PERSPECTIVE

Human Metapneumovirus: An Emerging Respiratory Virus

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ABSTRACT

Human metapneumovirus (hMPV), a significant yet often overlooked respiratory pathogen, causes mild to severe respiratory infections, particularly in children, the elderly, and immunocompromised individuals. Discovered in 2001, hMPV is now recognized globally as a leading cause of acute respiratory infections (ARIs) and severe acute respiratory illness (SARI). It spreads through respiratory droplets and exhibits seasonal peaks, often in winter. Studies in India, such as Chennai's 2016–2018 surveillance, detected 4% positivity in pediatric ARI cases, aligning with global rates (7–19%). However, India's dense population, high respiratory disease burden, and limited healthcare access pose unique challenges. Unlike the Northern Hemisphere's winter peaks, India's tropical climate may influence seasonality, while co-infections with RSV, influenza, and adenoviruses complicate diagnosis. The virus also poses risks for elderly individuals, given India's rising burden of COPD and asthma. Despite advances in molecular diagnostics, routine hMPV testing remains limited, leading to underreporting. Diagnosis relies on real-time PCR, with multiplex RT-PCR enabling co-infection detection. While no vaccine is available, preventive measures include hand hygiene, respiratory etiquette, and isolating infected individuals. Early detection through clinical suspicion, laboratory testing, and imaging is crucial for effective management. Expanding surveillance and epidemiological studies is vital to understanding hMPV's burden and guiding public health responses. Strengthening diagnostic capacity and awareness can help mitigate morbidity and mortality, particularly in high-risk populations in India.

Keywords: Human metapneumovirus, Acute respiratory infections, Diagnostic methods, Preventive measures, Epidemiology and Nursing Management

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Introduction

Acute respiratory tract infections (ARTIs) cause 1.9–2.2 million deaths annually, 70% in developing countries, and account for 30% of childhood fatalities.[1] Viruses like influenza, hRSV, parainfluenza, adenoviruses, rhinoviruses, and coronaviruses contribute to these infections, ranging from mild colds to severe pneumonia. Despite advancements, the cause remains unknown in 50% of adult pneumonia and 15–35% of paediatric pneumonia cases, indicating unidentified pathogens.[2] Human metapneumovirus (hMPV), first isolated in 2001 in The Netherlands, is one such discovery.[1]

Human metapneumovirus (hMPV) causes upper and lower respiratory infections, mainly in children under 5 and the elderly. Symptoms include fever, breathlessness, nasal congestion, cough, sore throat, and headache.[3] hMPV prevalence varies, reported at 0.2% in Cambodia (2007), 4.3% (2008), 0.3% (2009), and 4% in Chennai, India (2016–2018).[5] Related to avian metapneumovirus (APV), hMPV belongs to the Metapneumovirus genus in the Pneumovirinae subfamily of Paramyxoviridae.

The significance of global ARTI statistics on hMPV in India lies in its prevalence, impact, and public health implications. hMPV, a major cause of respiratory infections, poses a significant risk in India, where ARTI contributes to high morbidity and mortality.[6] Understanding its burden aids in better diagnostics, treatment protocols, and vaccine development[7], crucial for resource-limited healthcare settings. Seasonal trends of hMPV in India can help predict outbreaks and optimize healthcare resource allocation. Increased awareness among healthcare providers and the public is essential for early detection and management, reducing the strain on hospitals. Integrating hMPV surveillance into ARTI monitoring can enhance preparedness, guide research efforts for vaccines, and improve patient outcomes. Given India's high burden of respiratory diseases and co-infections, prioritizing hMPV in public health policies is vital for effective disease control, resource distribution, and awareness campaigns, ensuring a proactive healthcare response.[8]

EPIDEMIOLOGY OF HMPV IN INDIA: REGIONAL PREVALENCE, SEASONAL TRENDS, AND COMPARISON WITH OTHER RESPIRATORY VIRUSES

Since its discovery in 2001, hMPV has been detected worldwide, including in North America, Europe, Asia, Australia, and South Africa. Seroprevalence studies in The Netherlands, Japan, and Israel suggest nearly all children are infected by 5–10 years of age.[9] hMPV accounts for 7–19% of ARTIs in children, with an annual hospitalization rate of 1 per 1,000 comparable to influenza but lower than hRSV.[10]

Clinic and emergency visits are 55 and 13 per 1,000 children, respectively.[11] hMPV primarily affects young children, with the highest incidence in those under 2 years twice that of ages 2–5 and ten times higher than those over 9.[12] Infections start around 6 months, as maternal antibodies offer early protection, and over 90% of children are infected by age 5.[13] Detection in adults is lower (3%), but recurrences are common in older adults (≥65) and those with COPD, asthma, cancer, or lung transplants.[14]

