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RESEARCH ARTICLE

COVID-19 AND OTHER CORONAVIRUS: AIRBORNE INDOOR AND OUTDOOR TRANSMISSION? STATE OF EVIDENCE

Mauro Luisetto[1,*], Naseer Almukthar[2], Giulio Tarro[3], Ghulam Rasool Mashori[4], Gamal Abdul Hamid[5], Ahmed Yesvi Rafa[6], Caterina Fiazza[7] and Oleg Yurevich Latyshev[8]

[1]Independent Researcher, IMA academy Italy 29121
[2]Professor, Department of Physiology /College of Medicine, University of Babylon, Iraq
[3]Chairman della Commissione sulle Biotecnologie della Virosfera, WABT - UNESCO, Parigi, Rector of the University Thomas More U.P.T.M., Rome
[4]Full Professor of pharmacology, Peoples University of medical and health Sciences for Women, Nawabshah, Pakistan
[5]Professor Hematology Oncology, University of Aden, Aden, Yemen
[6]Founder and President, Yugen Research Organization, Western Michigan University, MI, USA
[7]Medical pharmacologist pharmaceutical department Pc Area 29121
[8]President of IMA academy RU

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ABSTRACT

Related health international organization there are two principal way of transmission of coronavirus covid- 19: direct contact whit infected subject or by droplets. Other way under deep investigation by researcher is airborne transmission. Related the evidence presented in this work is possible to verify that in indoor settings this is possible. Relevant is the distance considered. Observing the role played by PM10 of polluted air in accelerated diffusion of covid-19 in some world region Is interesting to observe the effect of musk use to reduce intake of this pollutants for a significative period. All this evidence must be applied in many healthcare settings like oncology or towards immunodepressed (or other kind of vulnerable condition) patients also during access to hospitals. ICU settings are the hospital area subjected to severe procedure to prevent diffusion of Covid -19 and other infectious disease like MDR bacteria or some invasive fungal but according published evidences other area in hospital settings must be considered at risk to diffuse this kind of infectious disease.

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INTRODUCTION

"Current theories of influenza viral- epidemiology have not explained the persistence, seasonality, and explosive- outbreaks of virus over large geographic areas. It is postulated in this paper that atmospheric- dispersion and inter-continental scale transport of airborne aerosolized influenza virus may contribute to the spread, persistence, and ubiquity of the disease, the explosiveness of epidemics, and the prompt region-wide occurrence of outbreaks and that seasonal changes in circulation patterns and the dispersive character of the atmosphere may help to explain the regular annual- cycle of influenza- activity." According WHO:"Corona-viruses are a large family of viruses that are known to cause illness ranging from the common cold to more severe diseases such as MERS and SARS. A new corona-virus (COVID-19) was identified in 2019 in Wuhan, in China. This is a new corona-virus that has not been previously identified in humans." And WHO 29 march: "Respiratory infections can be transmitted through droplets of different sizes: when the droplet particles are >5-10 μm in diameter they are referred to as respiratory droplets, and when this are <5μm in diameter, they are referred to as droplet-nuclei.

Corresponding author: **Mauro Luisetto,**
Independent Researcher, IMA academy Italy 29121.

According to current evidence, COVID-19 virus is primarily transmitted between people through respiratory- droplets and contact routes." (18)

According Guangbo Qu *et al*: "Transmission via the inhalation of small, exhaled respiratory droplets may occur as the aerosol droplets remain airborne for prolonged periods, mediating long-range human-to-human transmission via air- movement the relative contributions of large respiratory droplets, smaller airborne aerosol, or direct surface contacts to the transmissibility of COVID-19 still need to be evaluated to enable a fully- effective control of transmission and infection." (10)

Aim of this work is to observe some relevant literature related the Airborne transmission of some relevant respiratory viruses in order to produce a global conclusion. To do this is crucial to set the right questions: there are evidence of this kind of transmission

In Indoor but also in Outdoor environment?

In outdoor settings the great air amount diluite all aerosols produced. In indoor the situation is more complicated. The fact that viral RNA was recently founded in particulate of polluted air as showed by an Italia research (SIMA Italian society of environmental medicine) not imply that this viral charge can be infectant but is a real fact this presence.

MATERIALS AND METHODS

Whitan observational approach some relevant literature is analyzed to produce a global conclusion related the topics of this work. All literature comes from biomedical database, Pubmed Or other relevant. Then an experimental project hypotesis is submitted to researcher to be verified on field.

RESULTS

From literature:

"The transmission of SARS-CoV-2 in humans is thought to be via at least 3 sources: 1). inhalation of liquid droplets produced by and/or 2) close contact with infected persons and 3) contact with surfaces contaminated with SARS-CoV-2. aerosol transmission of pathogens has been shown in confined spaces.
There are many respiratory- diseases spread by the airborne route such as tuberculosis, measles and chickenpox. A retrospective cohort study conducted after the SARS- epidemic in Hong Kong in 2003 suggested that airborne spread may have played an important -role in the transmission of that disease. This study on airborne SARS-CoV-2 was conducted in different areas inside two hospitals and public areas in Wuhan, China, the epicenter- city during the initial disease outbreak. We aimed to 1) quantify the concentrations of airborne SARS-CoV-2 both inside the hospitals and in outdoor public areas, 2) evaluate the aerodynamic size- distributions of SARS-CoV-2 aerosols that may mediate its airborne transmission, and 3) determine the dry -deposition rate of the airborne SARS-CoV-2 in a patient ward- room. Thirty-five aerosol samples of three different types (total suspended particle, size segregated and deposition aerosol) were collected in Patient Areas (PAA) and Medical –Staff. Areas (MSA) of Renmin Hospital of Wuhan- University (Renmin) and Wuchang Fangcang Field Hospital (Fangcang), and Public Areas (PUA) in Wuhan, China during COVID-19 outbreak. A robust droplet digital polymerase chain- reaction (ddPCR) method was employed to quantitate the viral SARS-CoV-2 RNA genome and determine aerosol RNA-concentration. During the second batch of sampling, the two TSP samples in the PARRs had negative test results with reduced number of medical- staff and more rigorous sanitization processes in Fangcang. In PUA, SARS-CoV-2 aerosol concentrations were below 3 copies m-3, except for 2 occasions: one crowd gathering site near the entrance of a department- store with frequent customer flow and one outdoor site next to Renmin - Hospital with outpatients and passengers passing by. Concentration of airborne SARS-CoV-2 at different locations in Wuhan

Renmin hospital outdoor: 7 concentrations copies m-3 Department store; 11 concentrations copies m-3 And the highest concentration in ICU (zone 7) 113 concentration copies m-3 " (1)

According YU IT *et al* in an article published in new England journal of medicine 2004 was written:

"Recent studies into the March 2003 outbreak of SARS in Hong Kong have concluded that environmental factors played an important role in the transmission of the disease. These studies have focused on a particular outbreak- event, the rapid spread of SARS throughout Amoy Gardens, a large, private apartment complex. They have demonstrated that, unlike a typical viral outbreak that is spread through person-to-person contact, the SARS virus in this case was spread- primarily through the air. High concentrations of viral aerosols in building plumbing were drawn into apartment bathrooms through floor drains. The initial exposures occurred in these bath-rooms. The virus-laden air was then transported by prevailing winds to adjacent buildings at Amoy Gardens, where additional exposures occurred. This article reviews the results of the investigations and provides recommendations for maintenance and other measures that building owners can take to help prevent environmental- transmission of SARS and other flulike viruses in their buildings.

