IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 5, Issue 2, January 2025

Review on the HMPV Virus Prevention, Management and Diagnosis of their Symptoms

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Abstract: *A serious respiratory disease that affects people of all ages, but especially small children, the elderly, and those with weakened immune systems, is the human metapneumovirus (HMPV). The symptoms of an HMPV infection can vary from moderate to severe, and can include fever, coughing, and dyspnoea. The main routes of transmission include respiratory droplets, contaminated surfaces, and close contact. The most common molecular assays used for diagnosis are PCR and RT-PCR. The main goals of supportive treatment are symptom relief and problem management. Controlling the spread of HMPV requires preventative measures such immunization, hand cleanliness, and infection control procedures. An overview of HMPV's epidemiology, transmission, diagnosis, treatment, and prevention is given in this review, emphasizing the need for more study and education on this important respiratory virus.*

Keywords: Human Metapneumovirus, HMPV, respiratory droplets, epidemiology, transmission, diagnosis, treatment, prevention

I. INTRODUCTION

A single-stranded RNA virus, Human Metapneumovirus (HMPV) is a member of the genus Metapneumovirus and the family Pneumoviridae.

HMPV is a respiratory virus that is extremely infectious and can infect people of all ages, although it is most common in children, the elderly, and people with weakened immune systems. Since its first discovery in 2001 in the Netherlands, the virus has gained international recognition as a major contributor to respiratory illnesses.

Discovery-

#Initial Research (1950s–1960s)-

In the 1950s and 1960s, scientists discovered a mystery respiratory virus for the first time, although it was not yet recognized or described.

- A group of scientists at the National Institute of Allergy and Infectious Diseases (NIAID) under the direction of Dr. Robert Chanock identified a novel respiratory virus in the 1960s and named it the "Respiratory Syncytial Virus" (RSV).

#HMPV's discovery (2001)-

While looking into a respiratory disease epidemic in the Netherlands in 2001, a group of researchers headed by Dr. Albert Osterhaus at the Erasmus Medical Centre in Rotterdam, Netherlands, found a novel respiratory virus. The researchers identified the novel virus, which they named Human Metapneumovirus (HMPV), using molecular techniques such as PCR and sequencing.

#Preliminary Description (2001-2002)-

The original discovery, scientists started to describe the virus's genetic makeup, replication cycle, and modes of transmission. HMPV infections were first documented in 2002, when the virus was linked to respiratory illnesses in both adults and children.

#Worldwide Acknowledgment (2003-2005)–

-As more information became available, HMPV was acknowledged as a major respiratory infection on a global scale.

- The Canters for Disease Control and Prevention (CDC) started tracking HMPV activity in the US after the World Health Organization (WHO) identified HMPV as a novel respiratory virus in 2003.

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#Worldwide Prevalence -

1.Distributed widely :- HMPV has been found in a large number of nations in the Americas, Europe, Asia, Africa, and Australia.

2. Seasonal variation:- Infections with HMPV usually reach their peak in the fall and winter months in the Southern Hemisphere and in the winter and spring months in the Northern Hemisphere.

The prevalence of HMPV infections varies with age, although they are most prevalent in:

Youngsters under five (particularly those under two years old)

- Senior citizens (65 years and up)

Individuals with impaired immune systems, such as those suffering from HIV/AIDS, cancer, or immunosuppressive drugs

#Impact on a global scale -

1. Respiratory sickness :- HMPV is a major global cause of respiratory illness, contributing to five to fifteen percent of pediatric hospitalizations for acute respiratory infections (ARIs) and two to five percent of adult hospitalizations for ARIs.

2.Infections with HMPV can cause serious disease, especially in susceptible groups, which can lead to morbidity and death:

-The illness known as pneumonia

-Failure of the respiratory system Bronchiolitis

-Mortality (particularly in elderly and immunocompromised persons)

3. Financial burden:- Costs associated with healthcare (such as hospital stays and medical treatments) are among the major financial difficulties that HMPV infections can cause.

Decreased productivity (lost work or school days, for example)

The influence on family members and caregivers are examples of indirect expenses.

#Goal -

1. To give a thorough summary of the current understanding of HMPV, covering its epidemiology, dynamics of transmission, clinical characteristics, diagnosis, therapy, and prevention.

