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## A REVIEW OF CURRENT KNOWLEDGE ON AIRBORNE TRANSMISSION OF COVID-19 AND THEIR RELATIONSHIP WITH ENVIRONMENT

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### ABSTRACT:

**Background:** SARS-CoV-2 is considered the critical health pandemic of 21st century. Due to their extremely high rate of transmission people are more susceptible to viral infection. The airborne transmission considered to be the dominant over other route of transmissions. Viral RNA affiliated with droplets smaller than 5 micro meters has been detected in air and the virus has been shown to preserve infectivity in droplets of this size.

**Mechanism:** The modes of transmissions of virus is through direct contact and through inhaling aerosols. Transmission of SARS-CoV-2 could be directed not only by temperature and humidity but also by water and sewage, among other perspective factors. Airborne or aerosol transmission occurs by the direct spray of large droplets onto conjunctiva or mucous membranes. The optimum temperature and humidity for the survival of SARS-CoV-2 in vitro were 4 degree Celsius and 20-80% resp. 1-10 um aerosol particles are sufficiently large to carry a viable viral particle load. Under optimal conditions of humidity & temperature, the aerosol droplets of all sizes can travel up to 7-8 m. As the size of aerosol decrease, their ability to disperse in air increase.

**Discussion:** . The effect of transmission or spreadness of this virus is in a very sudden manner. The review of few studies shows that the behavior or mode of action of SARS-CoV-2 virus has been remarkable or unique with more survival rate and viable rates in the air and believed to remain in the air for extended period. This study is exploratory in nature and aims to carry out the nature of transmission of virus as a airborne transmission and their relationship with the environment.

Conclusion: The airborne transmission becomes severe with the change in strain & can

spread rapidly throughout the worldwide. The proper preventive measures will be necessary like double masks, social distancing, isolation should be necessary for prevention of spread.

### **Introduction:**

Novel Corona Virus Disease (COVID-19) pandemic caused by the Severe Acute Respiratory Syndrome Corona virus-2 (SARS COV-2). The types of transmissions are through respiratory droplet particles. Other types of accepted modes of SARS COV-2 transmissions are direct contact and through inhaling aerosols.[1] Transmission of SARS COV-2, could be directed not only by temperature & humidity but also by food, water & sewage, among other prospective factors. In condition to the latter, have strongly suggested that the SARS COV-2 has been disseminate through the air. The World Health Organization (WHO, 2014) has pronounced airborne transmission “as the spread of an infectious agent caused due to distribution of droplet nuclei, which remain contagious when stayed in air over long distances and time”. According to this the rapid spread of the SARS COV-2 would indicate that, in addition to the transmission person-to-person, other ways like airborne, can be also involved in transmission of this corona virus.[2]

Respiratory molecules may often be renowned to be droplets or aerosols based on the particle size and individually in terms of the aerodynamic diameter. Tiny aerosols are more responsive to be inhaled deep into the lung, which causes infection in the alveolar tissues of the lower respiratory tract, while large droplets generated when a symptomatic person coughs, sneezes, talks or exhales. In variation, talking, coughing & sneezing have produced more aerosols than droplets.[3]

Viral RNA affiliated with droplets smaller than 5 micro meter has been detected in air and the virus has been shown to preserve infectivity in droplets of this size. [4] Air quality is necessary for people’s health; however; 91% of world population lives in places where poor air quality exceeds the permission limits ( WHO , 2016). China executed strict traffic restrictions & self quarantine measures to control the growth of SARS-COV2. The steps taken by them brings changes in air pollution. Because of quarantine, NO<sub>2</sub> was reduced to 22.8ug/m<sup>3</sup> & 12.9 ug/m<sup>3</sup> in Wuhan & China respectively.[5] After the research on the

beginning spread, the findings indicated that like pneumonia, Since the COVID-19 is a respiratory disease & there is an established link between the spread of (past) respiratory disease in area exposed to high air pollution levels. [6] The pathogenesis of COVID-19 induced pneumonia was described as very closely resembling autoimmune / auto-inflammatory syndromes. The development & clinical complications of COVID-19 are greatly supported by the inflammatory process & the pathogenic activity of SARS-COV-2. In SARS-COV-2, hypoxia is a outcome of respiratory & circulation failure. Severe Hypoxemia is a relevant feature of respiratory failure & ARDS, where the core of clinical management is mechanical ventilation.[7]

### **Mechanism of generating & transmitting droplets & Aerosols:**

Aerosol or Droplet transmission occurs by the direct spray of large droplets onto face of a liable host when an infected patient sneezes, talks or coughs. It is a well-known fact that SARS-COV-2 is communicate by human-to-human contact ; hence contagious. Self-inoculation could occur by poor hand hygiene or by not following the common disease-controlling etiquettes. However, the curiosity of this outbreak limits the prima facie evidence to determine the transmission routes, and thus, it is assumed that SARS-Cov-2 also spreads as the other human coronavirus.