Human Metapneumovirus (hMPV) has emerged as a significant respiratory pathogen recognized for its role in respiratory infections worldwide, including India. Its prevalence varies across different regions and seasons, similar to other respiratory viruses like Respiratory Syncytial Virus (RSV). A comprehensive review of respiratory virus infections in India from 1970 to 2020 analyzed 22,000 cases, reporting 293 detected infections distributed as follows: North (11), East (111), West (115), and South (56).[15] Another Study highlights the significant role of human metapneumovirus (hMPV) in acute respiratory infections among infants under five in Puducherry, India. From 4519 nasal swab samples collected (January 2021–June 2024), 113 tested positive, with a notable outbreak between November 2022 and March 2023, peaking in December and January.[16] Infants under one year were most affected, with 67% experiencing wheezing and 6.9% reporting seizures.[17]

These numbers reflect study-reported cases rather than true prevalence, shaped by factors such as healthcare infrastructure and diagnostic capabilities. Such findings emphasize the need for region-specific surveillance and targeted public health responses to manage respiratory viral infections. The prevalence of respiratory viruses across India is significantly influenced by climate, temperature variations, and humidity levels. RSV is the dominant virus nationwide, but East India sees a more balanced contribution from multiple viruses. Influenza is most common in East India and North India, with lower occurrences in the West and South, where cases of influenza B outnumber A, particularly with the highest prevalence of parainfluenza virus in the East. While hMPV is the least prevalent overall, it is more frequently observed in West and South India, particularly during humid, rainy seasons. Understanding these regional patterns is crucial for developing effective public health strategies to control and manage respiratory virus outbreaks in India.[15]

CLINICAL MANIFESTATIONS OF HMPV: DISTINGUISHING PEDIATRIC AND ADULT SYMPTOMS WITH INSIGHTS FROM INDIAN STUDIES

hMPV causes upper and lower respiratory infections in young children, often resembling hRSV, especially in severe hospitalized cases. Bronchiolitis, with or without pneumonitis, is the most common diagnosis, with up to 50% also developing otitis media. Some studies link hMPV to acute wheezing and asthma ex-

acerbation.[17-18] Targeting ciliated epithelial cells, hMPV presents symptoms similar to other winter viruses, particularly hRSV.[19] It is rarely asymptomatic, causing 5–15% of pediatric URTIs, being the second leading cause of bronchiolitis and a major contributor to LRTIs.[20] Infected children tend to be older and experience milder illness than those with hRSV. hMPV-associated URTIs include rhinitis, pharyngitis, conjunctivitis, and acute otitis media (AOM), usually resolving within a week.[21] LRTIs often require hospitalization. hMPV can cause Eustachian tube obstruction, increasing bacterial AOM risk.[22] One-third of pediatric hMPV-related LRTIs involve AOM and are linked to febrile seizures and encephalitis.[23]

hMPV can cause severe morbidity in children and adults. Hospitalized children often present with bronchiolitis or pneumonia, with respiratory distress being the main reason for PICU admission.[24] Some require mechanical or non-invasive ventilation, especially those with underlying conditions. Severe cases, including apnea, shock, ARDS, and fatalities, have been reported.[25] In adults, hMPV poses a higher risk to the elderly, immunocompromised, and pregnant women, though severe cases can occur in healthy adults. Given its prevalence, hMPV should be considered in ICU patients with respiratory failure.[26,27]

Human metapneumovirus (HMPV) affects both children and adults, with varying severity. In children, severe symptomatic cases may lead to wheezing, bronchiolitis, or pneumonia, requiring hospitalization. Infants and those with pre-existing conditions are at higher risk.[28] In adults, older adults (65+) and immunocompromised individuals face a higher risk of severe complications, including bronchitis or pneumonia, which may require medical attention.[29,30] In India, HMPV prevalence among children with acute respiratory infections ranges from 4% to 12%, with frequent co-infections, particularly with influenza B, complicating diagnosis and treatment.[31] Given its impact, HMPV should be considered in respiratory infection management, especially in vulnerable populations, to improve early detection and targeted interventions.[32]

DIAGNOSTIC APPROACHES FOR HMPV IN INDIA: CHALLENGES, BARRIERS, AND STRATEGIES FOR IMPROVEMENT

hMPV is difficult to isolate in conventional cell cultures, making RT-PCR and real-time RT-PCR the preferred methods for detection.[33] These techniques enable strengthening and quantification of the virus in medical trials, with multiplex RT-PCR allowing for the detection of multiple pathogens and coinfections. While rapid methods like immunofluorescence and ELISA exist, they are less sensitive than molecular techniques.[34] Serologic tests can be useful for epidemiologic studies to track hMPV prevalence, but are not reliable for diagnosing recent infections unless there is a significant increase in antibody titters.[35,36]

