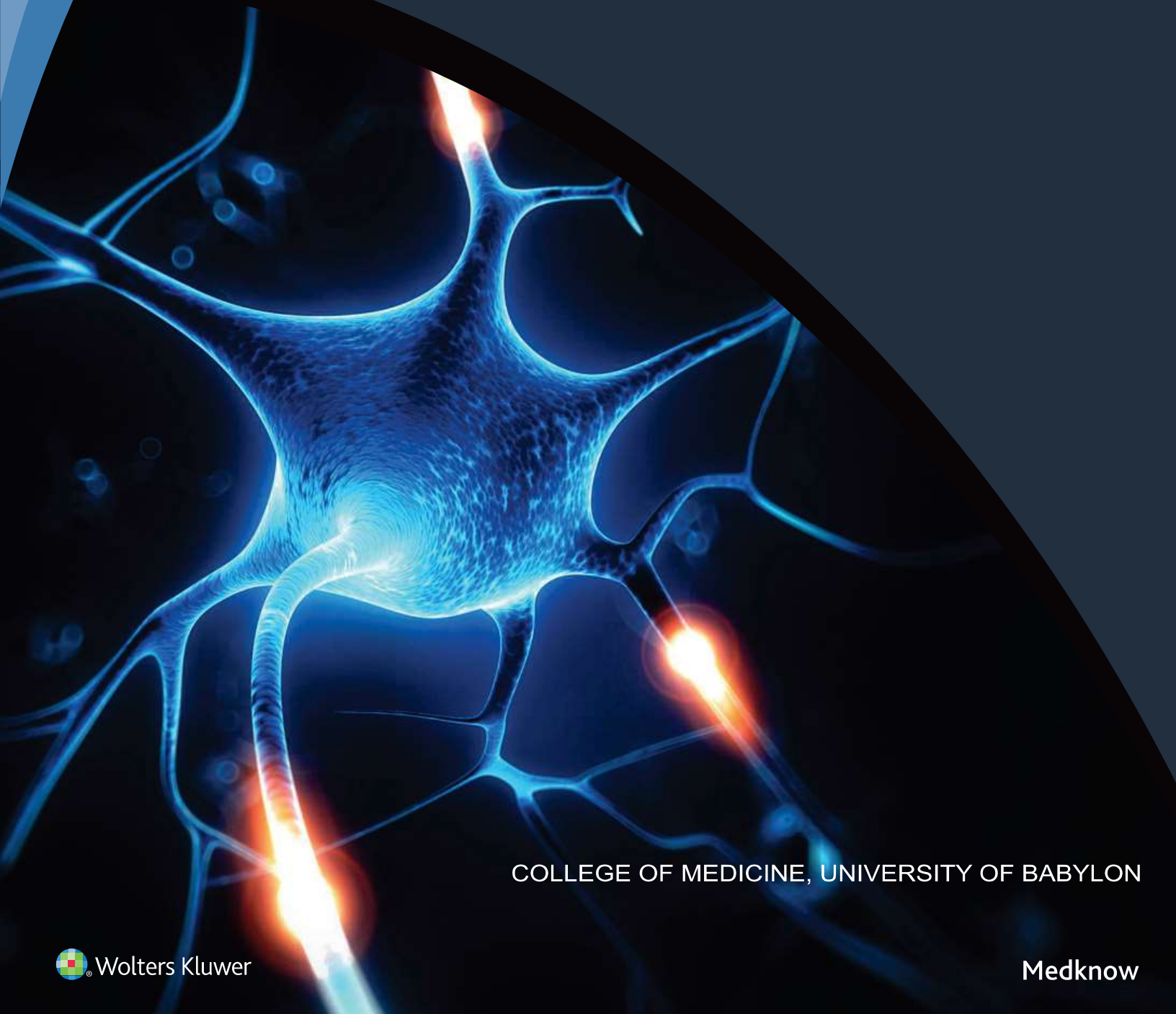
www.medjbabylon.org

ISSN (Print): 1812 -156X
ISSN (Online): 2312 - 6760

MEDICAL JOURNAL OF BABYLON

Volume 19 I Issue 2 I April - June 2022



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Review Article

A Review of Airborne Contaminated Microorganisms Associated with Human Diseases

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Abstract

Biological contaminants refer to environmental contamination and food source with living microorganisms such as bacteria, molds, viruses, and fungi, in addition to mites, house dust, and pollen. Temperature, relative humidity, movement of air, and sources of nutrients have influenced the presence and spread of biological contaminants. Numerous living microorganisms can grow independently on each other, such as bacteria and fungi. Viruses (a small obligate parasite) depend on other living organisms for their development and for performing vital functions. Indoor air can contaminate with biological contaminants by a different status, including living, dead, or debris of the dead microorganisms which were transported through ventilation systems, when the microorganism components dissolve in water. They become aerosolized when the contaminants are physically disturbed, like in renovation or construction, and when the contaminants discharge harmful gases into the indoor environment. Most studies conducted in recent years agree that air pollution rates are increasing, bringing more risks to human health, as pollution is related to the risk of heart and lung disease and its effect on children, especially infants and newborns. Also, environmental pollution may have become the most dangerous disaster faced by humans, because it means environment retrogradation in which humans lives as a result of an imbalance within the compatibility of the constituent elements and loses its ability to carry out its natural role in self-removal of contaminants by the natural factors noticeable within air, land, and water. In some cases, many common infections can spread through airborne contaminated microorganisms