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ANALYZE THE RELATIONSHIP BETWEEN THE HUMAN BODY AND THE VIRUS

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ABSTRACT
Coronaviruses are significant human diseases, and the study of their behavior dates back almost a century. A new coronavirus originated in Wuhan, China, in late 2019 and then disseminated globally. The World Health Organization officially named the human disease caused by severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) as coronavirus disease 2019 (COVID-19) in February 2020. SARS-CoV-2 was previously referred to as 2019-nCoV (2019 novel coronavirus). The most common severe clinical presentation of COVID-19 is viral pneumonia, which is characterized by symptoms such as fever, cough, difficulty breathing, low oxygen levels in the blood, and the presence of infiltrates on chest X-rays in both lungs.A dry cough is more prevalent than a productive cough, occurring in 3-6 cases. The onset of dyspnea often occurs within a median timeframe of 5 to 8 days.A considerable number of patients with COVID-19 pneumonia experience severe hypoxemic respiratory failure, which aligns with the Berlin definition of acute respiratory distress syndrome (ARDS).Patients necessitating mechanical breathing exhibit a significant mortality risk
Key Words : World Health Organization, COVID-19

INTRODUCTION

The human respiratory system is a vital component of the body. The respiratory system comprises the nose, nasal cavity, sinuses, mouth, pharynx, larynx, trachea, diaphragm, lungs, bronchi, bronchioles, alveoli, and capillaries. This mechanism facilitates the process of respiration in humans. The function of the nose and nasal cavity in this system is to intake air from the external environment and protect the lungs by filtering out large particles using nasal cilia. Sinuses regulate and measure the humidity and temperature of the air that is breathed in. In addition, it can reduce the size of the cranial bones to enhance vocal resonance. The mouth has a similar role to the nose in the respiratory system by facilitating the intake of air from the external environment. The pharynx, sometimes known as the throat, facilitates the passage of breathed air to the windpipe. The larynx serves as a safeguard to prevent the obstruction of the airway by any foreign substances. Additionally, it detects the inhalation and exhalation of air into the lungs and generates a range of auditory signals. The larynx connects the pharynx to the trachea, often known as the windpipe. The trachea transports the inspired air to the lungs. The diaphragm's function is to generate negative pressure within the lungs, facilitating the inhalation of air through the windpipe. The diaphragm primarily regulates the expansion and contraction of the thoracic cavity during respiration. The lung is the main component of this system. The respiratory system purifies breathed air, supplying oxygenated blood to the bloodstream and expelling deoxygenated air from the body through the indicated organs. The bronchi serve as the primary means of entry and departure for the lungs.

The bronchi, which are two major branches located at the carina (the terminal part of the windpipe), extend into the lungs and then divide into smaller bronchioles. The bronchioles facilitate the intake of oxygenated air into the lungs and the expulsion of air containing carbon dioxide. The many organs associated with the respiratory system

are highly susceptible and prone to being impacted if adequate precautions are not observed. In the modern era, as a result of technological progress, the atmosphere becomes contaminated with a multitude of detrimental particles that might have an adverse impact on our respiratory system. These particles can include viruses, bacteria, chemical compounds, and other similar entities. The nose possesses the potential to monitor the ingress of sizable particles into the lungs, nevertheless there exist several minuscule particles that can effortlessly bypass the nasal cilia. These substances elicit detrimental effects on the human body. Recently, there was an epidemic of a virulent virus that did significant damage to the healthcare industry. The new coronavirus, known as SARS-CoV-2, disseminated illnesses globally. Thanks to its mutagenic capabilities, the virus undergoes constant transformations in order to propagate infections. This virus epidemic resulted in a worldwide pandemic. A significant proportion of individuals were impacted during this epidemic. The primary impact of this virus and its variations is predominantly on the respiratory system, with secondary effects on the brain, kidney, heart, and skin.

Coronaviruses are single-stranded RNA viruses that are encased in a positive sense. The SARS-CoV-2 virus is located within the beta-coronavirus group. This is the third zoonotic virus, following SARS and MERS. Several researchers have stated that the virus is transmitted through droplets. These particles are released into the air by the affected person through breathing, talking, and saliva. While larger droplets quickly descend to the ground within a few of seconds, smaller particles remain suspended in the air. These suspended particles are actively involved in the aggregation of the population. To ensure correct usage of masks and avoid the spread of diseases, it is important to practice frequent hand hygiene.The maximal incubation duration is 14 days.