#Scope -

1. To evaluate HMPV's seasonality, worldwide distribution, and transmission dynamics.
2. To explain how HMPV infections manifest clinically, including their symptoms and severity.
3. To Examine the diagnostic tests that are available, such as molecular, serological, and antigen detection techniques.
4. To go over the available treatment options, such as breathing assistance, antiviral therapy, and supportive care.
5. To go over the ways to stop the spread of HMPV, such as immunization, infection control methods, and personal hygiene methods.
6. To determine potential areas of study, such as the creation of vaccines, antiviral treatments, and enhanced diagnostic tests.

Virology & Epidemiology -

Structure -

Fig 1:- Simple structure of HMPV Virus

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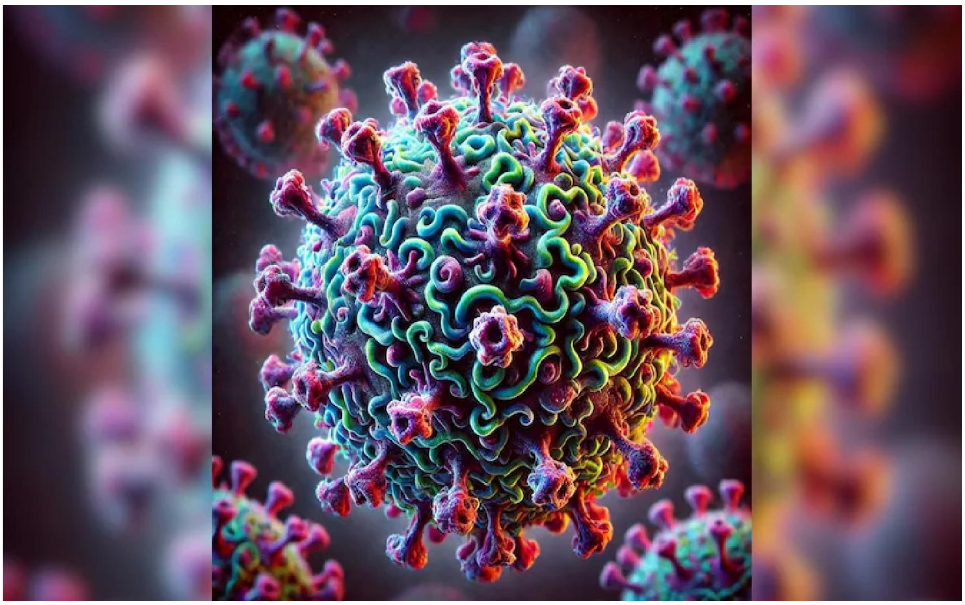

Fig2:- Complex structure of HMPV Antigen

1. HMPV is classified as a single-stranded RNA virus.
2. The Pneumoviridae family.
3. The Metapneumovirus genus.
4. HMPV viral particles have an enclosed structure, are pleomorphic (have uneven shapes), and have a diameter of 150–200 nanometres (nm).
5. The single strand of RNA that makes up the HMPV genome is around 13 kilobases (kb) long and encodes for nine different proteins.

Reproduction-
1. Attachment:-The G glycoprotein's binding to cellular receptors, HMPV binds to host cells.
2. Penetration:- The virus enters the host cell by means of endocytosis, in which the virus is engulfed by the cell.
3. Uncoating:- The viral envelope is taken off, allowing the viral DNA to enter the cytoplasm of the host cell.
4. Viral RNAdependent :- RNA polymerase (RdRp) is responsible for the transcription of the viral genome into messenger RNA (mRNA).
5. Translation:- Viral proteins, such as the RdRp, which is essential for viral replication, are produced from the mRNA.
6. Replication:- The RdRp replicates the viral genome, producing new viral RNA in the process.
7. Assembly:- The freshly produced viral RNA and proteins are used to form new viral particles.

#Replication Cycle-
The duration of the HMPV replication cycle varies from 24 to 48 hours, dependent on the kind of host cell and the surrounding circumstances.

Epidemiology –
Worldwide Distribution-
1.Global reach:- HMPV has been found in several nations in the Americas, Europe, Asia, Africa, and Australia.
2. Regional variability:- In certain areas, including North America, Europe, and East Asia, the virus is more often found.

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Seasonality -
1. Winter-spring seasonality:- Infections with HMPV usually reach their peak in the Northern Hemisphere during the winter and spring, and in the Southern Hemisphere during the fall and winter.
2. Year-round detection:- HMPV may be found all year round, while some research indicates that there is a secondary surge in the summer.

