properties of copper with drug resistant deadly Middle East Respiratory Syndrome (MERS) and the Swine Flu (H1N1), and found that “copper just blew it apart”.

Entire human population across the world is undergoing the trauma of living under the threat of highly infectious virus, risk of contracting infection cumulatively multiplying post lockdown period, as contact acquired infection is extremely difficult to contain. Preventive measures like use of sanitiser, wearing mask, washing hands frequently, immunity boosting activities give protection till the vaccine or medicine for curing SARS-CoV-2 is not found. Use of metals and metallic alloys, that have been found potent to destroy genetic material of bacteria or virus, in frequently visited places like hospitals, market places or malls, is getting attention of prudent researchers and progressive planners.

“Hospital-acquired infections sicken approximately 2 million Americans annually, and kill nearly 100,000, numbers roughly equivalent to the number of deaths if a wide-bodied jet crashed every day”. These are the words of Michael G. Schmidt [27]. These words describe the grim situation precisely. Pullman, Washington- A level IV trauma centre, responding to the hazardous viral and microbial load on healthcare centres, has installed copper components throughout the facility. Encouraged by the results of early experimentation, intensive care unit (ICU) beds outfitted with copper rails, footboards, bed controls are setup and their pathogen contamination level were found to be far below that of the traditionally used ICU paraphernalia.

IV. CONCLUSION

The enormity and complexity of studies related with SARS-CoV-2 is reflected in failure of all the efforts by scientists all over the world to develop vaccine and a cure for this intimidating and spiking new disease. For now, only preventive measures are the means to remain healthy and free of infection. A microscopic virus has proved itself more powerful than the self-proclaimed invincible human being. In these pandemic times, people have learnt a lesson that any time nature can unleash a fury of destruction and the mighty humans would feel belittled and helpless. But, in the past too, we have fought as warriors and came out as winners. Many countries have started testing vaccine and any time we can get a news of its success, till then let us take precautions to remain healthy and safe.

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