The global Covid-19 epidemic has affected a vast number of individuals worldwide, resulting in millions of infections. It exerts a greater impact directly on the organs of the human body. An individual exhibited clinical symptoms in reaction to SARS-COV-2. The respiratory organ is most frequently damaged. The virus readily adhered to Angiotensin, which is subsequently transformed to the enzyme2 receptors. These receptors were also found in several organs such as the lungs, brain, liver, pharynx, and vascular endothelial cells. An ailment characterized by the virus that affects the entire body.

Impact on coagulation: Hemorrhaging is infrequent during the pandemic. During this period, instances of pulmonary embolism, venous thromboembolism, and pulmonary arterial embolism were observed. Pulmonary effect: The diffuse alveoli were injured without the presence of fibrosis or organization. The primary cause of this condition is attributed to the dysfunction of alveolar cells and the impairment of endothelial cells. It results in the secretion of substances from cells and fluids.

Cardiac effects during a pandemic can arise due to the loss of pulmonary function, leading to complications. Furthermore, please include information regarding any further symptoms. Renal impact: Dialysis patients encounter difficulties in kidney transplantation. The Covid-19 pandemic has introduced significant challenges.

Neurological impact: The ACE2 receptor is found in both the cerebral cortex and the brain stem.

Impact on the respiratory system: The virus has the most pronounced detrimental impact on this organ. The virus's pathogenicity is the cause. The majority of individuals in this predicament experienced many ailments such as requiring breathing assistance and necessitating hospitalization. In multiple instances, the condition manifested as acute respiratory distress syndrome. Other disorders such as acute renal failure, heart failure, and sepsis, among others. Chronic diseases and elderly people are considered significant risk factors for mortality.

The work focuses on the impact of the post-coronavirus outbreak on the human respiratory system. Several papers have been examined that explain the impact of post-COVID on the human respiratory system, aiming to provide a clearer understanding of the virus's affect.

THE DIAGNOSIS OF VIRUSES THAT AFFECT THE RESPIRATORY TRACT

It is nearly hard to distinguish the cause of a respiratory tract infection only on the clinical circumstances. In order to treat and stop the spread of viral respiratory infections, a quick and accurate diagnosis of the etiological agent is absolutely crucial. Based on the right diagnostic technique selected by the medical staff when performing the test, laboratory diagnosis can significantly improve patient care. There are several ways to find respiratory tract

infections, including molecular-based nucleic acid amplification assays, immunofluorescence tests for antibody detection, conventional and quick cell culture methods, and rapid antigen testing. The numerous specimen types for the identification of respiratory viruses include sputum, endotracheal aspirates, broncheoalveolar lavages, nasopharyngeal aspirates, nasopharyngeal washes, nasopharyngeal swabs, and oropharyngeal swabs in viral transport media. Each method's sensitivity is influenced by a variety of variables, including sample type, timing of sampling after the beginning of symptoms, patient age, antigen target, and virus characteristics. Immunocompromised patients shed low titres of virus over prolonged periods, making it challenging for non-molecular approaches to identify it. Because they are quick and very sensitive assays, nucleic acid amplification using molecular based methods has thus gained popularity for the identification of respiratory viruses. The numerous techniques for identifying respiratory viruses each have their own benefits and limitations.

ISOLATION OF A VIRUS IN CELL CULTURE

Even though technique is time-consuming and difficult, virus isolation in cell culture is still regarded as the "gold standard" in viral diagnosis. The virus obtained in culture is additionally needed for additional identification. As it may identify just one infected virion, it is also an extremely sensitive approach. Cell culture techniques have a number of drawbacks, including the necessity for technical know-how, the need for separate cell lines for strains of the same line, and the need for alternative methods for the identification of viruses that do not exhibit any cytopathogenic effects in cell culture.