There is uncertainty about the mode of transmission of the SARS. We analyzed the temporal and spatial distributions of cases in a large community outbreak of SARS in Hong Kong and examined the correlation of these data with the 3-dimensional spread of a virus-laden aerosol plume that was modeled using studies of airflow -dynamics. We determined the distribution of the initial 187 cases of SARS in the Amoy-Gardens housing complex in 2003 according to the date of onset and location of residence. We then studied the association between the location (building, floor, and direction the apartment unit faced) and the probability of infection using logistic- regression.

The spread of the airborne, virus-laden aerosols generated by the index -patient was modeled with the use of airflow-dynamics studies, including studies performed with the use of computational fluid-dynamics and multizone modeling. For building E, apartment units (not persons) on the middle and upper floors had higher- probabilities of infection than did units on lower floors, with an odds ratio of 5.15 (95 percent confidence interval,2.6 to 10.3; $P<0.001$) for the middle floors and 3.1 (95 percent confidence interval, 1.6 to 6.2; $P<0.01$) for the upper floors.

The risk of infection was highest (odds ratio, 14.5; 95 percent confidence interval, 5.5 to 38.4) for units that faced- direction Ab(unit 8 on each floor), and it was also significantly elevated in apartment units that faced direction

Ad (unit 7). The units that faced- directions Da (unit 6) and Dc (unit 5) appeared to have a slightly lower risk of infection than the other- units. Results of the test for heterogeneity were statistically- significant (P<0.001) for both floor level and direction. For buildings B, C, and D, the variation among the 3 categories of floor level was statistically-significant (P = 0.01), but the variation among the eight directions was of only borderline significance (P = 0.06). For middle-level floors and for directions Ad, Ba, and Da there was a significantly higher-risk of infection than on the lower -floors and in direction Cb, respectively. In the analyses stratified ac- cording to building, only the model for building C showed significant heterogeneity among floor- levels and directions. The odds ratios for the middle- level floors (16.3) and for apartment units coded Da (9.9) were statistically significant, whereas those for the upper-level floors (7.2) and for units coded Ad (6.4) were of borderline- significance. Lo- cation (floor level and direction) was not statistically significant for buildings B and D., in building B, all apartment units with windows that faced direction D (either at the front or the side) — that is, the direction from which the wind blew from building E — had high odds ratios, between 0 and 5.2; An investigative team from the WHO found that traps in the floor drains in many of the housing units seemed not to have been filled with water for long periods; the seals in the traps thus dried out, and as a result, a connection was opened to the vertical soil -stack (drainage pipe).

The investigative- team suggested that an exhaust fan that was running behind a closed-door in the bathroom could have drawn fine drop- lets or aerosols from the soil stack into the bath--room through the unsealed floor drain and thereby contaminated the bathroom. The exhaust fan could have transported contaminated- droplets or aerosols from the bathroom into the air shaft. These contaminated- droplets or aerosols could have been carried upward by the natural air current and could have entered other apartment- units, even units several floors away from the source of infection, if the virus-laden aerosols had reached an open window in building D, two directions the windows faced were of borderline significance — namely, Ab(odds ratio, 6.3) and Ba (odds ratio, 6.3). We repeated the modeling assuming five or six residents in each unit and obtained similar results (data not shown).

Our epidemiologic- analysis, experimental research, and airflow simulations support the probability of an airborne spread of the SARS virus in the outbreak in Amoy Gardens. Virus-laden aerosols generated in the vertical soil stack of unit 7 in building E returned to the bathroom through the dried-up seals of the floor-drain traps and then entered the air- shaft, probably by means of suction created by an exhaust fan. The aerosols moved up-ward owing to the buoyancy of the warm, humid -air within the air shaft and could enter apartment units that bordered the air shaft on the upper floors because of the negative -pressure created by the exhaust fans or the action of wind- flows around the building.The horizontal- spread of infection to other units in building E was by movement of the air betweenapartment- units. After the plume reached the top of the air shaft in building E, the virus was spread to some units at certain heights in buildings B, C, and D by the action of a predominant northeasterly- wind. Our hypothesis adequately explains the temporal- spatial distribution of cases of SARS. This hypothesis remains to be confirmed by further analytic epidemiologic, environmental, and experimental -studies and should have important public- health implications for the prevention and control of SARS, should the disease recur Airborne- spread of the virus appears to explain this large community outbreak of SARS, and future efforts at prevention and control must take into consideration the potential for airborne- spread of this virus."(2). Figure n. 1 Distribution of Cases of SARS Infection in Buildings A to G in the Amoy Gardens Housing Estate. (from reference n 17). The prevailing wind (red- arrows) during the period of possible exposure was north-easterly, or roughly perpendicular to the exterior walls of apartment units Dc and Da in building E. The distance between buildings E and B is 60 m. The direction from which the wind -blew shifted from nearly- north to east and even southeast. The red dot in building E indicates the unit that the index patient- visited. The directional indicator for the units at the lower right-hand corner indicates the direction each unit-faced. In the directional code (Ab, Ad, Ba, Bc, Cb, Cd, Da, Dc) used to designate an apartment unit, uppercase letters denote front-facing windows and lowercase letters side-facing windows.

According to computational fluid-dynamics modeling, the buoyant plume (blue) rose from the air shaft between two-housing units in building- E (yellow) and was carried by a northeasterly wind toward the middle-level floors in buildings C and D. The L-shape structure (Panels A and B) was a nearby construction site that blocked the wind flowing toward lower-level floors in buildings E, C, and D. The wake flow of the construction site created a region of negative air- pressure in the space between buildings E, C, and D (Panel B) that caused the plume to bend -downward, toward buildings C and D " the truth is that we have only a rudimentary knowledge of several aspects of infection spread, including on one critical aspect of the SARS-CoV-2 virus: how THIS virus- transmits. It is considered that viral respiratory- infections spread by direct-contact, such as touching an infected person or the surfaces and fomites that the person has either touched, or on which large virus-containing droplets expired by the person have landed, and there the virus can remain stable for days. The droplets can also be deposited directly on a person in close-proximity to the infected person. frequent hand-was hing and maintaining distance of at least one meter (arm's length) are considered the main -precautions against contracting the infection. One transmission route that is mentioned only in passing, or not tall, is the transport to fvirus-laden particles in the air. Immediately after droplets are expired, the liquid content starts to evaporate, and some droplets become so small that transport by air current affects them more than gravitation. Such small drop lets are free to travel in the air and carry their viral-content meters and tens of meters from where they originated IsitlikelythattheSARS-CoV-2 virus spreads by air? Its predecessor, SARS-CoV-1, did spread in the air. This was reported in several research and retrospectively explained the pathway of transmission in Hong Kong's Prince of Wales Hospital, as well as in health- care facilities in Toronto, Canada, and in aircraft. These studies concluded that air borne transmission was the main-transmission route in the indoor cases studied. Other examples of air borne transmission of viral-infections include the spread of Norwalk-like virus between school children."(3)

In a Position Paper: "Relazione circa l'effetto dell'I nquinamen to da particolato atmosferico e la diffusione di virus nella popolazione" univ. BARI, BOLOGNA e SIMA: "Si evidenzia come la specificità della velocità di incremento dei casi di contagio che ha interessato in particolare alcune zone del Nord Italia potrebbe essere legata alle condizioni di inquinamento da particolato -atmosferico che ha esercitato un'azione di carrier di boost. Come già riportato in casi precedenti di elevata diffusione di infezione -virale in relazione ad elevati livelli di contaminazione da particolato- atmosferico, si suggerisce di tenere conto di questo contributo sollecitando misure restrittive di contenimento dell'inquinamento." (4)

Related avian influenza outbreaks in USA in 2015: The unprecedented 2015 outbreaks of highly pathogenic avian influenza (HPAI) H5N2 in the U.S.A. devastated its poultry industry and resulted in over $3 billion economic impacts. Today HPAI continues eroding poultry operations and disrupting animal protein supply- chains around the world. Anecdotal evidence in 2015 suggested that in some cases the AI virus was aerially- introduced into poultry houses, as abnormal bird- mortality started near air inlets of the infected houses. This study modeled air- movement trajectories and virus concentrations that were used to assess the probability or risk of airborne transmission for the 77 HPAI cases in Iowa.