Dynamics of Transmissions-
1. Person-to-person transmission:- HMPV is mostly spread via intimate contact with an infected person, including sharing utensils, touching, and handshakes.
2. Respiratory droplets:- Coughing and sneezing can release respiratory droplets, which are another way the virus can spread.
3. Fomites:- In addition, contaminated objects and surfaces may contribute to the spread of HMPV.

Risk Elements-
1. Age:- Infants under the age of five, particularly those under the age of two, are more likely to contract HMPV.
2. Older adults:- People over 65 are even more vulnerable, especially if they have underlying medical issues.
3. Immunocompromised people:- HMPV infection is more common in people with impaired immune systems, especially those who have HIV/AIDS, cancer, or are on immunosuppressive drugs.
4. Underlying medical disorders:- People who have underlying medical issues, such as heart disease, asthma, or chronic obstructive pulmonary disease (COPD), are more likely to get a serious HMPV infection.

Clusters and Outbreaks-
1. Outbreaks linked to healthcare:- Clinics and long-term care institutions are among the healthcare settings where HMPV infestations have been documented.
2. Community based epidemics:- these types of epidemics have also been documented and are frequently linked to social events or cramped living arrangements.
3. Family clusters:- The significance of household transmission is shown by the fact that HMPV infections may circulate within households.

Transmission Dynamics -
Transmission Modes-
1. Person-to-person transmission:- The main way that HMPV is spread :
-Shaking or touching hands
-Sharing personal belongings or utensils
Talking closely or sneezing or coughing close by
2. Respiratory droplets:- Respiratory droplets of HMPV can also be spread:
-Sneezing or coughing
-Singing or conversing
3. Fomites:- In addition, contaminated objects and surfaces may contribute to the spread :
-Touching one's face after coming into contact with contaminated surfaces or things
-Sharing personal belongings like cutlery or towels

Factors Associated with Transmission-
1. Viral load:- Transmission may be impacted by the quantity of virus found in an infected person's respiratory secretions.
2. Duration of infectiousness:- The possibility of transmission is increased since infected people may spread the virus for several days.
3. Host factors:- Age, immunological state, and underlying medical disorders can all affect a person's risk of contracting HMPV.

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4. Environmental factors:- Cold temperatures, inadequate ventilation, and crowding can all lead to the spread of HMPV.

Configuration for Transmission-
1. Healthcare settings:- Institutions like hospitals and rehabilitation centres are potential sites for HMPV transmission.
2. Schools and daycare:- Schools and childcare facilities can be places where HMPV can spread, especially to young children.
3. Transmission among households:- Family members are more susceptible to HMPV transmission.
4. Community settings:- Places like shopping malls, public transit, and social events can all be places where HMPV might spread.

Preventing Transmission-
1. Hand hygiene:- Using hand sanitizer or washing your hands often with soap and water will help prevent the spread of the disease.
2. Respiratory etiquette:- When coughing or sneezing, cover the area around your nose and mouth with a tissue or your elbow to prevent the spread of the infection.
3. Surface cleaning and sterilization:- Transmission can be decreased by routinely cleaning and disinfecting items and surfaces.
4. Vaccination:- Creating potent vaccinations can aid in stopping the spread of HMPV.

Risk Factors -
The following are risk factors for infection with the Human Metapneumovirus (HMPV):

Risk Factors for Demographics-
1. Age:- Children below the age of five, particularly those under the age of two, are more likely to contract HMPV.
2. Older adults:- People over 65 are even more vulnerable, especially if they have underlying medical issues.
3. Pregnancy:- Women who are expecting, particularly those who are in the final stages of pregnancy, may be more susceptible to a serious HMPV infection.

Fundamental Medical Conditions-
1.COPD :- People who have chronic obstructive pulmonary disease (COPD) are more likely to get a serious HMPV infection.
2. Asthma:- During an HMPV infection, those who have asthma may have worsened symptoms.
3. Heart illness:- People who have heart problems may be more susceptible to a serious HMPV infection.
4. Immunocompromised people:- HMPV infection is more common in people with impaired immune systems, like individuals having HIV/AIDS, cancer, or immunosuppressive drugs.

Social and Environmental Risk Factors-
1. Crowding:- the possibility of HMPV infection is increased when people live in close quarters, such as in residential care centres or in homes with several family members.
2. Inadequate ventilation:- HMPV transmission may be facilitated by inadequate ventilation in automobiles, buildings, or other confined environments.
3. Travel:- Attending big events or going to places with a lot of HMPV activity raises your chance of exposure.
4. Exposure in healthcare:- close interaction with infected persons may put patients and healthcare staff at higher risk of HMPV transmission.