Primary, diploid, and continuous cell culture are the three main types. Animal tissues are used to prepare the primary cell cultures. Proteases are applied, the cells are divided into single cells, and then they are suspended in culture medium. After that, it is maintained and moved to appropriate flasks. The lifespan of the cells is constrained. The most often utilized primary cell cultures come from chicken or mouse embryos, human embryonic amnion or kidneys, and monkey kidneys. In diploid cell cultures, homogeneous populations of cells that can divide into up to 100 different types are utilized. The most widely used strain of diploid cells, the WI-38 strain generated from human embryonic lung, is created from human embryos. The majority of continuous cell lines come from tumor tissues or when primary and diploid cell lines are subjected to mutagens. Human epithelial (HEp-2) and HeLa (Henrietta Lacks) cells from human tumor tissues, Vero cells from African green monkey kidneys, and BHK-21 (baby hamster kidney) cells from hamster kidneys are the most widely utilized cell lines. A positive culture result indicates that there is a live virus in the sample. The virus can be isolated and utilized for pathogenecity testing and medication susceptibility experiments. The procedure known as "shell vial culture" combines centrifugation and inoculation of the material on cell monolayers, which is followed by incubation for a predetermined amount of time. Labeled monoclonal antibodies that are directed against viral proteins that are generated shortly after cell infection can precisely detect the virus.

The advantages of shell vial culture over traditional culture include its greater specificity, shorter turnaround time, and lower technical requirements for results reporting. The biggest drawback of this method is that it can only detect specific viruses that are the target, leaving out novel infections. The right choice, collection, storage, transport, and preservation of the sample are necessary for the efficient isolation of the virus by cell culture.

ANTIGEN DETECTION

By identifying the exact protein present in the sample, the virus can be quickly identified. They are frequently employed for the detection of respiratory syncytial and influenza viruses. This can be done by using either a specific primary antibody and a labelled antispecies antibody in an indirect fluorescent assay (IFA) or a specific fluorescein-labeled antibody in a direct fluorescence assay (DFA) on a sample that has been mounted on a microscope slide. Due to the fact that more labels are linked to an infected cell, the indirect technique may be more sensitive. Due to the simplicity of the test and the speedy availability of data, DFA is frequently chosen as the method of screening for different respiratory viruses. However, due to the test's shortcomings, such as its lack of

sensitivity when compared to nucleic acid amplification and conventional culture methods, the negative results must be verified using these methods.

Enzyme Linked Immuno Sorbant Assay (ELISA) techniques can also be used to identify the viral antigens. By observing the color reaction, it enables the detection and measurement of the antigen contained in the sample. In addition, it has the ability to be automated, which increases the test's accuracy. However, compared to other tests like DFA and culture, their sensitivity is low. Recently, simple and quick assay methods including membrane ELISA and lateral flow immunochromatography assays have been accessible. Children are more sensitive to the fast tests than adults are. This might be because children shed more virus during infection than adults do. The traditional serological methods for identifying respiratory viral pathogens include the neutralization test, hemadsorption inhibition test, hemagglutination inhibition test, and complement fixation test.

MOLECULAR APPROACHES

Because significant amounts of the nucleic acid (DNA or RNA) may be detected and because the assay is very sensitive and short on incubation time, nucleic acid amplification methods (NAAT) have gained popularity for the detection of respiratory viruses. NAAT is a popular research tool for classifying and identifying different viruses. Several amplification methods, including PCR, RT-PCR, NASBA, strand displacement amplification, and transcription-mediated amplification, can be used to find the respiratory viral pathogens. The location and timing of sample collection, as well as different extraction, amplification, and detection methodologies, all affect how well NAAT assays work. For the early detection of numerous respiratory viral infections, normal clinical practice can make use of very sensitive nucleic acid assays that have been properly standardized and validated. The benefit of molecular assays is that they are very sensitive, take less time, and can be used to identify several viruses in a single assay. In practice, it has been claimed that molecular approaches are more sensitive than non-molecular ones. The cost of the equipment and reagents is substantial, and there is a risk of cross-contamination.