such as *Mycobacterium tuberculosis*, measles virus (MV), influenza virus, *Morbillivirus*, chickenpox virus, norovirus, enterovirus, less commonly coronavirus, adenovirus, and respiratory syncytial virus (RSV). When an infected person coughs, talks, sneezes, has throat secretions, and releases nasal into the air, the airborne infection can spread. Bacteria or viruses spread out noticeably in the air or ground and transport to other persons or surfaces. This review provides the conception of biological contaminants and their properties, nature of the indoor environment, and adverse health effects associated with biological contaminants.

Keywords: Aerobiology, airborne pathogens, coronavirus, pollutions, respiratory infection

Background

Aerobiology is the study of many processes including the living organism movement within the air from one geographic area to another. The aerosolized organism plays an essential function in the transmission of illness via airborne and droplet. The transmission of droplet occurs when an individual is in close contact (within 1 m) to an infected individual who has respiratory manifestations such as coughing and sneezing. Therefore, mouth, nose, or eyes are at risk of exposure to infectious respiratory droplets that contain contagious live microorganisms. Transmission can also occur by objects which are present in the immediate environment surrounding the infected person. Consequently, COVID-19 virus transmission can occur through direct contact with an infected individual and through indirect contact

Access this article online

Quick Response Code:

Website: www.medjbabylon.org

DOI: 10.4103/MJBL.MJBL_20_22

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Submission: 30-Jan-2022 **Accepted:** 08-Feb-2022 **Published:** 30-Jun-2022

How to cite this article: Hussain HH, Ibraheem NT, Al-Rubaey NKF, Radhi MM, Hindi NKK, AL-Jubori RHK. A review of airborne contaminated microorganisms associated with human diseases. Med J Babylon 2022;19:115-22.

with objects or surfaces, which are utilized by the infected persons within the immediate environment.[1]