Clinical Symptoms -
Typical Signs-
1. Cough:- One of the most typical signs of an HMPV infection is a chronic, frequently severe cough.
2. Fever:- Individuals infected with HMPV may experience a high temperature, often exceeding 102°F (39°C).

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3. Runny nose:- Typical symptoms of HMPV virus include sinus pressure, congestion, and runny nose.
4. painful throat:- Those who have an HMPV infection may experience a painful or scratchy throat.
5. Wheezing:- People infected with HMPV, particularly those with existing respiratory disorders, may experience coughing, a high-pitched sound made when exhaling.
6. Breathlessness:- Breathing difficulties or shortness of breath may be experienced by those infected with HMPV.

Severe Symptoms-
1. Pneumonia:- A viral infection of the airways caused by HMPV can result in pneumonia, which can have serious consequences.
2. Bronchiolitis:- A swelling of the airways' tiny airways, bronchiolitis can be brought on by an HMPV infection.
3. Respiratory failure:- Mechanical ventilation may be necessary in severe cases of HMPV infection due to respiratory failure.
4. Acute breathing difficulties :- An HMPV infection may result in ARDS, a potentially fatal illness that need critical care.

Additional Symptoms -
1. weariness:- Muscle pains, headaches, and weariness are common symptoms of HMPV infection.
2. Appetite loss:- An HMPV infection may cause appetite loss, which may lead to malnourishment and dehydration.
3. Ear irritation:- Some individuals infected with HMPV may have discomfort or pain in their ears.

Prevention and Controls -
The Human Metapneumovirus (HMPV) preventive and control measures:

Practices of Personal Hygiene-
1. Hand hygiene:- Using hand sanitizer or washing your hands often with soap and water will help prevent the spread of the disease.
2. Respiratory etiquette:- When coughing or sneezing, cover the area around your nose and mouth with a tissue or your elbow to prevent the spread of the infection.
3. Steer clear of close contact:- You can lessen the spread of illness through preventing close contact with sick people.

Cleaning and Disinfection of the Environment -
1. Frequent cleaning:- Transmission can be decreased by routinely cleaning and disinfecting items and surfaces.
2. Disinfect high-touch places:- Transmission can be decreased by disinfecting high-touch surfaces including light switches, doorknobs, and worktops.
3. Use of ultraviolet (UV) light:- Transmission can be decreased by disinfecting surfaces and air with UV light.

Immunization -
1. Vaccine development:- A number of potential HMPV vaccines are at different phases of development.
2. Target populations:- High-risk groups, including small children, the elderly, and people with impaired immune systems, may benefit from vaccination.

Infection Prevention Strategies-
Isolation:- Keeping people with HMPV infections apart can help stop the virus from spreading.
2. PPE :- Personal protective equipment (PPE) can help prevent transmission.
Examples of PPE include masks, gloves, and gowns.
3. touch tracing:- Transmission can be decreased by tracking down and identifying those who have come into touch with an HMPV-infected person.

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Diagnosis -

#Medical Diagnosis-

1. Medical history:- To determine symptoms and risk factors, a comprehensive medical history is obtained.
2. Physical examination:- To determine any problems and evaluate respiratory function, a physical checkup is conducted.
3. Clinical presentation:- Diagnosing an HMPV infection might be difficult since its clinical manifestation can resemble that of other respiratory viruses.

Diagnosis in the Laboratory -

1. Molecular testing:- To find HMPV RNA in respiratory specimens, molecular techniques like PCR (polymerase chain reaction) as well as RT-PCR (reverse transcriptionpolymerase chain reaction) are utilized.
2. Serology:- HMPV specific antigens in serum or plasma can be found using serological assays such the enzyme linked immunosorbent assay (ELISA).
3. Viral culture:- Although viral culture is a less sensitive and timeconsuming procedure than molecular testing, it may be utilized to separate HMPV from respiratory specimens.
4. Antigen detection:- HMPV antigens in airway specimens can be found using antigen detection assays, such as fast antigen testing.

Specimens for Respiration-

1. Nasopharyngeal swabs:- For HMPV testing, throat swabs are the recommended specimen type.
2. Nasopharyngeal swabs are more sensitive than oropharyngeal swabs, however oral specimens can also be utilized.
3. Bronchoalveolar lavage (BAL):- In patients with severe breathing problems, BAL fluid can be utilized for HMPV testing.