POLYMERASE CHAIN REACTION (PCR)

A single or a few copies of DNA can be amplified across multiple orders of magnitude using the polymerase chain reaction (PCR), which produces thousands to millions of copies of a specific DNA sequence. In the year 1984, American biochemist Kary Mullis created it for the first time. One DNA fragment is used to create two copies, then four, eight, and so on, depending on the situation. It is performed with the aid of primers, which act as templates for attaching the bases, and polymerase enzyme, which joins the bases adenine, thymine, cytosine, and guanine in the correct order to make the specific strand of DNA. The process amplifies a specific tiny section of the big DNA molecule. In the PCR process, there are three main steps: denaturation, annealing, and extension. At high temperatures (between 90 and 97 oC), the DNA gets denatured. In the second stage, the bases attach to the annealed primers to form a complementary strand after the primers anneal to the DNA strands to start extension. One of the original DNA strands and its new complimentary strand make up each freshly created DNA strand. For the amplified cDNA product to be present in adequate quantities, this cycle is repeated 30–35 times. The primers are annealed at a lower temperature (50–60 °C), which makes it easier for the primers to hybridize with their respective complimentary strands. The nucleotides are added to the end of the annealed primers by the Taq polymerase. The extension process is performed at roughly 72°C for 2–5 minutes. A RNA genome can be converted via a reverse transcription procedure, and the cDNA can then be amplified as previously indicated. Utilizing a thermostable DNA polymerase with reverse transcriptase activity, this can be carried out in a separate tube or as a single reaction. Cross contamination is less likely when amplification is done in a single tube. A qualitative assay is conventional PCR. By nucleic acid hybridizing the amplicon to a labelled oligonucleotide probe that is directed to a conserved sequence of the amplicon sensitivity, the sensitivity of the standard PCR assay can be enhanced. Through the use of a microtiter plate and a biotinylated primer, the PCR product can be hybridized utilizing liquid phase techniques. Additionally, the specific enzyme linked probe and an enzyme

substrate can be identified using a spectrophotometer, as can the reaction. Although more time-consuming, it offers good sensitivity and specificity.

REVERSE PCR

The precise and more reproducible measurement of DNA/RNA is made possible by real-time PCR. Greater sensitivity, repeatability, and precision, quantification, a lesser chance of contamination, and quick analysis are benefits of real-time PCR over conventional PCR. A thermal cycler with an optical system to detect fluorescence and a computer with additional software to conduct the final analysis make up the fundamental real-time PCR apparatus. The amount of the amplified PCR product is exactly proportional to the signal produced by the emission of the fluorescence. SYBR®Green and TaqMan® are the two fluorescent compounds that are frequently utilized. The fluorescent dye that is most frequently used is SYBR Green I. When bound to dsDNA, it fluoresces, and its capacity for binding is 100 times more than that of ethidium bromide. Minor groove DNA binder probes (MGB) are 14–15 bp long oligonucleotides with a fluorescent dye in the 5' terminal, a non-fluorescent quencher in the 3' terminal, and MGB that specifically bind to the target region. MGB is released from a probe that binds to the minor groove of the dsDNA, which is related to the nucleotide sequence and contains a portion of the MGB probe and the corresponding target sequence with which it is hybridized. The MGB makes the amplification probe's binding more stable.

REVIEW OF LITERATURE

In 2021, Xydakis et al. published an article titled "Post-viral effects of COVID-19 in the olfactory system and their implications." The objective of the research is to address the substantial lack of knowledge regarding the detrimental effects of SARS-CoV-2 on the chemosensory function in the olfactory system. According to the authors, the acceleration of disease progression in neurodegenerative diseases may be caused by the irritating effect of the olfactory epithelium on the olfactory bulbs. Additionally, individuals who have recovered from COVID-19 may be at risk of developing long-lasting neurodegenerative disorders.

In their 2021 paper titled "Bovine colostrum: benefits for the human respiratory system and potential contributions for clinical management of COVID-19," Galvino et al. outlined the advantages of using "bovine colostrum." The objective of this research is to gather information on the biological effects of supplementing with "bovine colostrum" in order to enhance the bioactive molecular components and improve human respiratory health. As per the authors, lactoferrin can effectively combat SARS-CoV-2 by generating specific antibodies.

In 2020, De Felice et al. specifically examined the "severe acute respiratory syndrome coronavirus 2" in their study titled "Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) and the Central Nervous System." This work aims to provide a concise overview of the potential effects on human organs, specifically focusing on neurological and neurodegenerative consequences (De Felice et al., 2020). According to the authors, the association between SARS-CoV-2 and neurological changes leads to a range of clinical symptoms. In particular, the impact of SARS-CoV-2 on the central nervous system can directly result in neurological changes, worsen pre-existing neurological conditions, and increase susceptibility to damage or heightened sensitivity.