The air is a mixture of many gases and dust particles. The industrialization has a significant responsible factor in pollution of air, which leads to make the air quality poor in chemical composition, noting that weather phenomena can minimize levels of chemical pollution, as it was found that during dust storms, the percentage of polluted gases decreases.[2] But the biological aspect of air quality does not obtain enough attention when compared with the chemical aspect. Bioaerosols or biological contaminants pose equivalent or more serious threats than chemical contaminants. Bioaerosols generated by bacteria, viruses, parasites, and fungi are can be dangerous to human health because they have an ability to remain suspended for a long period of time in the air, so the time between the exposure and infected person is generally very short. The pollution of the indoor air has a significant responsibility for severe diseases and deaths when compared with the pollution of the outdoor air, because the human beings spend great part of their time indoors. In developing countries, the indoor air pollution has caused about 2 million deaths and responsible for 4% of the global illness burden.[3] The environmental building is a specific interest because humans spend >90% of their time inside.[4] Microbial populations have been discovered to have various kinds of indoor environments such as hospitals, schools, and houses according to researchers.[5] Sometimes multiple rooms in the same building (e.g., bathroom vs. bedroom) actually have several microbiomes.[6] The heterogeneous presence of droplets and airborne releases is a complicating factor that is commonly made up of "single and numerous cells, spores, and viruses" borne by respiratory excretions and particles of dust. The sources of droplets or microorganisms in the air are also heterogeneous: infected individuals can produce infectious particles, cooling tower water in hospitals, and ventilation systems. All of these sources have the ability to generate airborne infectious particles. The infectious illness transmission via the airborne route is based on the size of the particles.[7] The large particle size ranging from 30 to 60 μm commonly composed of organic and inorganic dirts, mold spores, fibers, and pollens. The nasal vibrissae filtered out those. Generally, the bacteria are smaller than spores of fungi, and the droplet released from sneezing, coughing, and talking makes up the respirable particle group; therefore, these enter the terminal airways and vary between 1 and 5 μm in size. The viral is <1 μm expelled by exhalation from the human respiratory tract. They usually adsorbed droplet nuclei after entering the respiratory tract and will stay there and then infiltrate the epithelial respiratory tract cell and causes the infection.[8] Generally, a bigger particle falls out of the air, whereas a tiny particle stays airborne. The diameter of airborne particles is specified by the World Health Organization (≤5 μm) and droplet (>5 μm) transmission by using a particle diameter of 5 μm.[9]

A basic denominator of all human life is susceptible to airborne pathogens. Testing techniques for the analysis of airborne diseases have advanced to demonstrate that microorganisms originating from an infectious source such as fungi, fungal spores, and viruses can disperse by air currents over a very long distance and be finally inhaled, swallowed, or brought into contact with persons who have not been exposed to the contagious source. In the prevention of infectious diseases and illnesses, airborne pathogens present a particular problem, as only a limited number of sick people are responsible for the dissemination of most infectious particles.[10]

Common Sources of Droplet and Airborne Infections

The droplet and airborne lead to transmission of infections, which are characterized by clinical expression of the disease; the origin of these infections includes the infection site, the presence and the type of a pathogen. It can also depend on the frequency of the originating activity such as one sneeze may contain more particles of infection than coughing.[11]

Infected individuals are not necessarily the cause of respiratory infectious particles. For instance, many of us spend a substantial amount of time in office buildings and thus are susceptible to airborne pathogens transmitted by non-human origin, e.g., molds and its toxins, pest droppings, pet dander, and pollen.[12] The health effects of naturally occurring biological air pollution in indoor environments include infections, toxicoses, and hypersensitivity diseases.[13] Furthermore, indoor biological air toxins have been attending with "sick building syndrome," a series of non-specific signs which will include an upper respiratory symptom, exhaustion, rash, and headaches, which "appear to be linked to time spent in a building, but no specific illness or cause is often identified."[14]

Environmental Factors

Temperature and relative humidity are the most frequently cited environmental factors in modifying airborne disease transmission. Altogether they help to figure out, an airborne sample may or may not stay contagious.[7] Rather, low temperatures contribute to inhibit the growth of several microorganisms replicating at room temperature. While the *Aureobasidium pullulans* mold and the *Sporobolomyces* yeast are well developed and sporulated under cool conditions, certain microbes do thrive at higher temperatures. The *Aspergillus* fungi may grow at temperatures beginning from 12°C to 57°C. On the contrary, by supplying the water and nutrients