Management and Treatment -

The management and treatment of Human Metapneumovirus (HMPV) infection:

Support with Care-

1. Fluid replacement:- To avoid dehydration, promote fluid intake.
2. Rest:- To aid in the body's recovery, promote rest.
3. Pain management:- To treat fever and body pains, take OTC (overthecounter) pain relievers like acetaminophen (paracetamol)or ibuprofen.
4. Oxygen treatment:- To assist control respiratory symptoms, use oxygen therapy as required.

Antiviral Treatment-

1. Ribavirin:- Ribavirin is an antiviral drug that has been used to treat HMPV spread of infection, especially in patients with impaired immune systems or in situations of severe infection.
2. Other antivirals:- Although their efficacy is unknown, other antiviral drugs such oseltamivir and zanamivir have been investigated for the treatment of HMPV infection.

Support for Respiratory Function-

1. Mechanical ventilation:- To support respiratory function, administer mechanical ventilation as required.
2. Non-invasive ventilation:- To sustain respiratory function, use non-invasive ventilation techniques such bilevel positive airway pressure (BiPAP) or continuous positive airway pressure (CPAP).

Epidemiological Studies-

1. Antibiotics:- Treat subsequent bacterial infections, such pneumonia, with antibiotics.
2. Bronchodilators:- To control symptoms similar to asthma, use bronchodilators.
3. Corticosteroids:- In extreme situations, use corticosteroids to lessen inflammation.

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Future Direction -

The following are some possible avenues for future Human Metapneumovirus (HMPV) review:

Development of Vaccines-

1. Enhanced vaccination effectivenesss:- creating vaccines that are more effective and providing longerlasting protection.
2. Developing vaccinations :- that offer protection against many HMPV strains is known as broadspectrum vaccination.
3. Combination vaccines:- Creating vaccinations that incorporate influenza and RSV in addition to HMPV.

Antiviral Treatments-

1. Targeted antiviral treatment:- creating antiviral drugs that target HMPV in particular.
2. The development of antiviral drugs that are efficient against a variety of respiratory viruses is known as broad spectrum antivirals.
3. Immunomodulatory treatments:- investigating treatments that alter the body's reaction to HMPV infection.

Developments in Diagnostics-

1. Quick diagnostic tests:- creating quick, pointofcare HMPV diagnostic assays.
2. Better molecular diagnostics:- Improving molecular diagnostic methods for HMPV detection, such PCR and sequencing.
3. Serological tests:- Creating assays to identify antibodies specific to HMPV.

Transmission and Epidemiology-

1. Global surveillance:- Putting in place measures to keep an eye on the spread and circulation of HMPV.
2. Transmission dynamics:- Examining the role of symptomfree carriers in the transmission pattern of HMPV.
3. Finding and evaluating risk variables for a severe HMPV infection is the third step in the risk factor analysis process.

Pathophysiology and Immunology-

1. Immune response:- Examining the immune system's reaction to HMPV infection, taking into account the function of immune cells and cytokines.
2. Pathogenesis:- Researching the processes behind tissue damage and viral replication in HMPV infection.
3. Creating animal models:- Using animal models to investigate HMPV infection and evaluate possible treatments.

Prevention and Public Health-

1. Vaccination strategies:- Creating efficient vaccination plans for highrisk groups, such elderly people and small children.
2. Control of infections strategies:- To stop the spread of HMPV, put into practice efficient infection control measures such hand cleanliness and personal protective equipment.
3. Public awareness programs:- Educating people on HMPV control and prevention strategies through public awareness initiatives.

II. CONCLUSION

A serious respiratory disease that can afflict people of all ages, human metapneumovirus (HMPV) is most harmful to small children, the elderly, and those with weakened immune systems. The symptoms of an HMPV infection can vary from moderate to severe, and can include fever, coughing, and dyspnoea.

Close contact with an infected person, contaminated surfaces, and respiratory droplets are the main ways that HMPV is spread. The most common molecular assays used for diagnosis are PCR and RT-PCR.

The main goals of supportive treatment for HMPV infection are symptom relief and problem management. In extreme situations, antiviral drugs like ribavirin may be prescribed. Controlling the spread of HMPV requires preventative

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measures such immunization, hand cleanliness, and infection control procedures. In order to create vaccinations, antiviral treatments, and diagnostic tests that work, further research is required.

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