In 2020, Deshmukh et al. released a systematic review titled "Histopathological observations in COVID-19." This work aims to delineate the novel "histopathological alterations" in different organs through the examination of autopsies conducted on individuals with COVID-19. Based on an analysis of 45 studies, the authors reached the conclusion that the virus primarily impacts the immunological and respiratory systems. The virus also impacts the reproductive system, cardiovascular system, integumentary system, and gastrointestinal tracts.

In 2020, Brosnahan et al. published an article titled "COVID-19 and Respiratory System Disorders" that focused on current knowledge and future research questions in the field of translational and clinical research. The objective of this work is to elucidate the idea of the "underlying biology of respiratory disease" by providing a detailed analysis of the impact of the "severe acute respiratory syndrome coronavirus-2" on different components

(Brosnahan et al., 2020). The authors assert that COVID-19 impacts all components of the respiratory system. They present a rudimentary outline of the established information regarding "COVID-19-induced respiratory system disorders."

In 2020, Muller, McNamara, and Sinclair collaborated to write an essay titled "Why does COVID-19 have a greater impact on older individuals?" The objective of this article is to demonstrate the molecular disparities among individuals of different age groups, specifically older, middle-aged, and younger individuals, in order to elucidate why the disease is relatively mild in some individuals but fatal in others. According to the scientists, the presence of comorbidities such as diabetes, obesity, and cardiovascular disease does not alone account for the risk of mortality of older individuals. Furthermore, they deliberated on the potential benefits of restoring patients' ability to combat the infection, modulating immunological responses, and impeding viral replication, which could enhance the survival rate among elderly individuals.

In 2021, Andrade et al. released an article titled "Long-COVID and Post-COVID Health Complications: An Up-to-Date Review on Clinical Conditions and Their Possible Molecular Mechanisms." The authors thoroughly examine the adverse health consequences that occur after COVID-19 and during the long-term recovery phase (Andrade et al., 2021). The researchers examined the likely biological process behind the symptoms of various disorders and elucidated the "mechanisms of action".

In 2020, an article titled "Long-Term Respiratory and Neurological Sequelae of COVID-19" was published by Wang, Kream, and Stefano. In this paper, the author presents the reasons behind the development of long-lasting consequences of "SARS-CoV-2 infection" in neuronal and pulmonary damage, as well as neurodegenerative illnesses. The authors also present a theory on the suppression, recognition, and management of the long-lasting consequences.

In 2021, Su et al. published a research titled "Changes in prevalence of nosocomial infection pre- and post-COVID-19 pandemic from a tertiary Hospital in China." The authors have examined the strategies for controlling and preventing the spread of the COVID-19 pandemic, specifically focusing on reducing "nosocomial infections" in all areas except the ICU, particularly in regard to gastrointestinal, respiratory, and oral infections (Su et al., 2021).

In 2021, Pierce et al. published an essay on the topic of "Post-COVID-19 Syndrome." The authors provide a concise and evaluative analysis of the "post-COVID-19 syndrome" from a biological perspective. The authors emphasized four pathophysiological variables, namely virus-specific pathophysiological alterations, inflammatory damages, oxidative stress, and immunologic abnormalities (Pierce et al., 2021). They reached the conclusion that these factors influence many processes.

In 2020, Barker-Davies et al. published a paper titled "The Stanford Hall consensus statement for post-COVID-19 rehabilitation." Based on recent research and the probable areas for improvement in "post-COVID-19 illness," the authors suggest. It has been stated that the virus has a profound impact on the respiratory system, leading to fatalities.

In 2020, Lu et al. released an article titled "Cerebral Micro-Structural Changes in COVID-19 Patients - An MRI-based 3-month Follow-up Study." The authors observed significant increases in the sizes of the hippocampi, bilateral olfactory cortices, right cingulate gyrus, insulas, left Rolandic operculum, and left Heschl's gyrus. According to their findings, frequent loss of the sense of smell during upper respiratory tract infections (URTI) leads to a decrease in stimulation and subsequent decrease in volume during the acute phase. Following the recovery of the sense of smell, GM's volume increased progressively in the "central olfactory system".