The results show that majority of the positive cases in Iowa might have received airborne- virus, carried by fine particulate matter, from infected farms within the state (i.e., intrastate) and infected- farms from the neighboring states (interstate). The modeled airborne- virus concentrations at the Iowa recipient sites never exceeded the minimal- infective doses for poultry; the continuous exposure might have increased airborne-infection risks. In the worst-case scenario (maximum virus shedding rate, highest emission- rate, and longest half-life), 33 Iowa cases had > 10% (three cases > 50%) infection-probability, indicating a medium to high risk of airborne-transmission for these cases. Probability of airborne HPAI infection could be affected by farm type, flock size, and distance to previously infected- farms; and more importantly, it can be markedly reduced by swift depopulation and inlet air filtration. The research results provide insights into the risk of airborne- transmission of HPAI- virus via fine dust particles and the importance of preventative and containment- strategies such as air filtration and quick depopulation of infected flocks.
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According L.Settis *et al* preprint: "we present the first results of the analyses that we have performed on 34 PM10 samples of outdoor/airborne PM10 from an industrial site of Bergamo(Province), collected with 2 different air samplers over a continuous 3-weeks period, from February 21 st to March 13 th. Because of the nature of the sample, and considering that the sampling has not been carried- out for clinical- diagnostic purposes but for environmental -pollution tests (taking also into account that filters were stored for at least 4 weeks before undergoing molecular- genetic analyses, as consequence of the Italian shutdown), we can confirm to have reasonably demonstrated the presence of SARS-CoV-2 viral RNA by detecting highly specific "RtDR gene" on 8 filters."(6)

According J. Whan *et al*: "On Feb 18, the National Health Commission of the People's Republic- China published the guidelines for the diagnosis - treatment of COVID-19 infection (trial version 6). With the awareness and understanding of the disease, the guidelines show that the droplets and close contact- transmission are the main routes of transmission, and aerosol transmission is possible under the condition of long exposure to high concentrations of aerosols in a relatively closed environment. Aerosols are particles formed by solid or liquid particles dispersed - suspended in the air. They contain soil -particles, industrial dust particles, particulates emitted by automobiles, bacteria, microorganisms, plant spore powders, and other components. When a person, who was infected with the virus, coughs, sneezes, breathes vigorously, or speaks loudly, the virus will be excreted from the body and may dissolve with the aerosol and become the bio-aerosols. The particles in a bio-aerosol are generally 0.3 to 100 μm diameter; the respirable size fraction of 1 to 10 μm is of primary concern. Bio-aerosols ranging in size from 1.0 to 5.0 μm generally remain in the air, whereas larger- particles are deposited on surfaces. Droplets are droplets of saliva discharged by people sneezing or coughing, and their particle size is generally 1 to 5 mm. They spread in a space of about 1 to 2 m from the source of infection.

The aerosol can travel hundreds of meters or more: Current study researches have proven that aerosols are involved in the spread of SARS, MERS, H1N1, and some other diseases If COVID-19 infection cannot transmit by aerosol, it will hardly to explain some confirmed cases. On Feb 3, the Disease Control- Department of Dalat Banner, Ordos City, Inner Mongolia, announced that the fourth confirmed case lived upstairs of the first confirmed case, who went up and down the building several times by passing by the door of the first-confirmed case, of whom the door was often opened and there was some domestic- garbage beside the door. four clinical laboratory technicians in the Department of Clinical Laboratory of Jinyintan Hospital, Wuhan, were infected with COVID-19, of whom had no contact with the confirmed cases. How did they get infected? One possibility is that the patients' blood samples are exposed to the air to form aerosols, and the viruses in the aerosols are transmitted to the four technicians. All in all, COVID-19 may transmit through aerosol directly, but it needs to be further verified by experimental studies. If the aerosols can spread COVID-19, prevention and the control will be much more difficult. “(7)

And according WHO covid- 199 situation report n. 66: “An experimental study, which evaluated virus persistence of the COVID-19 virus (SARS-CoV-2), has recently been published in the NEJM1. In this study, aerosols were generated using a three-jet Collison nebulizer and fed into a Goldberg drum under controlled- laboratory conditions. This is a high-powered machine that does not reflect normal human coughing or sneezing nor does it reflect aerosol- generating procedures in clinical settings. The findings do not bring new evidence on airborne- transmission as aerosolization with particles potentially containing the virus was already known as a possibility during procedures generating aerosols.

In all other contexts, available evidence indicates that COVID-19 virus is transmitted during close- contact through respiratory- droplets (such as coughing) and by fomites. The virus can spread directly from person to person when a COVID-19 case coughs or exhales producing droplets that reach the nose, mouth or eyes of another personas the droplets are too heavy to be airborne, they land on objects and surfaces surrounding the person. Other people become infected with COVID-19 by touching these contaminated- objects or surfaces, then touching their eyes, nose or mouth. According to the currently available- evidence, transmission through smaller droplet nuclei (airborne transmission) that propagate through air at distances longer than 1 meter is limited to aerosol generating procedures during clinical care of COVID-19 patients.”(8)

“Any microorganism, including viruses, can become airborne. Contaminated -material can be aerosolized in many different ways, ranging from wind to human and animal activities such as sneezing, mechanical processes, etc. If the aerodynamic-size of an infectious particle is appropriate, it can remain airborne, come into contact with humans or animals, and potentially cause an infection. The probability of an airborne microorganism-laden particle causing an infection depends on its infectious- potential and its ability to resist the stress of aerosolization. Many epidemiological studies have proposed that viruses can spread from one host to another by using air for transport. The capacity of the foot-and-mouth disease (FMD) virus to spread by air has been studied and reviewed over the years and is now being investigated using computer-models. One of these models predicted that in a “worst-case scenario” of an FMD outbreak, cattle could be infected as far as 20 to 300kilometers away from an infectious source. Dispersion models based on meteorological data and information on the spread of FMD at the beginning of the 1967–1968 epidemic in the UK strongly suggested that the infection may have spread by the airborne - route over a distance of 60 km.

Airborne transmission of FMD was also reported to have occurred during the 1982–1983 epidemic in Denmark.

In the latter case, an analysis of epidemiological- dynamics using molecular methods coupled with meteorological data concluded that the infection had spread by air over a distance of 70 km.

the results of a Canadian research - study on an FM Depidemic reported that airborne viruses may have traveled 20km downwind from the contaminated source.