needed, high relative humidity promotes the growth of bacteria, molds, and the arachnid dust mites. Maintaining relative indoor humidity between 35% and 50% typically results in a decrease in condensation and indoor humidity, as well as a decrease in the development of bacteria, fungi, and dust mites.[15] Temperature is a crucial factor affecting on virus survival. As the temperature rises, the survival of the virus, in general, decreased. Relative humidity is considered to have an effect on the viability of viral transmission via airborne infections and droplets. Also, influenza was recognized to be transmissible under cold and dry conditions via an airborne vector. But the relationship is unclear. Lowen *et al.* discovered that in relative humidity, bounded survival exists for both lipid enveloped and non-lipid enveloped viruses, ranging from 40% to 70%.[16] The persistence of gram-negative aerosolized bacteria, such as *Enterobacter* spp., *Klebsiella* spp., and *Pseudomonas* spp., is described to be greater at low temperature and high relative humidity.[17] The rates of fungi and their spores in both indoor and outdoor air have been identified in specific studies regarding fungi.[18] Airborne fungi and their spores are thought to be able to enter a building through natural ventilation, rather than viruses or bacteria. Some kinds (e.g., *Aspergillus* sp.) when introduced to immunocompromised patients, they are also regarded as potentially life-threatening respiratory pollutants, for instance, in a healthcare facility.[19] Individuals who work frequently in indoor settings such as a school or workplace have developed hypersensitivity reactions, including rhinitis, sinusitis, or asthma as a result of fungal exposure.[15] Even so, the conclusions of several studies revealed a seasonal variability in concentrations of airborne fungi and their spores, correlated with typical environmental factors, including atmospheric temperature, relative humidity, wind speed, and precipitation. Mostly, fungi and their spores seem to be more durable and resistant to dehydration and rehydration, also the ultraviolet radiation, than viruses and bacteria.[20]

Airborne Pathogens in Workplace Building

The heating, ventilation, and air conditioning (HVAC) system is a current common divisor that affects and/or decreases the transmission of airborne particle emission inside a building. There are three main elements of a standard HVAC system: (1) outdoor air, air intake ducts, and controls; (2) air processing equipment (i.e., fan devices, heating and cooling coils, air filters, and controls); and (3) the systems of air distribution (i.e., registers, grilles, air ducts, diffusers and controls, exhaust air ducts and plenums, return and return and exhaust air collectors). Tools, whenever practicable, should be sensitive to dangerous exposures in extreme circumstances.[21] Air currents, temperature, and relative humidity are three proven key variables in airborne infectious particle transmission that HVAC systems control at the same time.[22] The microorganism differs with the addition of airborne contagious agents in an industrial or commercial building.[23] Bacteria, allergens, and molds can quickly penetrate a building from an HVAC air intake and spread across the air-treatment system. Often recognized as causes of airborne contaminants, entering an office or industrial building includes construction products, carpets, furniture, plants, livestock, and pests. Another problem for molds and fungi often grown in wet or moist areas, such as cooling tubes, condensate pans, filters, and humidifiers, acts as a continuing source of pollution in the house. This is therefore understood that bacteria and mold organisms thrive in areas where water has been stored such as insulation, ceiling tiles, and carpeting, which function as an ongoing cause of infection. Viruses that are quickly transmitted through airborne infection such as influenza A virus may be carried into a building through infected people, which can then enter the return air network and distributed through the HVAC system in a facility. These affected persons may have no signs; hampering infection management efforts about 30–50% of people diagnosed with influenza A may not have any symptoms.[24] In addition, it should be remembered that there has not been a quantification of the degree to which HVAC systems lead to airborne disease transmission.[25]

Humans as a Source of Airborne Microorganisms

Breathing and shedding of millions of skin cells participate to bioaerosols in the built environment every day. Furthermore, human occupation is likely to have the greatest impact on the total amount and composition of bioaerosols in the built environment, particularly in weakly ventilated or densely populated areas.[6] The total airborne microbial freight is influenced not just by human occupancy, but also by population structure.[26] Ventilation and occupancy affected microbial populations in an indoor air.[27] Human-associated bacteria were more than two times greater in an inhabited indoor climate, despite the fact that the population structure in an indoor air roughly correlated with that of the outdoor air. *Micrococcus* spp., *Streptococcaceae* spp., and *Staphylococcus* spp. are the most frequent kinds contained in safe office building's air. This bacteria are indicative of the normal human flora and provide empirical proof that human activity influences bacterial populations in indoor air to some extent.[28] Many taxa of airborne bacteria are found in indoor air, but are not found in outdoor air, including human-pathogen-related taxa, suggesting the importance of microbial communities in the natural built environment from a health perspective.[29] The bacteria produced by male vs. female occupation may have variations. The researchers have found that households with a higher proportion of male inhabitants have larger relative abundances of *Dermabacter* spp., *Corynebacterium* spp., and *Roseburia* spp., whereas households with a majority of female