In 2020, Zhang et al. published an article titled "New understanding of the damage caused by SARS-CoV-2 infection beyond the respiratory system." This article carefully examines the characteristics of pathogens, including their transmission routes and mechanisms of infection, as well as their detrimental effects on the central nervous system, digestive system, circulatory system, and urogenital system. The authors present a comprehensive analysis of the clinical and theoretical foundations for identifying, classifying, treating, and assessing the prognosis of infections caused by the "SARS-CoV-2" virus.

In 2022, Kompaniyetset et al. released a publication titled "Post–COVID-19 Symptoms and Conditions Among Children and Adolescents — United States, March 1, 2020–January 31, 2022." According to the authors, patients with pre-existing mental problems, anxiety and fear-related diseases, sleeping difficulties, respiratory symptoms, muscle disorders, mood disorders, and neurological conditions were less affected by COVID-19 compared to other patients. The literature extensively focuses on the problems and symptoms associated with "post-COVID illness in both adults and children."

Cheng, Yang, and Gao authored a publication titled "Infectivity of human coronavirus in the brain" in 2020. The article provides a comprehensive overview of the research conducted on hCoVs in relation to the central nervous system (CNS), as well as a comparison with the most recent strain, in order to facilitate a lucid comprehension. The author emphasizes the importance of utilizing many diagnoses, such as respiratory conditions, CNS infections caused by viruses, encephalopathy related to ARDS, metabolic acidosis, drug effects, and hypoxia, in order to establish an accurate clinical identification and treatment approach.

In 2020, Mishra et al. published an article titled "Global impacts of pre- and post-COVID-19 pandemic: Focus on socio-economic consequences." As to the authors, the "COVID-19 pandemic" can be rebranded as "respiratory tract associated disease," which possesses the ability to harm the lungs as well as other tissues or organs. The virus spreads readily in plasma or serum within the respiratory tract, enabling it to be transmitted by blood transfusion.

In 2021, Gasper-Rodriguez, Padilla-González, and Rivera-Toledo authored an article titled "Coronavirus persistence in human respiratory tract and cell culture: An overview." The authors provide a comprehensive summary of all the information pertaining to the deliberate presence of "SARS-CoV-2 RNA" in respiratory samples, as well as the results obtained from cell culture and histology. These intricate and long-lasting illnesses are caused by the coronavirus. In addition, they commented on the potential mechanisms that are pertinent and enduring to the coronavirus.

In 2020, Ortiz et al. released a research titled "Heterogeneous expression of the SARS-Coronavirus-2 receptor ACE2 in the human respiratory tract." The researchers discovered a significant abundance of ACE2 protein in the "pulmonary alveoli" and "sinonasal cavity," which are potential sites for viral transmission and contribute to the rapid progression of the disease. The ACE2 protein is located on the apical surface of alveolar type II cells in the lung parenchyma. It is accompanied by a co-factor called TMPRSS2, which is involved in the entry of SARS-CoV-2.

CONCLUSION

This study established the significance of viral etiologies, including influenza viruses, human respiratory syncytial viruses, human metapneumovirus, human rhinovirus, and human parainfluenza viruses, in the development of acute respiratory illness (ARI) in children. In this area, our study is the first to describe the molecular epidemiology of viral etiologies. The most common virus in this study was discovered to be HRSV, which is known to frequently cause ARI, particularly lower respiratory tract infections in newborns and young children. For this population, the lack of vaccinations and other preventative treatments for HRSV infection poses a major hazard. Therefore, routine viral identification of respiratory viruses should be established in healthcare settings in addition to bacterial diagnosis in order to facilitate early treatment and prevent the unnecessary use of antibiotics.

The more sensitive PCR techniques have replaced the laborious procedure of viral diagnosis using the gold standard cell culture. The findings of our investigation showed that real-time RT-PCR is an effective molecular tool for ARI virus diagnosis. However, due to the low cost of the instrument and consumables, nested RT-PCR may be used in settings with limited resources.

Our study demonstrates that low fidelity of the RNA polymerase enzyme makes RNA viruses susceptible to frequent mutations. Understanding viral ecology and transmission by molecular characterisation is essential for the creation of vaccines. This is one of the rare studies from South India that use molecular techniques to characterize HRSV and hMPV. This study is the first to describe the A2c subcluster of hMPV circulation in India,

to the best of our knowledge.

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