Nevertheless, a recent study on the O/UKG/2001 strain of FMD virus indicated that it does not spread efficiently between sheep by the airborne- route. other strains may behave differently.

In 2001, a Norwalk-like virus outbreak in a school in the UK was believed to have been caused by airborne-transmission. A similar occurrence has also been reported for a hotel restaurant. A retrospective cohort study conducted after a SARS epidemic in Hong Kong in 2003 suggested that airborne spread may have played an important role in the transmission of the disease. The same mode of transmission was also hypothesized in other studies of SARS. Aerosols may also be responsible for the transmission of other viral- diseases” (9)

“A further transmission route could be via airborne dust. It is considered that micro-organisms in airborne particulate matters (PM) or dust is linked to infectious- diseases.

Poor nation-wide air pollution is frequent in some developing countries, and the role of air PM and dust in the transmission of COVID-19 infection remains un-investigated. Inhalation of virus-laden fine particles could transport the virus into deeper alveolar and trachea-bronchial regions, which could increase the chance of infective transmission. Adsorption of the COVID-19 virus on airborne dust and PM could also contribute to long-range transport of the virus investigations on adsorption, survival, and behavior of the COVID-19 virus with the surface of PM are needed to help to understand the role of air PM pollution in COVID-19 transmission.

The extent to which the COVID-19 virus induces respiratory-stress in infected individuals may also be influenced by the extent to which an individual’s respiratory system is already compromised.

The high levels of PM- pollution in China may increase the susceptibility of the population to more serious symptoms and respiratory- complications of the disease.

oxidant pollutants in air can impair the immune- function and attenuate the efficiency of the lung to clear the virus in lungs.

The simultaneous inhalation of chemical pollutants in PM alongside COVID-19 virus may also exacerbate the level of COVID-19 infection. Pro-inflammation, injury, and fibrosis from inhaled PM combined with an immune- response or cytokine storm induced by COVID-19 infection could enhance the infection severity. Larger numbers of patients displaying more serious infection symptoms also created an increased risk of enhanced transmission potential.”(10). “The latest guidelines from Chinese health authorities described three main transmission routes for the COVID-19: 1) droplets transmission, 2) contact transmission, and 3) aerosol transmission may occur when respiratory droplets mix into the air, forming aerosols and may cause infection when inhaled high dose of aerosols into the lungs in a relatively closed environment. ”(11).

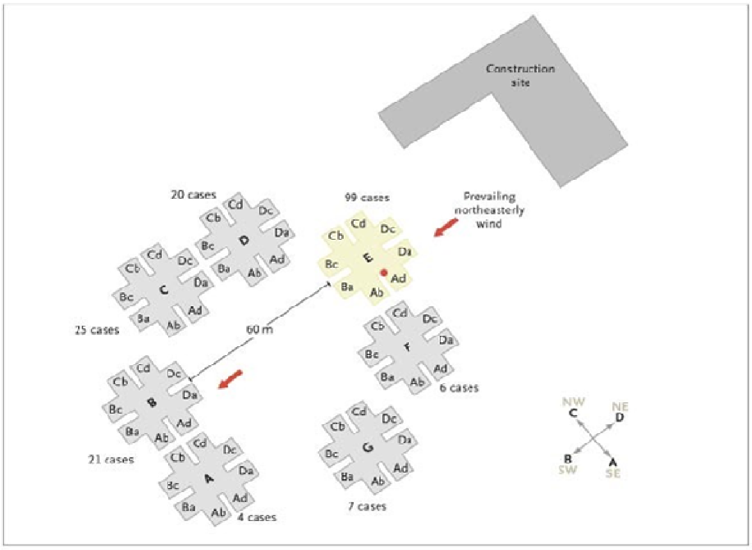

Figure n. 1. Distribution of Cases of SARS Infection in Buildings A to G in the Amoy Gardens Housing Estate. (from reference n 2)

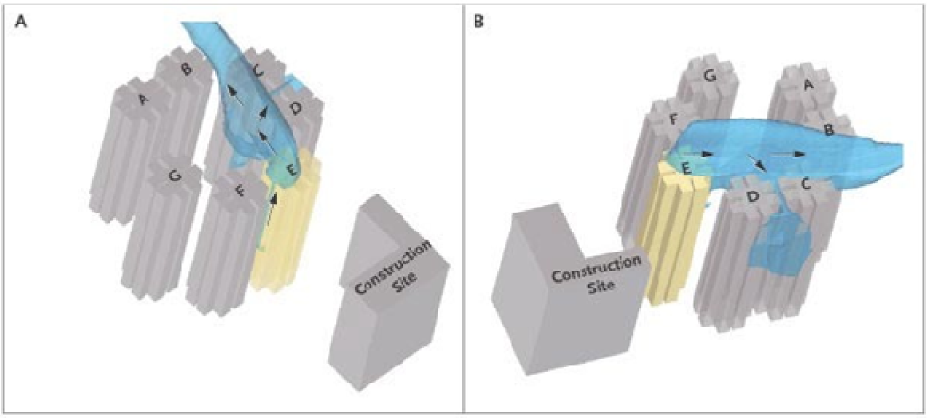

Fig. 2. Model of the Movement of the Virus-Laden Plume (from reference n. 2)

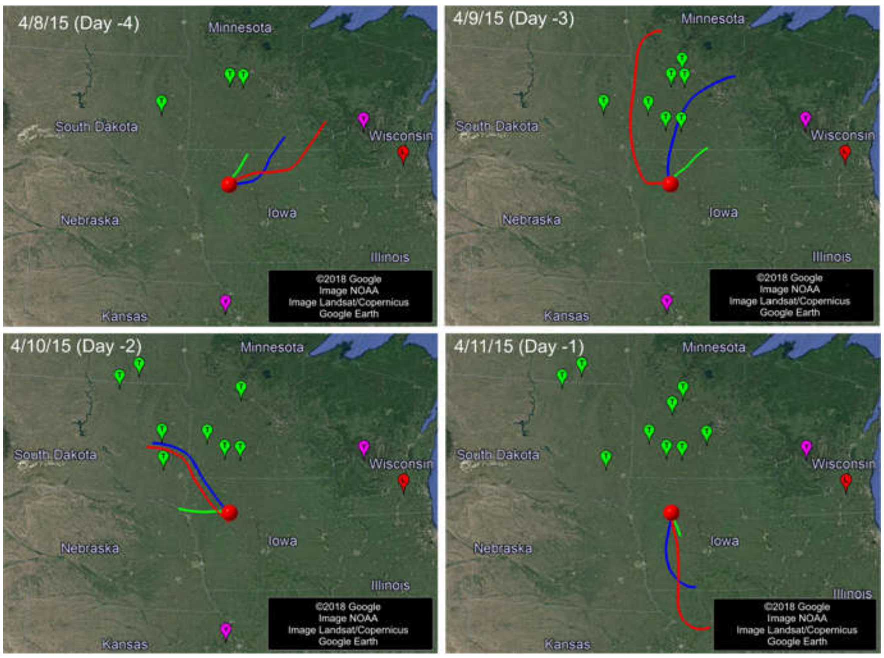

Figure n 3 From reference n 5 Backward air trajectories of four example days (4/8 – 4/11/2015) prior to the infection confirmation date (4/12/2015) of the first Iowa case. Red, blue and green lines are the 24-h (12am-12am, Local Standard Time or LST), 16-h (12am-4pm, LST) and 8-h (12am-8am, LST) trajectories, respectively. The round red dot represents the first case location; other dots are cases (green for turkey, red for laying hen, purple for backyard) that had been confirmed positive before the first Iowa case and the infected flocks had not yet been depopulated.