residents have a higher relative profusion of *Lactobacillus* spp.[30] Despite the fact that humans are the main sources of several viruses, little is known about viral populations in the air and how human activity impacts population composition and overall microbial freight.[31] The development of quantitative polymerase chain reaction is made by the researchers to detect and research numerous viruses in the air, but much of the studies have concentrated exclusively on influenza virus. During the 2009–2010 flu season, an aerosol sample contained influenza virus concentrations of up to 3.7×105 genome copies M^{-3}, which were present in an aerosol sample found in a community clinic, daycare centers, and aircraft cabins.[32] Patients of influenza who have been reported positive exhale up to 2.6×105 copies of influenza virus genomes per hour. The scientific researchers discovered that fine particles contained approximately 9-fold more copies of the influenza genome than coarse particles, meaning that a substantial amount of the virus would stay airborne for hours.[33] We aimed at quantifying aerosol particles that are produced during a cough in people who have been diagnosed with influenza. Several studies observed that patients coughed up a total of 75,400 particles per cough (38.3 pL aerosol volume) when infected when compared to 52,200 particles per cough (26.4 pL aerosol volume) after recovery. Particles produced from sick persons are likely carrying the influenza, and so individuals with the flu are potentially a larger source of infectious infection than healthier persons. The same may refer to other respiratory infections.[34] When a patient coughs, *Mycobacterium tuberculosis* that causes tuberculosis can be aerosolized and remain viable.[35] In the respiratory tract and saliva, humans who bear a variety of viruses and bacteria, while sneezing, coughing, talking, and even just breathing, discharge the microorganisms in the natural atmosphere with aerosols.[36]

Pets as a Source of Pollution

Latest research has discovered that dog-generated bioaerosols and dust are valuable for the health of children and infants in shaping an indoor microbiome, specifically dogs and cats. One researcher reported that 56 of the bacterial genera and other researchers noticed that 24 of the bacterial genera in households with dogs and cats were slightly more common, respectively. Dogs have been correlated with a larger number of *Moraxella* spp., *Porphyromonas* spp., *Arthrobacter* spp., *Bacteroides* spp., *Neisseria* spp., and *Blautia* spp., whereas cats were associated with large numbers of *Porphyromonas* spp., *Prevotella* spp., *Jeotgalicoccus* spp., *Moraxella* spp., *Bifidobacterium* spp., and *Sporosarcina* spp. It is unclear if animal-specific microorganisms are responsible for enhancing these safety initiatives or if the animals actually raise access to resuspend dust through their activity and likely to outside microorganisms if they step outdoors.[30,37]

Suspended Dust as a Source of Pollution

In fact, the suspended dust constitutes up to 60% of the overall particulate matter in indoor air.[38] Dust can be seen on almost every surface in the house like the walls, sheets, mattresses, and furnishings. Concentrations of microorganisms are highly variable in household dust, varying from invisible to 109 cells/g. Several studies have discovered the diversity of bacterial and microbial species found in house dust. They are prevailed by skin-associated and Gram-positive bacteria and contain up to 112,000 phylotypes "from 1200 households within samples."[5] The most common genera of bacteria present in household dust include *Staphylococcus, Lactococcus, Corynebacterium, Actinobacteria*, and *Firmicutes*. Household dust fungal flora is also complex, with up to 57,000 phylotypes, and appears to contain fungal organisms occurring outdoors such as household molds (*Cladosporium* spp., *Aspergillus* spp., and *Penicillium* spp.) and wood-degrading fungi and those which are related to humans, such as *Saccharomyces* spp. and *Candida* spp. Indoor fungi types may be influenced by air conditioning, moisture, pets, and ventilation.[30]