Human metapneumovirus (hMPV) is a respiratory pathogen affecting young children and the elderly. In India, challenges in its diagnosis include limited access to advanced tools like PCR tests, especially in rural areas, and a shortage of trained laboratory personnel, leading to potential misdiagnoses. The high costs of molecular diagnostics further deter their use, resulting in reliance on less accurate methods. Additionally, insufficient funding for respiratory virus research leads to low awareness among healthcare providers about hMPV's clinical significance.[37]

To overcome these barriers, developing affordable, point-of-care diagnostic kits suitable for smaller healthcare settings is essential. Implementing training programs for healthcare professionals and laboratory staff can enhance their understanding of hMPV and ensure proficiency in diagnostic techniques. Advocating for increased funding from both government and private sectors can bolster research and development in this area.[38] Public health campaigns are essential to educate healthcare providers and the general public about hMPV, its symptoms, and potential severity, promoting proactive testing behaviors. Strengthening collaborations with international health organizations can provide technical expertise, resources, and funding to enhance diagnostic capabilities in India. By implementing these solutions, India can improve its capacity to diagnose and manage hMPV effectively, leading to better patient outcomes and strengthened public health strategies.[39]

Lessons from the COVID-19 Pandemic: Strengthening India's Response to hMPV Outbreaks

The COVID-19 pandemic has highlighted key strategies to improve the management of Human Metapneumovirus (hMPV) outbreaks in India. Strengthening public health surveillance systems enables early detection and rapid response to emerging threats, thereby mitigating potential outbreaks. The pandemic also underscored the importance of clear communication and public awareness.[40] Effective dissemination of information fosters public trust and encourages adherence to health guidelines, which is vital during outbreaks of respiratory viruses like hMPV. Additionally, the development and distribution of vaccines during COVID-19 revealed challenges in logistics and public acceptance. Exploring alternative vaccination methods, such as nasal vaccines, could address issues related to storage, distribution, and needle aversion, potentially increasing vaccination rates and providing more effective immunity against respiratory pathogens. By applying these lessons-enhancing surveillance, improving communication, and innovating vaccination strategies-India can better prepare for and manage hMPV outbreaks, ultimately strengthening its overall pandemic preparedness.[41]

In response to recent hMPV detections, the Indian government has implemented a multi-layered strategy. The ICMR and the NCDC have enhanced investigation, integrating hMPV monitoring with existing

Table 1: Differences between hMPV and COVID-19

Aspect	hMPV	COVID-19
Virus Family	Paramyxoviridae (Metapneumovirus genus)	Coronaviridae (SARS-CoV-2)
Transmission	Droplet, direct contact	Airborne, droplet, close contact, aerosols
Primary Affected Groups	Young children, elderly, immunocompromised	Primarily adults, elderly, immunocompromised
Common Symptoms	Fever, cough, wheezing, nasal congestion, sore throat	Fever, cough, difficulty breathing, fatigue, anosmia (loss of smell)
Complications	Bronchiolitis, pneumonia, otitis media	Severe pneumonia, ARDS, multi-organ failure
Hospitalization Rate	10% of hospitalized children	High hospitalization rate, especially among older adults
Severe Cases	Less common in healthy children, severe in immunocompromised	Higher in adults, especially elderly and those with comorbidities
Diagnostic Method	PCR, antigen detection	PCR, antigen detection, antibody tests
Treatment	Supportive care (oxygen, ventilation)	Antiviral treatments (e.g., remdesivir), supportive care, vaccines
Vaccine Availability	None available	Multiple vaccines available
Mortality Rate	Relatively low in healthy children	Higher in older adults and those with comorbidities
Impact on Children	Common respiratory infection in children	A significant cause of illness in children, though less severe than in adults

respiratory disease systems.[29] The Union Health Ministry has urged states to strengthen healthcare infrastructure, increase hMPV testing, and establish isolation wards in tertiary hospitals, alongside public awareness campaigns promoting hygiene practices.[39] Collaboration with the World Health Organization ensures India stays updated on global advancements in diagnostics, treatments, and vaccines. State governments have adopted localized approaches: Delhi has directed hospitals to prepare for potential surges in respiratory illnesses, emphasizing strict isolation protocols and proper documentation of cases.[29] These coordinated efforts reflect India's robust response, with ongoing research, vaccine development, and public health education crucial for long-term mitigation.[42] Table 1 describes differences.