"To help prevent spread from suspected cases, health care practitioners should use standard, contact, and airborne or droplet precautions with eye protection. Airborne precautions are particularly relevant for patients undergoing aerosol-generating procedures. Patients with respiratory symptoms should be identified and masked immediately upon entry to any healthcare facility" (12) Hua QIAN *et al*: "Case reports were extracted from the local Municipal Health Commissions of 320 prefectural cities (municipalities) in China, not including Hubei province, between 4 January and 11 February 2020. We identified all outbreaks involving three or more cases and reviewed the major characteristics of the enclosed spaces in which the outbreaks were reported and associated indoor- environmental issues. Three hundred and eighteen outbreaks with three or more cases were identified, involving 1245confirmed- cases in 120 prefectural cities. We divided the venues in which the outbreaks occurred into six categories: homes, transport, food, entertainment, shopping, and miscellaneous. Among the identified outbreaks, 53·8% involved three cases, 26·4% involved four cases, and only 1·6%involved ten or more cases. Home outbreaks were the dominant- category (254 of 318outbreaks; 79·9%), followed by transport (108; 34·0%; note that many outbreaks involved more than one venue category). Most home outbreaks involved three to five cases. We identified only a single- outbreak in an outdoor environment, which involved two cases.

The first salient feature of the 318 identified outbreaks that involved three or more cases is that they all occurred in indoor environments. Although this finding was expected, its significance has not been well recognised by the community and by policy- makers. Indoors is where our lives and work are in modern civilisation. The transmission of respiratory-infections such as SARS-CoV-2 from the infected to the susceptible is an indoor phenomenon" (13). "In the first outbreak, 126 passengers took 2 buses (59 from Bus #1 and 67 from #2) on a 100-minute round trip to attend a 150-minute worship event. The source patient was a passenger on Bus #2. We compared risks of COVID-19 among individuals taking Bus #1 (n=60) and Bus #2 (n=67), and among all other individuals (n=172) attending the worship -event. We also divided seats on the exposed bus into high- and low-risk zones according to distance to the source patient and compared COVID-19 risks in each zone.

The second outbreak occurred among 30 trainees attending a 3-day workshop in several conference -rooms. In both buses and conference rooms, central air-conditioners were in indoor recirculation mode Our data strongly suggest that airborne-transmission contributed to the COVID-19 outbreak among lay Buddhists in Zhejiang province. The index patient was the only person exposed to individuals from Wuhan and the first at the event to be diagnosed with COVID-19 suggesting a high probability that she was the source of the outbreak. The 2 buses mimicked a quasiexperiment and the second unexposed bus, which left and arrived at the temple at similar times with similar individuals, provided a credible control- group. Both buses had an air conditioning system on a re-circulating mode, which may have facilitated the spread of the virus in the exposed bus. Attack rates on the exposed and unexposed-buses were sharply distinct (34.3% versus 0%) suggesting that the exposure and the environment in which the exposure took place contributed to this outbreak. Passengers sitting closer to the index case on the exposed bus did not have statistically higher risks of COVID-19 as those sitting further away. If COVID-19 transmission occurred solely through close contact or respiratory- droplets during this outbreak, risk of COVID-19 would likely be related to distance from the index case and 'high-risk' zones on the bus would have more infected cases.

Our findings suggesting airborne transmission of COVID-19 is in line with a past report of a SARS- outbreak on a plane. Both SARS and COVID-19 are caused by corona-viruses and both 12 outbreaks occurred in enclosed spaces. It should be noted that, except for a passenger sitting next to the index, all passengers sitting close to a window on the left- side of the bus remained healthy. This may be related to airflow within the bus; But we were unable to empirically test this hypothesis. transmission at the worship event between the bus rides only led to few infections, and all of those reported close -contact with the index case. These data suggest that forced, circulating air might play an important -role in airborne spread of the virus. "(14)

"We evaluated the stability of SARS-CoV-2 (covid -19) and SARS-CoV-1 in aerosols and on various surfaces and estimated their decay rates using a Bayesian regression model. SARS-CoV-2 nCoV-WA1-2020 and SARS-CoV-1 Tor2 were the strains used. Aero-sols (<5 μm) containing SARS-CoV-2 (10 exp5.2550% tissue-culture infectious dose [TCID 50] per milliliter) or SARS-CoV-1 (10 exp 6. 75 -7.0 0TCID50per milliliter) were generated with the use of a three-jet Collison nebulizer and fed into a Goldberg -drum to create an aerosolized environment. The inoculum resulted in cycle-threshold values between 20 and 22, similar to those observed in samples obtained from the upper and lower- respiratory tract in humans. Our data consisted of 10 experimental- conditions involving two viruses (SARS-CoV-2 and SARS-CoV-1) in five environmental- conditions (aerosols, plastic, stainless steel, copper, and cardboard). All experimental measurements are reported as means across three replicates. SARS-CoV-2 remained viable in aerosols throughout the duration of our experiment (3 hours), with a reduction in infectious titer from 103.5 to 102.7 TCID50 per liter of air. This reduction was similar to that observed with SARS-CoV-1, from 104.3 to 103.5 TCID50 per milliliter We found that the stability of SARS-CoV-2 was similar to that of SARS-CoV-1 under the experimental- circumstances tested. This indicates that differences in the epidemiologic characteristics of these viruses probably arise from other factors, including high viral- loads in the upper respiratory tract and the potential for persons infected with SARS-CoV-2 to shed and transmit the virus while asymptomatic. Our results indicate that aerosol and fomite- transmission of SARS-CoV-2 is plausible, since the virus can remain viable and infectious in aerosols for hours and on surfaces up to days (depending on the inoculum- shed). These findings echo those with SARS-CoV-1, in which these forms of transmission were associated with nosocomial- spread and super-spreading events, and they provide information for pandemic mitigation efforts" (15). According G. Buonanno *et al* : "Airborne- transmission is a pathway of contagion that is still not sufficiently investigated despite the evidence in the scientific literature of the role it can play in the context of an epidemic. While the medical research area dedicates efforts to find cures and remedies to counteract the effects of a virus, the engineering area is involved in providing risk assessments in indoor environments by simulating the airborne transmission of the virus during an epidemic. To this end, virus air-emission data are needed. this information is usually available only after the outbreak, based on specific reverse engineering cases. In this work, a novel approach to estimate the viral- load emitted by a contagious subject on the basis of the viral load in the mouth, the type of respiratory- activity (breathing, speaking), respiratory physiological parameters (inhalation rate), and activity level (resting, standing, light exercise) is proposed. The estimates of the proposed approach are in good agreement with values of viral -loads of well-known diseases from the literature. in recent years a marked development has occurred both in the techniques for detecting the viral load in the mouth and in the engineering area of the numerical simulation of airborne- transmission of the viral load emitted. the problem of estimating the viral- load emitted, which is fundamental for the simulation of airborne transmission, has not yet been solved. This is a missing "transfer function" that would allow the virology area, concerned with the viral -load values in the mouth, to be connected with the aerosol- science and engineering areas, concerned with the spread and mitigation of contagious particles.