Some Diseases Spread by the Airborne and Direct Contact

Contact diseases are spread when an infected individual comes into close contact directly with an uninfected individual, and the microbe is therefore transferred from one person to another. Indirect interaction with the air or personal objects of an infected individual may also spread contact diseases. The existence of wound or other ooze from the body means the possibility of infection, and environmental pollution has increased potentially. The procedures that reduce or remove the microorganism in the atmosphere or on personal appurtenances form the basis for preventing the transmission of disease by close communication.[39] Among the illnesses are:

- *Acute flaccid myelitis*: It is a rare, yet dangerous disease that impacts the spinal cord, resulting in weaker muscles and reflexes.
- *Anthrax*: A dangerous and deadly disease caused by *Bacillus anthracis*. A bacterium is a single-celled organism capable of producing spores. A spore is a dormant (asleep) cell that can be reawakened and come to life under the proper conditions.
- *Carbapenem-resistant Enterobacteriaceae infection*: Enterobacteriaceae is a family of bacteria that are usually located in our intestines. They can induce serious infections in bladder, wounds, blood, and lungs.
- *Coronavirus infection*: Coronaviruses are a big family of viruses which can cause a variety of human diseases, including the common cold, SARS, MERS, and COVID-19.

- *Enterovirus infection*: Non-polio enteroviruses are extremely common viruses, infecting between 10 and 15 million people in the USA every year.
- *Group A streptococcal* (*GAS*) *infection*: Common bacteria are present in the throat and on the skin. People may carry GAS within the throat or on the skin and may not have any symptoms of illness. Most GAS infections are comparatively mild illnesses like streptococcal sore throat or impetigo. Sometimes, these bacteria can cause serious and life-threatening diseases.
- *Invasive group B streptococcal* (*GBS*) *infection*: This bacterium causes the disease in pregnant women, newborn, adults, and elderly persons suffering from the other diseases such as liver disease or diabetes. GBS causes a life-threatening infection in newborns.
- *Invasive Haemophilus infections*: *Haemophilus influenzae* type b causes illness and can affect many organ systems. The commonest kinds of invasive disease include pneumonia, occult febrile bacteremia, otitis media, epiglottitis, meningitis, septic arthritis, purulent pericarditis, cellulitis, and other less common infections such as osteomyelitis and endocarditis.
- *Influenza*: *Influenzae* A virus caused illness that infects the nose, mouth, and lungs. For all of us, influenza may cause severe, life-threatening complications, and illness.
- *Legionellosis*: An inflammation is brought about by *Legionella pneumophila* bacterium. Key tracks the prevalence of *Legionellosis* by healthcare centers, research laboratories, and other public health partners.
- *Measles*: The signs of influenza, a respiratory illness triggered by the MV, include fever, nausea, cough, runny nose, and swelling "rash" around the body.
- *Meningococcal disease*: Any infection caused by the bacteria *Neisseria meningitidis*, also known as meningococcus, is referred to as meningitis. This disease is often serious and fatal. Meningitis (infection of the lining of the brain and spinal cord) and bloodstream infections are among them (bacteremia or septicemia).
- *MERS-CoV*: All MERS cases to date have been related to travel or reside in and around countries in the Arabian Peninsula. In 2015, the Republic of Korea experienced the largest reported MERS epidemic outside of the Arabian Peninsula.
- *Mumps*: A mumps virus caused illness. Typically, this infection starts with headache, fever, tiredness, body aches, and lack of appetite and hence gland swelling follows.
- *Methicillin-resistant Staphylococcus aureus* (MRSA) infection: This is a bacterial infection that is resistant to antibiotic treatment. When MRSA microbes are present on the skin, but do not cause disease, this is referred to as "colonization." MRSA, in most instances, does not cause any complications or mild illnesses, such as pimples or boils. MRSA, in contrast, can also lead to more severe infections.
- *Pertussis*: A respiratory disease generally referred to as whooping cough. Typically, it begins with cold-like signs, such as a cough that gets worse after a few weeks.
- *Plague*: *Yersinia pestis* is a disease-causing bacterium. It is found in many parts of the world, in rodents, and their fleas.
- *Respiratory syncytial virus* (*RSV*) *infection*: RSV is an infectious virus which attacks the lungs and respiratory tract. Safe individuals usually have moderate, cold-like symptoms. RSV can be dangerous, particularly in babies and the elderly.
- *Streptococcus pneumoniae infection*: *S. pneumonia* is a Gram-positive bacterium, does not form spores, encapsulates diplococci that predominately colonize the human nasopharyngeal, and is capable of asymptomatic spread.
- *SARS*: A coronavirus-related respiratory disorder, the latest is recorded in 2004.
- *Tuberculosis*: An infectious illness usually involves the lungs.
- *Varicella*: A type of skin illness which is known as chickenpox is caused by varicella-zoster virus.