HMPV IN INDIA: ENHANCING SURVEILLANCE, POLICY RECOMMENDATIONS, AND PUBLIC HEALTH PREPAREDNESS

In Uttar Pradesh, India, a study at the ICMR-RMRC Gorakhpur tested 100 pediatric patients with ARI and severe acute respiratory illness (SARI) using semi-nested PCR. Four cases (4%) tested positive for human metapneumovirus (hMPV), with one (25%) resulting in death. Phylogenetic analysis showed close similarities to hMPV strains from Singapore and the USA. The study emphasizes the importance of routine hMPV testing and calls for further research on its impact in the region.[43]

A study conducted from November 2011 to December 2013 in Puducherry, India, tested 447 nasopharyngeal samples for hMPV RNA. hMPV was detected in 5% of samples, with 11 cases in adults aged 14–30 years. Co-infections with RSV and influenza B were observed. The seasonal distribution showed peaks during rainy months, with a summer peak in 2012. Phylogenetic analysis revealed close sequence homology with Indian strains from 2006 and 2011. The study indicates hMPV is more common in adults and highlights the circulation of closely related strains in India.[44]

Between January 6 and 29, 2025, India reported 59 cases of Human Metapneumovirus (HMPV) across 11 States/UTs, according to Union Minister of State for Health Prataprao Jadhav. Recent cases include two infants in Bengaluru and a two-month-old in Ahmedabad, all identified through routine surveillance by the Indian Council of Medical Research (ICMR). The Union Health Ministry stated that while HMPV is globally present, there is no uncommon surge in ILI or SARI in India.[45]

To mitigate the impact of Human Metapneumovirus (HMPV) in India, a multi-faceted public health approach is essential. Strengthening surveillance systems by expanding laboratory capacity and integrating HMPV testing into routine diagnostics will enhance detection. Standardized testing guidelines should be developed for healthcare providers, particularly for vulnerable populations. Public awareness campaigns must educate communities on symptoms, transmission, and preventive measures like respiratory hygiene and handwashing. Healthcare workers should receive training on infection management, including PPE use and hospital infection control. Research on HMPV epidemiology, seasonality, and genetic diversity will inform targeted interventions and vaccine development. Additionally, international collaboration with health organizations and affected countries will facilitate data sharing and best practices. Implementing these strategies or policies will enable a proactive and effective response to HMPV outbreaks in India.

EARLY DETECTION AND PREVENTIVE MEASURES OF HMPV:

Early detection of hMPV is vital for effective management, and it relies on clinical recognition, labora-

tory testing (primarily PCR), and imaging. Preventive measures, while not perfect, focus on infection control, hygiene, and avoiding close contact, especially in vulnerable populations. Although a vaccine is not available, ongoing research may provide one in the future, offering the potential for more effective prevention.[46-48]

The Union Ministry of Health & Family Welfare has implemented key measures to monitor and control HMPV spread while raising public awareness. Since January 6, 2025, the Public Health Emergency Operation Centre (PHEOC) at NCDC has been actively monitoring the situation, issuing daily reports to stakeholders. States and UTs have been advised to remain vigilant and send respiratory samples from hospitalized SARI cases to designated VRDLs for testing and sequencing. A robust surveillance system for ILI and SARI is already in place through ICMR and IDSP networks. Additionally, states have been instructed to enhance public awareness through Information, Education, and Communication (IEC) campaigns promoting preventive measures like hand hygiene, avoiding contact with symptomatic individuals, and proper respiratory etiquette.[49]

To ensure preparedness, the government conducted a nationwide drill to assess the healthcare system's capacity to manage seasonal respiratory illnesses. High-level meetings, chaired by the Secretary (Health & Family Welfare) and the Director General of Health Services, involved key stakeholders, including the Department of Health Research, DGHS, ICMR, NIV, NCDC, and State Surveillance Units. These discussions reviewed the status of respiratory illnesses, including HMPV cases, ensuring a coordinated national response.