A new approach is here presented for estimating the viral -load emitted by an infected individual. This approach, based on the principle of conservation of mass, represents a tool to connect the medical area, concerned with the concentration of the virus in the mouth, to the engineering -area, dedicated to the simulation of the virus dispersion in the environment. On the basis of the proposed approach, the quanta emission rate data of SARS-CoV-2 were calculated as a function of different respiratory activities, respiratory parameters, and activity-levels. The quanta emission- rates of an asymptomatic SARS-CoV-2 infected subject, with a viral load in the mouth of 10^8 copies mL^{-1}, were 10.5 quanta h^{-1} and 320 quanta h^{-1} for breathing and speaking respiratory activities, respectively, at rest. In the case of light- activity, the values would increase to 33.9 quanta h^{-1} and 1.03×10^3 quanta h^{-1}, respectively. The findings in terms of quanta- emission rates were then adopted in infection risk models to demonstrate its application by evaluating the number of people infected by an asymptomatic SARS-CoV-2 subject in Italian indoor micro-environments before and after the introduction of virus containment-measures. The results obtained from the simulations clearly highlight that a key role is played by proper ventilation in containment of the virus in indoor environments" (16)

Joshua L. Santarpia *et al*: "Lack of evidence on SARS-CoV-2 transmission- dynamics has led to shifting isolation guidelines between airborne and droplet isolation precautions. During the initial isolation of 13 individuals confirmed positive with COVID-19 infection, air and surface- samples were collected in eleven isolation rooms to examine viral shedding from isolated individuals. While all individuals were confirmed positive for SARS-CoV-2, symptoms and viral shedding to the 15 environment varied considerably. Many commonly used items, toilet facilities, and air samples had evidence of viral-contamination, indicating that SARS-CoV-2 is shed to the environment as expired- particles, during toileting, and through contact with fomites. Disease- spread through both direct (droplet and person-to-person) as well as indirect- contact (contaminated objects and airborne transmission) are indicated, supporting the use of airborne isolation- precautions Other emerging corona-viruses (SARS and MERS) have been suggested to have airborne -transmission potential in addition to more direct contact and droplet- transmission. At least one study suggests that MERS-CoV has the possibility of transmission from mildly ill or asymptomatic individuals. Surface samples taken in patient care areas for 10 MERS and SARS have shown positive PCR result Nosocomial-transmission 15 of SARS-CoV-2 has been reported, but the role of aerosol -transmission and environmental contamination remains unclear To improve the understanding of potential environmental- transmission risk of SARS-CoV-2, 30 refine IPC- practices and protocols within the NBU and NQU specifically, and inform outbreak control strategies more broadly, we initiated an ongoing study to obtain surface and air -samples in 2 NBU hospital and 9 NQU residential isolation-rooms where individuals who tested positive for SARS-CoV-2 were being monitored. Samples were obtained in the NQU on days 5-9 of activation, - when mildly ill or asymptomatic individuals infected with SARS-CoV-2 were housed in their 35 rooms for 5 to 9 days. Samples were obtained in the NBU on day 10, when Patients 1 and 2 had been admitted for ten days. Additional samples were obtained in the NBU on day 18, after Patient 3 had been admitted to the unit for 4 days. Three types of samples were taken during this survey: surface samples, high volume air samples, and low volume personal air samples.

The surface samples fell into three general- categories of location: common room surfaces, personal 40 items, and toilets. Viral -gene copy concentrations recovered from each sample type were generally low and highly variable from sample to sample ranging from 0 to 1.75 copies/µL (Figure 1A and 2), with the highest- concentration recovered from an air handling grate in the NBU. Since both the sampling time and 20 flow rate were known for all aerosol samples collected in this study, the airborne concentration was calculated for all air -samples (copies/L of air). Overall, 76.5% of all personal items sampled were determined to be positive for SARS-CoV-2 by PCR. Of these samples, 81.3% of the miscellaneous personal items, which 25 included exercise- equipment, medical equipment (spirometer, pulse oximeter, nasal cannula), personal computers, iPads and reading glasses, were positive by PCR, with a mean concentration of 0.217 copies/µL. Cellular phones were 83.3% positive for viral RNA (0.172 copies/µL mean concentration) and remote- controls for in-room televisions were 64.7% percent positive (mean of 0.230 copies/µL). Samples of the toilets in the room were 81.0% positive, with a mean 30 concentration of 0.252 copies/µL. Of all room surfaces -sampled , 80.4% were positive for SARS-CoV-2 RNA. This included 75.0% of the bedside tables and bed rails indicating the presence of viral RNA (mean concentration 0.263 copies/µL), as did 81.8% of the window ledges (mean- concentration 0.219 copies/µL) sampled in each room. The floor beneath patients' beds and the ventilation-grates in the NBU were also sampled. All five floor samples, as well as 4 35 of the 5 ventilation -grate samples tested positive by RT-PCR, with mean concentrations of 0.447 and 0.819 copies/µL, respectively Air samples, both in the rooms and in the hallway spaces , provide information about airborne -viral shedding in these facilities.

In room- air samples were 63.2% positive by RT-40 PCR (mean concentration 2.86 copies/L of air). In the NQU, samplers were placed either on the bedside table or a desk, wherever there was space. No attempt was made to ensure the sampler was placed a specific distance from the individual in the room, so, while distance between sampler and individual was neither defined nor consistent, individuals in the room did not directly interact with the sampler. In the NBU, for the first 2 sampling events performed on Day 10, the sampler was 45 placed on the window- ledge away from the patient (NBU Room A occupied by Patient 1) was positive for viral RNA (3.76 copies/L of air). During the sampling- event on Day 16 in NBU Room B occupied by Patient 3, one sampler was placed near the patient and one was placed near the door greater than 6ft from the patient's bed while the patient was receiving oxygen (1L) via nasal -cannula. Both samples were positive by PCR, with the one closest to the patient indicating a higher airborne concentration of RNA (4.07 as compared to 2.48 copies/L of air). Samples taken 5 outside the rooms in the hallways were 66.7% positive, with a mean concentration of 2.59 copies/L of air. Both personal air- samplers from sampling personnel in the NQU showed positive PCR results after 122 minutes of sampling -activity, and both air samplers from NBU sampling indicated the presence of viral RNA after only 20 minutes of sampling activity. The highest airborne concentrations were recorded by personal 10 samplers in NBU while a patient was receiving oxygen through a nasal- cannula (19.17 and 48.21 copies/L). Neither individuals in the NQU or patients in the NBU were observed to cough while sampling personnel were in the room -wearing samplers during these events.