Respiratory viruses replicate in the respiratory tract before being shed and spread by respiratory secretions. They are divided into several families based on their virulence and target groups. Infections of the respiratory tract can vary from asymptomatic to severe life-threatening diseases, posing a serious risk to young children, the elderly, and those with weakened immune systems. Respiratory viruses are transmitted through three routes: aerosol transfer, droplet transmission, and direct or indirect contact.[40,41] The transmission of infection is by contact related to direct transfer of the virus from an infected individual to a sensitive individual by means of contaminated hands or the indirect transmission by means of intermediary items. The virus may spread through air by droplets or aerosols. The cutoff size between bigger droplets and tiny aerosols is commonly accepted to be 5 μm, but it differs greatly between experiments, reaching up to 12 μm.[11] Coughing, sneezing, or talking creates droplets that do not stay suspended in the air and spreads less than 1 m before landing on the mucosa of nearby contact persons or environmental surfaces. The aerosols settle slowly, which means that they stay suspended in the air for a longer period of time and can spread more.[42]

Humans' Respiratory Viruses

Measles virus

Measles is one of the most contagious human-infected viral infections, and it has been related to aerosol that transmitted for a long time.[43] An inquiry into air circulation in a sports arena where a measles epidemic happened led to this conclusion. According to the authors' suggestion, MV had scattered by the ventilation system. As a result, it was determined that aerosols would spread the MV. While

coughing is a typical measles symptom, the patient index in pediatric practice outbreak reports was characterized as coughing often and vigorously. Remington *et al.* measured that the infectious dose of MV was released by the case index by coughing, utilizing an airborne transmission-based statistical model. They observed that the case index generated a very large infectious dose in comparison to other outbreaks, a phenomenon known as superspreading. Super-spreaders are people who are capable of infecting an unusually high number of susceptible contacts relative to a normal adult.[44,45]

Parainfluenza virus (PIV)

There are four types of human PIVs (HPIVs) that belonged to the Paramyxoviridae family and are classified into two genera, Respirovirus stereotypes: 1 and 3 and Rubulavirus stereotypes: 2 and 4. They are both known to cause infections of the upper and lower respiratory tracts,[46] including the fact that HPIV epidemics cause a significant disease burden in children " reporting approximately 40% of all pediatric hospitalizations related to lower respiratory tract infections." They can also induce up to 15% of all adults respiratory diseases, as well as predispose compromised and/or weakened older persons with serious illnesses.[47] HPIV-induced infections can be intermittent, although outbreaks are common. In fact, the seasonal infection patterns seen in the Northern Hemisphere are essentially absent in tropical and subtropical countries with a temperate climate, where infection rates vary little or not at all during the year. Thus, seasonal differences in the incidence of HPIV infections are usually found when serotype-specific infection rates are analyzed, which are strongly based on the area.[48]