The WHO has proclaimed that certain hospital policy would also generate aerosols under specific circumstances: endotracheal intubation, bronchoscopes, open suctioning, administration of nebulized treatment, manual ventilation before intubation, turning the patient to the susceptible position, disconnecting the patient from the ventilator, non-invasive positive-pressure ventilation, tracheostomy, and cardiopulmonary resuscitation. As precautions to prevent such plausible airborne transmission of viruses, the WHO has recommended a myriad of management protocols.[3]

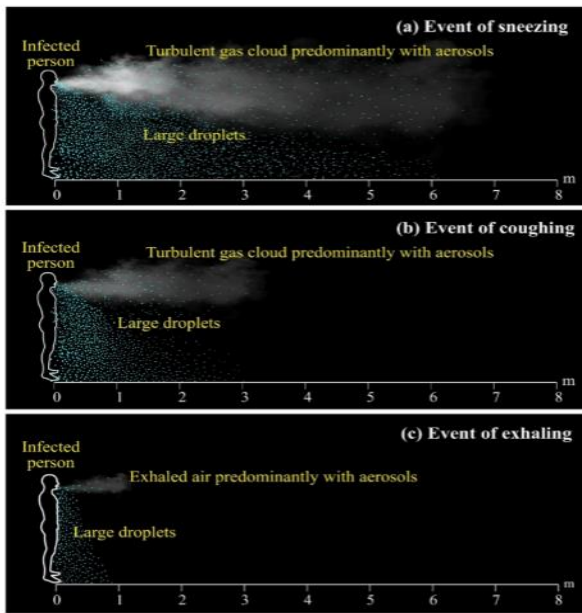


Fig.1. Trajectories of droplets and aerosols from an infected patient (a) event of sneezing with droplets travelled for 6m at a speed of 50 m/s within 0.12 sec (b) event of coughing with droplets travelled for 2m at a speed of 10 m/s within 0.2 sec (c) event of exhaling within droplets travelled for 1m at a speed of 1 m/s within 1 sec. [3]

### Temperature and humidity and SARS-CoV-2 infection:

The study investigated the relationship between the daily average temperature and the average rate of increase of new patients with Covid-19. A significant difference in the average daily air temperature between the two regions was correlated with a considerable difference in the daily average cumulative rate of new patients in those two regions. Therefore, the average temperature & humidity of infected cities were found to be 5 degree celcius and 11 degree celcius and 47 to 79%, respectively, and the optimum temperature and humidity for the survival of SARS-CoV-2 in vitro were 4 degree celcius and 20 to 80%, respectively. Although the above mentioned reports suggest a relationship between temperature and the distribution of the virus, comparing the global climate and COVID-19 distribution maps, it could be come to the point that there was no significant relationship between temperature, humidity & the virus distribution. [8]

### COVID-19 and waste water:

Spread of COVID-19 has been established to take place from person to person through direct contact of secretions from an infected individual and contaminated surfaces or objects; However this virus has been found in feces and urine. Few of studies describe recognition of COVID-19 viral RNA in fecal samples from infected humans in Australia, the Netherlands and Italy in untreated waste water, which could spread the virus through excreta. [9]

### Features of Droplets / Aerosols Emitted by SARS-CoV-2 Patients:

In the beginning it was found that the pathogens are carried from the patient via larger droplets, which settle on the surfaces and are then carried to the host by the dust rising from the dried droplets. It has been identified that sneezing & dry cough suffered by SARS-CoV-2 patients generate droplet sizes ranging between 0.6 and 100  $\mu\text{m}$  and the number of droplets increases proportionately with coughing rate.

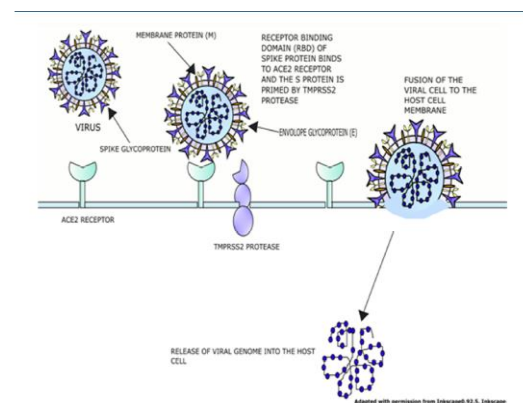


Fig2. Host receptor interaction with the SARS-CoV-2 spike protein and subsequent viral cell fusion with the host cell membrane[10]

More than 97% of these droplets tend to be lower than 50  $\mu\text{m}$  and a majority of them are smaller than 10  $\mu\text{m}$ . Pre or asymptomatic patients can also generate and emit large quantities of droplets smaller than 1  $\mu\text{m}$ , through normal breathing and speak. The average size of SARS-CoV-2 is around 0.1  $\mu\text{m}$ . Therefore, even 1-10  $\mu\text{m}$  aerosol particles are sufficiently large to carry a viable viral particle load.