Table 2 Nursing Management of hMPV: Strategies for Effective Care and Support

Category	Interventions
1. Assessment and Monitoring	
Respiratory Status	Assess for signs of respiratory distress: tachypnea, wheezing, nasal flaring, and hypoxia.
	Monitor oxygen saturation levels using pulse oximetry.
	Auscultate lung sounds for abnormalities such as crackles or wheezing.
Vital Signs	Regularly check temperature, heart rate, respiratory rate, and blood pressure.
Symptoms Progression	Document cough severity, nasal congestion, rhinorrhea, and signs of fatigue or lethargy.
	Observe for complications like pneumonia, bronchiolitis, or ARDS.
2. Infection Control Practices	
Hand Hygiene	Implement strict hand hygiene protocols for healthcare workers and visitors.
PPE Use	Use PPE, including masks and gloves, especially during aerosol-generating procedures.
Patient Isolation	Isolate patients in single rooms or cohorts to prevent cross-infection.
Environmental Cleanliness	Ensure thorough cleaning of high-touch surfaces.
3. Supportive Care	
Oxygen Therapy	Administer oxygen for hypoxia via nasal cannula, mask, or advanced ventilation support as required.
Hydration and Nutrition	Provide oral or intravenous fluids to prevent dehydration, especially in febrile or tachypneic patients.
	Encourage small, frequent feedings for infants and children.
Symptom Relief	Administer antipyretics (e.g., acetaminophen) for fever and analgesics for discomfort.
	Use nasal suctioning for infants with severe nasal congestion.
	Monitor and manage wheezing with bronchodilators if prescribed.
4. Education and Family Support	
Infection Prevention	Teach families about proper handwashing, cough etiquette, and limiting exposure to infected individuals.
	Emphasize avoiding crowded places during respiratory virus season.
Symptom Monitoring	Guide caregivers on recognizing worsening symptoms (e.g., increased breathing effort, cyanosis) and when to seek medical help.
Vaccination Advocacy	Encourage routine vaccinations to prevent respiratory illnesses like influenza and RSV.
5. Care for At-Risk Populations	
Pediatric Patients	Provide extra monitoring for children under 2 years as they are more vulnerable to severe disease.
	Offer emotional support to caregivers, addressing concerns about the child's condition and care plan.
Elderly and Immunocompromised	Prioritize preventive measures and closely monitor for signs of deterioration.
	Collaborate with interdisciplinary teams for holistic care, including nutritional support and physical therapy if needed.
6. Discharge Planning and Follow-Up	
Education on Care	Educate families on completing the prescribed treatment course and attending follow-up; appointments.
	Advise on maintaining a clean, safe home environment to reduce reinfection risk.
	Reinforce adherence to any prescribed medications or therapies.

NURSING CARE AND PRACTICE FOR HMPV: STRATEGIES FOR MANAGEMENT IN RURAL AND RESOURCE-LIMITED SETTINGS

Nurses play a crucial role in managing Human Metapneumovirus (HMPV) in rural and under-resourced settings, where access to healthcare is often limited. Their responsibilities include early identification, symptom management, infection control, community education, and strengthening referral systems. Since diagnostic facilities are scarce, nurses must rely on clinical assessments such as monitoring respiratory distress and using basic tools like pulse oximeters to identify severe cases. They also implement low-cost infection control measures, including hand hygiene, respiratory etiquette, and isolating symptomatic individuals to prevent transmission within households and communities. Given the lack of widespread awareness about HMPV, nurses engage in public education campaigns, using local languages, posters, and community health workers to spread information on symptoms and preventive practices. They also play a key role in strengthening referral systems, ensuring that critical cases reach higher healthcare centers through clear protocols and leveraging telemedicine where possible. Additionally, advocating for government and NGO support helps improve healthcare infrastructure, expand diagnostic capacity, and ensure access to essential treatments. Through proactive care, resource optimization, and community engagement, nurses in these settings are instrumental in reducing HMPV transmission and improving health outcomes.

Nursing care for patients with hMPV involves a comprehensive approach focused on symptom management, infection control, and prevention of complications. Nurses play a pivotal role in monitoring patients, implementing supportive care measures, and educating patients and their families. Below is a detailed outline of nursing care and practices for hMPV (table 2).

Conclusion

Since its discovery, human metapneumovirus (hMPV) has been the subject of extensive research, yielding valuable insights into its molecular replication, clinical impact, pathogenesis, and diagnostic approaches. These advancements have significantly enhanced our understanding of the virus and its role in respiratory infections. However, several critical areas remain underexplored.

Further studies are required to investigate hMPV's antigenic variability and its implications for immunity in diverse populations. Additionally, the mechanisms of innate and adaptive immune responses following hMPV infection need to be clarified. Another pressing issue is the need to confirm whether initial exposure to hMPV provides long-lasting cross-protection against different viral genotypes. Addressing these knowledge gaps is essential to creating comprehensive strategies for managing and preventing hMPV infections.

The findings from future research can provide the foundation for the development of effective therapeutic interventions and vaccines. These advancements will not only help reduce the global burden of hMPV-related illnesses but also improve outcomes for vulnerable populations, such as children, the elderly, and the immunocompromised. By continuing to expand our understanding of hMPV, we can take meaningful steps toward mitigating its impact and safeguarding public health worldwide.

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