Respiratory syncytial virus

RSV is a widespread respiratory virus that usually induces symptoms that are mild and cold-like. In 1–2 weeks, most infected individuals recover, but RSV can be more serious, particularly in infants and elderly patients. In the USA, RSV is the main reason of respiratory disease in older adults and the main reason of both pneumonia and bronchiolitis in children under 1 year of age.[49] One study of transmission through objects observed that RSV may be recovered from the surface for several hours, however, only for a few minutes from tissue paper and skin. RNA of the RSV was discovered up to 7 m away from a patient's head by Aintablian *et al.* in the late 1990s. Nevertheless, since it cannot demonstrate the infectivity of the virus, RSV airborne transmission was considered to be negligible, whereas the RSV was believed to be transmitted only via touch and droplet transfer. In a recent report, investigators were able to obtain aerosols containing a viable airborne virus from the air surrounding children contaminated with RSV.[50]

Rhinovirus (common cold)

Human Rhinoviruses are usually associated with common cold and leading causes of upper respiratory tract infections worldwide.[51] It has infected humans by direct contact, contact with surfaces and objects, or through an airborne method.[52] Humans have the ability to have cold at any time during the year, but most individuals have colds in the winter and spring. The symptoms of the common cold are headaches, sore throat, runny nose, sneezing, coughing, and body aches. The majority of those infected recover within 7–10 days. However, individuals with asthma, compromised immune systems, or problems affecting the lungs and respiratory passages may experience extreme illnesses, such as pneumonia. Popular colds are the primary source of missed work for children from their schools and for adults. In 2019, millions of adults in the USA have common cold, and children have even more.[53]

Influenza A virus

Influenza viruses are of four types, known as "A, B, C, and D." Every winter in the USA, human influenza A and B viruses trigger seasonal infectious illnesses, often known as flu season. Only one form of influenza exists (influenza A viruses) that is causing worldwide flu epidemics. When a new and distinct influenza A virus strain develops, a pandemic will occur. A virus develops that infects humans and has the potential for transmission easily. Influenza A viruses cause illness. Hemagglutinin (H) and neuraminidase (N), two proteins found on the surface of viruses, are used to divide them into subtypes. There are 18 various subtypes of hemagglutinin from "H1 to H18" and 11 distinct subtypes of neuraminidase from "N1 to N11." The present influenza A virus subtypes that have regularly infected humans include the following: A (H1N1) and A (H3N2). Depending on the vaccine, every season's influenza vaccine contains one influenza A (H1N1) and one influenza A (H3N2) strain. Obtaining a flu vaccine will protect us from flu viruses that are similar to a vaccine used in the industry, but seasonal flu vaccines do not protect from "influenza C or D" viruses. Moreover, the influenza and sickness that are caused by other viruses which can induce flu-like symptoms will not be prevented by influenza vaccination.[54]

Coronavirus

The new public health crisis challenges all the people in the world with the emergence, development, and spread of COVID-19, compromising the world. The virus was produced from bats and in Wuhan City in China and then transmitted to humans by unknown intermediate animals on December 2019. Estimated 96,000 confirmed cases of coronavirus infection occurred in 2019 (COVID-2019), whereas there are 3,300 confirmed deaths to date (March 5, 2020).[55] The virus continues to spread and in

June 2021 the world will be in pandemic mode for a year and a half; approximately 250 million people have been infected, whereas 1.75 million are dead.[56] The fatality risk of the event is expected to range from 2% to 3%. The treatment is usually supportive, and the role of antiviral agents has been identified so far. Infection prevention includes home isolation; hospitals with confirmed cases and those with temperate diseases and serious infection control measures include contact precautions.[55] The disease was given a specific name "COVID-19" by the World Health Organization (WHO). The virus was given the name Severe Acute Respiratory Syndrome "SARS-CoV-2" by the International Committee on Virus Taxonomy. In clinical and scientific research, the creation of a formal name for the novel coronavirus and the disease it caused contribute to the communication. This virus is a member of β-coronavirus, a broad class of common naturally occurring viruses. As with other SARS-CoV-2 viruses, natural hosts, intermediate hosts, and definitive hosts are all available. Infection control and recovery would be greatly hampered as a result of this. Despite the low mortality rate of virus, it has a high transmissibility and infectivity compared with SARS and MERS.[57]

Ethical consideration

Not applicable.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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