Air samples that were positive for viral RNA by RT-PCR were examined for viral propagation in Vero E6 cells. Cytopathic effect was not observed in any sample, to date, and immune-fluorescence 15 and western blot analysis have not, so far, indicated the presence of viral- antigens suggesting viral replication. the low concentrations of virus recovered from these samples makes finding infectious virus in these samples difficult. Further other experiments are ongoing to determine viral- activity in these samples. It is interesting to note the presence of viral RNA on the floor under the bed of the patients and on the window ledges (which were not obviously used by the patient) in the hospital NBU. Airflow in NBU suites enters from the top center of the room and exits at grates near the head of the patient's bed on either side of the room. Airflow modelling has suggested that turbulent -eddies 20 may form under the patient's bed, which may cause the observed contamination under the bed, while the dominant airflow likely carries particles away from the patient's bed towards the edges of the room, likely passing by the windows resulting in some deposition- there. Although this study did not employ any size-fractionation techniques in order to determine the size range of SARS-CoV-2 droplets and particles, the data is suggestive that viral -aerosol particles are produced by individuals that have the COVID-19 disease, even in the absence of cough. First, in the few instances where the distance between individuals in isolation and air- sampling could be confidently maintained at greater than 6 ft, 2 of the 3 air samples were positive for viral RNA. Second, 66.7% of hallway air samples indicate that virus-containing particles were being transported from the rooms to the hallway during sampling activities. It is likely that the positive 30 air samples in the hallway were cause by vira-l aerosol particles transported by personnel exiting the room. Personal air samplers worn by sampling personnel were all positive for SARS-CoV-2, despite the absence of cough by most patients while sampling -personnel were present. "(17). Chen P-s *et al* :"The spread of influenza and highly pathogenic avian- influenza (H5N1) presents a significant threat to human health. Avian influenza outbreaks in downwind areas of Asian dust storms (ADS) suggest that viruses might be transported by dust -storms We developed a technique to measure ambient-influenza and avian influenza- viruses. We then used this technique to measure concentrations of these viruses on ADS days and back-ground days, and to assess the relationships between ambient- influenza and avian influenza viruses, and air- pollutants. A high-volume air sampler was used in parallel with a filter cassette to evaluate spiked- samples and un-spiked samples. Then, air samples were monitored during ADS seasons using a filter- cassette coupled with a real-time quantitative polymerase chain reaction (qPCR) assay. Air samples were monitored during ADS- season (1 January to 31 May 2006). We successfully quantified ambient influenza-virus using the filtration/real-time qPCR method during ADS days and back-ground days. this is the first report describing the concentration of influenza virus in ambient air. In both the spiked and un-spiked samples, the concentration of influenza virus -sampled using the filter cassette was higher than that using the high-volume sampler. The concentration of ambient influenza- A virus was significantly higher during the ADS days than during the background days. Our data imply the possibility of long-range transport of influenza- virus. "(18)

Lydia Bourouiba: "According to Wells, isolated droplets are emitted upon exhalation. Large- droplets settle faster than they evaporate, contaminating the immediate vicinity of the infected individual. In contrast, small droplets evaporate faster than they settle. In this model, as small droplets transition from the warm and moist conditions of the respiratory system to the colder and drier outside -environment, they evaporate and form residual- particulates made of the dried material from the original droplets. These residual particulates are referred to as *droplet nuclei* or *aerosols*. These ideas resulted in a dichotomous classification between large vs small droplets, or droplets vs aerosol, which can then mediate transmission of respiratory -disease. Infection control strategies were then developed based on whether a respiratory infectious disease is primarily transmitted via the large or the small droplet route. Given various combinations of an individual patient's physiology and environmental conditions, such as humidity and temperature, the gas cloud and its payload of pathogen-bearing droplets of all sizes can travel 23 to 27 feet (7-8 m). Importantly, the range of all droplets, large and small, is extended through their interaction with and trapping within the turbulent- gas cloud, compared with the commonly accepted dichotomized droplet model that does not account for the possibility of a hot and moist gas cloud. Moreover, throughout the trajectory, droplets of all sizes settle out or evaporate at rates that depend not only on their size, but also on the degree of turbulence - speed of the gas cloud, coupled with the properties of the ambient -environment (temperature, humidity, and airflow)." (20).

Transmission of virus through the air can occur via droplets or aerosols. The commonly accepted cut-off size between the large droplets and small- aerosols is 5 µm, although this varies considerably between studies, ranging up to 12 µm. Droplets generated during coughing, sneezing or talking do not remain suspended in air and travel less than 1 m before settling on the mucosa of close- contacts or environmental surfaces. Aerosols have a slow settling- velocity, thus they remain suspended in the air longer and can travel further. "(21). Chandini Raina MacIntyre *et al* Related smallpox diffusion: "In addition to direct respiratory- transmission from person to person within 1–2 m of spatial separation, a more distant transmission has been described. Whilst it is well-established that airborne infection can occur, the spread of smallpox by means of "aerial- convection" is less well understood. Aerial convection refers to transmission over a substantial distance, (greater than expected during direct person to person respiratory-transmission of 1–2 metres and possibly aided by wind or air currents) a concept accepted by many epidemiologists. In recognition of this, the Ministry of Health regulations in Britain in the 1940s stipulated that smallpox hospitals should be "at least a quarter of a mile from another institution or a population of 200, and at least a mile from a population of 600". A 2 distinct phenomena of airborne transmission of variola virus (smallpox) were described in the pre-eradication era—direct respiratory -transmission, and a unique phenomenon of transmission over greater distances, referred to as "aerial convection". We conducted an research analysis of data obtained from a systematic review following the PRISMA criteria, on the long-distance transmission of smallpox. Of 8179 studies screened, 22 studies of 17 outbreaks were identified—12 had conclusive evidence of aerial convection and five had partially conclusive evidence.

Aerial- convection was first documented in 1881 in England, when smallpox incidence had waned substantially following mass vaccination, making unusual transmissions noticeable. National policy at the time stipulated spatial separation of smallpox -hospitals from other buildings and communities. The evidence supports the transmission of smallpox through aerial convection at distances ranging from 0.5 to 1 mile, and one instance of 15 km related to bioweapons testing. Other explanations are also possible, such as missed chains of transmission, fomites or secondary aerosolization from contaminated material such as bedding. The window of observation of aerial convection was within the 100 years prior to eradication. Aerial- convection appears unique to the variola -virus and is not considered in current hospital infection control protocols. Understanding potential aerial convection of variola should be an important consideration in planning for smallpox treatment facilities and protecting potential contacts and surrounding- communities. the evidence from these outbreaks is supportive of aerial convection of smallpox at distances of more than a mile in some cases and is biologically- plausible due to higher concentration of virus in the lower respiratory tract, environmental factors such as wind, and the low infectious dose.

In many of the observed long-range transmissions, there was a temporal association between potential exposure to a known case and illness. It is possible, that some cases of smallpox were "super-spreaders" with much higher viral- shedding than others. This has been seen with other viral respiratory pathogens such as SARS. If this is the case, super-spreaders could explain long-range transmission. "(22). Fig. 4Maximum-reported distance (miles) of aerial- convection of smallpox in different outbreaks, where distance was quantified. summarises the distances of aerial convection of smallpox in different outbreaks. where distance was quantified. This ranged from half a mile (0.8 km) to over 9 miles (15 km) in the case of the Aralsk outbreak. Most were between 0.5–1 mile (0.8–1.6 km). (From reference n 22)

"Particles of small -size can remain suspended in the air for long periods, potentially exposing a large number of susceptible individuals, including those close to the source and those at greater- distances. A spherical particle of 4 μm in diameter takes 33 min to settle 1 m in still air, compared to a 1μm particle that will take 8 h. Relative humidity, temperature and wind -currents are the most important environmental factors that will determine the settling time of airborne particles that contain volatile -components "(23) According a Cochrane Database Syst Rev. 2017 "Acute -bronchiolitis is the most common lower respiratory tract infection in children aged up to 2 years. Bronchiolitis occurs when small- structures (bronchioles) leading to the lungs become infected, causing inflammation, swelling, and mucus production. This makes breathing difficult, especially in very young children, who develop coughs and wheezing. Because bronchiolitis is usually caused by a virus, drug- treatment is usually not effective. Hypertonic- saline (sterile salt water solution) breathed in as a fine mist using a nebuliser may help relieve wheezing and breathing- difficulty. We compared nebulised hypertonic (≥ 3%) saline solution with nebulized- normal (0.9%) saline for infants with acute- bronchiolitis. nebulised hypertonic- saline may have benefits on other outcomes such as rate of hospitalisation and clinical severity score in infants with acute bronchiolitis, providing a good safety profile and low- cost. Hypertonic saline solution has been shown to increase mucociliary- clearance in disease-free people and people with asthma, bronchiectasis, cystic fibrosis, and sinonasal- diseases. Such benefits would also be expected in infants with acute-bronchiolitis. The postulated mechanisms of benefit of hypertonic saline are:

- induces an osmotic flow of water into the mucus layer, rehydrating the airway surface liquid and improving mucus clearance (Mandelberg 2010; Robinson 1997);
- breaks the ionic bonds within the mucus gel, thereby reducing the degree of cross-linking and entanglements and lowering the viscosity and elasticity of the mucus secretion (Ziment 1978);
- stimulates cilial beat via the release of prostaglandin E2 (Assouline 1977). by absorbing water from the mucosa and sub mucosa, hypertonic saline solution can theoretically reduce oedema of the airway wall in infants with acute bronchiolitis (Mandelberg 2003; Mandelberg 2010; Sarrell 2002). Hypertonic- saline inhalation can also cause sputum induction and cough, which can help to clear the sputum outside of the bronchi and thus improve airway- obstruction. the quality of the evidence as low to moderate."(26)

EXPERIMENTAL HYPOTESYS PROJECT

After observing the results of this review and the possibility of airborne transmission and the effect of Polluted air it is interesting to verify the effect of aereosol therapy whit simply saline solution in two Groups of animal model of respiratory virus disease:

All subject with comorbidity for covid-19 disease or age more then 50 years but without any simptoms related to corona-virus – covi-19 living in area with high level of air pollution.(PM10, NO_2,OZONE)

Group 1: 100 subject treated whit normal saline aereosol therapy (with saline solution only)

Group 2: 100 subject non treated whit this. (Control group)

All patients no smokers (to avoid confounding effect). A questionary must be submitted to all to verify comorbidity, use of DPI, social distancing habist and other measure of public interest for containing of covid-19 diffusion. This questionary must describe the daily activity of the subject (work, travel, other activity). Not in lockdown situation Time of treatment: 15 days Other phases of this research is related to verify the effect of musk use also to prevent air pollution intake:

The same 2 other group of subject: First group using musk in all daily activity The second group only using musk in place as public institution ask officially. (not for all activities). In example in metro, bus, public office, indoor market et other. This make possible to verify the effect of musk use to prevent also air pollution intake. In this phases the verify must be longer: 60 days of exposition and then observation of the effect. In this way is possible verify if this simply precaution make possible to remove particulate air polluted in Respiratory tract improving pulmonary functionality.

DISCUSSION

Related this review phases is possible to verify that indoor airborne transmission is, whit high probability, a way of transmission According some research published for the various corona-viruses. To explain some cases of transmission with out direct contact or by droplet (and relative distance) airborne transmission can be a factors to be taken in consideration. "the aerosol can travel hundreds of meters or more current researches have proven that aerosols are involved in the spread of SARS, MERS, H1N1, and some other diseases If COVID-19 infection cannot transmit by aerosol, it will hardly to explain some confirmed cases. "(7).

This kind of indoor transmission by aereosols must be taken in consideration in situation like oncologic patients or immunodepresses even when they have access to hospital and not only when are in ICU or other high intensity wards. Contaminated zone was finded in patient bath in high intensity wards, but also in other zone like outdoor Access Hospital (1) Related SARS :"The virus-laden air was then transported by prevailing winds to adjacent buildings at Amoy Garden", (2) "We identified only a single outbreak in an outdoor environment, which involved two cases". (13)

"that forced, circulating air might play an important role in airborne spread of the virus. "(14) "isolated droplets are emitted upon exhalation. Large droplets settle faster than they evaporate, contaminating the immediate vicinity of the infected individual. In contrast, small droplets evaporate faster than they settle. In this model, as small droplets transition from the warm and moist conditions of the respiratory system to the colder and drier outside environment, they evaporate and form residual particulates made of the dried material from the original droplets. These residual particulates are referred to as *droplet nuclei* or *aerosols* the gas cloud and its payload of pathogen-bearing droplets of all sizes can travel 23 to 27 feet (7-8 m)". (20). And related Variola virus transmission

"The evidence supports the transmission of smallpox through aerial convection at distances ranging from 0.5 to 1 mile, and one instance of 15 km related to bioweapons testing. in many of the observed long-range transmissions, there was a temporal association between potential exposure to a known case and illness." (22) So when particulary vulnerable patients ore obliged by their severe clinical conditions to get some save life therapy like parenteral anticancer Is relevant that in all phases from access to wards the zone must be virus free using the necessary instrument available But what is relevant is the infect ant charge. "aerosol transmission may occur when respiratory droplets mix into the air, forming aerosols and may cause infection when inhaled high dose of aerosols into the lungs in a relatively closed environment. "(11)

If there are evidence for transmission capability in low distance this is not verified at long distance. Also the great rate of diffusion of covid -19 even in lockdown situation seem to tell something related the way of diffusion and spread.

Conclusion

If some evidence indoor airborne transmission of covid-19 are present not the same for outdoor situation. From literature Rna of covid- virus was finded in PM in polluted air in some world region it is not verified that this charge – dose can be infect ants for humans. One reference show outdoor contamination (1) Other relevant evidence was finded related other respiratory viruses (22). This data are crucial for public institution to adopt the right preventive measure to avoid airborne indoor transmission of some relevant respiratory viruses. The fact that some other viruses showed long distance diffusion (airborne) is other to be take in consideration (9) Other conclusion is that the mask not only prevent droplet transmission but in area very polluted prevent PM10 intake , whit a reduced related toxicity that can increase the respiratory problems. "The extent to which the COVID-19 virus induces respiratory- stress in infected individuals may also be influenced by the extent to which an individual's respiratory system is already compromised. The high levels of PM pollution in China may increase the susceptibility of the population to more serious symptoms and respiratory complications of the disease. The simultaneous inhalation of chemical pollutants in PM alongside COVID-19 virus may also exacerbate the level of COVID-19 infection. Pro-inflammation, injury, and fibrosis from inhaled PM combined with an immune- response or cytokine storm induced by COVID-19 infection could enhance the infection severity. Larger numbers of patients displaying more serious infection symptoms also created an increased risk of enhanced transmission potential. "(10). All The authors agree with the fact that depurative strategies involving PM and other pollutants from respiratory apparatus can help in reducing pulmonary pro- inflammatory status in elderly and In subject with polipathologies to prevent some respiratory viruses pathology. A deep knowledge in this kind of phenomena is an useful instrument for international organization and public institution to control diffusion of some respiratory viral disease.

Clarifications

This work as no any diagnostic or therapeutic intent , only to submit to researcher new hypotesis of work. All the rules. governative and regionals normatives, all the measure taken by Italian and World health organization related preventing the diffusion of covid 19 must to be followed and this work not is produced to avoid this. In this work some reference are in Italian language, not translated to show the original concept. In this research are also reported not peer reviewed (at the data of this publication) some Preprint because the covid-19 emergency need rapid research activity to translate in practice the evidence Finded. All images comes from the references reported and only for scientific scope.

Conflict of Interests: No

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