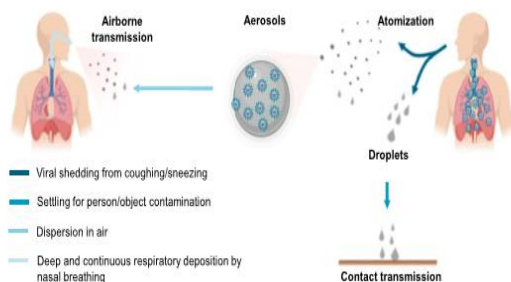
### Transmission of Airborne viral particles:

Expulsion of air due to exhalation, sneezing and coughing results in the release of multiphase turbulent flow, which generally composed of hot moist air. In addition coughing and sneezing also generate the

aerosol plumes at a high enough velocity to infect someone who is standing in proximity to the patient, Under optimal conditions of humidity & temperature, the aerosol droplets of all sizes can travel up to 7-8 m. [10]

The characteristics of aerosols generated by cough or sneeze are dynamic, notably reduction in size due to evaporative loss of water depending on surrounding humidity and temperature levels. As the size of aerosol decrease, their ability to disperse in the air is enhanced. In recent laboratory testing, aerosolized SARS-CoV-2 remained viable for upto~3hr. In-activation studies suggested that survival on surfaces, and in the air, may be further enhanced at relative humidities of less than 50%.

These results are consistent with other airborne viruses- including SARS-CoV-1, influenza H1N1 and MERS-CoV, which also show evidence of airborne transmission. Viability of SARS-CoV-2 in aerosol collected from reel-world air samples. [11] The contribution of airborne transmission to the outbreak by comparing the trends and mitigation measures during the pandemic worldwide and by considering the viral transmission routes. Face covering prevents both airborne transmission by blocking atomization & inhalation of virus-bearing aerosols and contact transmission by blocking viral shedding of droplets.



Similarly, Aerial transmission also contributes dominantly to the increase in the infection prior to the onset of mandated face covering. Hence, the unique function of face covering to block inhalation of virus-bearing aerosols accounts for the significantly reduced infections indicating that airborne transmission of COVID-19 represents the dominant route for infection. [12]

## DISCUSSION

The impact of SARS-CoV-2 infection on human health is very catastrophic. The effect of transmission or spreadness of this virus is in a very sudden manner. The review of few studies shows that the behavior or

mode of action of SARS-CoV-2 virus has been remarkable or unique with more survival rate and viable rates in the air and believed to remain in the air for extended period. This study is exploratory in nature and aims to carry out the nature of transmission of virus as a airborne transmission and their relationship with the environment. However, the mode of transmission is either by the direct contact and aerosol transmission is either by the direct contact and aerosol transmission. But the further studies will be necessary for the better learning about the airborne transmission of virus and their nature with the environment. Although, optimum temperature and humidity for survival of virus was 4 degree Celsius. In some studies a notable evidence supports a clear association between concentrations of various air pollutants and human respiratory viruses interacting to adversely affect the respiratory system. Long term exposure to air pollution increases the danger associated with the biggest COVID-19 mortality risk. Airborne transmission particularly via nascent aerosols from human atomization, is highly virulent and represent the dominant route for the transmission of the disease. The virus crisis brings other environmental problems that may last longer and may be more challenging to manage if countries neglect the impact of epidemic on environment. Airborne transmission is dominated with the change in strain of the virus, they can cause harm to human health in many of the worldwide.

## CONCLUSION:

SARS-CoV-2 could be spread through various or following routes but airborne transmission is the primary mode of transmission of the COVID-19. Droplets and aerosols generated from non-violent and violent expirations of SARS-CoV-2 infected people may be responsible for airborne transmission of COVID-19 disease. The review of few studies shows that the behavior of SARS-CoV-2 virus has been unprecedently unique with more survival and viable rates in the air & believed to linger in the air for an extended period. According to WHO studies found that SARS-CoV-2 virus RNA in air samples within aerosols for up to 3 hours in one study and 16 hours in another, which also found viable replication-competent virus, Airborne transmission contributes dominantly linear increase in the infection prior to the onset of mandated face covering. The function of face covering block atomization. SARS-CoV-2 virus will

produce both positive and negative indirect effects on the environment, but latter will be greater. Furthermore, For the proper investigation regarding the exploration of the viral particles in the environment research studies should be necessary for prevention of the spread of COVID-19. The airborne transmission is dominated with the change in the strain of the virus, they can spread very crucially in some of the countries like India, Brazil etc. The proper preventive measures will be necessary like double masks, social distancing, isolation should be necessary for prevention of the spread.

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