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Mycoplasma pneumoniae returns: understanding its spread and growing impact

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Abstract

Mycoplasma pneumoniae, atypical bacterium known for causing respiratory infections, has risen as a major public health concern worldwide. This agent, primarily responsible for 'walking pneumonia', is infamous for triggering outbreaks in densely populated areas such as schools, hospitals, and military bases. Although typically mild, its global effect is profound, with around 2 million cases reported each year. The recent increase in cases in China closely mirrors the early indications of an unidentified pneumonia outbreak in Wuhan in late 2019, which signaled the beginning of the COVID-19 pandemic. Contributing factors to these developments may include influenza, respiratory syncytial virus, SARS-CoV-2, and influenza. Herein, we shed light on the public health challenges brought forth by *Mycoplasma pneumoniae*, emphasizing its notable spread in nations including Denmark, the Netherlands, South Korea, Singapore, the USA, and Sweden, thereby highlighting its extensive global reach.

Keywords: *mycoplasma pneumoniae; respiratory infections; epidemic control; disease surveillance; antibiotic resistance; preventive strategies; epidemiology; unidentified pneumonia; walking pneumonia; atypical pneumonia*

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Evidence in Context

• Discusses the global resurgence of Mycoplasma pneumoniae, known for causing respiratory infections. • Notes significant case increases in multiple countries, underlining its widespread health impact. • Analyzes the bacterium's genetic dynamics, indicating broader health implications. • Advocates for One Health strategies to manage its spread effectively. • Calls for global cooperation in surveillance and public health responses.

To view Article

Introduction

Mycoplasma (*M.*) *pneumoniae* is a unique bacterium lacking a cell wall, and, has been a known human pathogen since the early 20th century. Its ability to cause respiratory infections, particularly the milder form known as 'walking pneumonia', has been recognized and studied for several decades [1]. *M. pneumoniae* notably affects the respiratory tracts of children across all age groups, ranking as the second leading cause of community-acquired pneumonia (CAP) in children, after *Streptococcus pneumoniae* [2]. Despite its typically mild manifestations,M. pneumoniae represents a significant public health challenge due to its widespread occurrence and tendency to cause outbreaks in crowded environments, concerns that continue even in the post-COVID-19 lockdown era [3].

Analyzing the Worldwide Proliferation of *Mycoplasma pneumoniae*

The first cases of *M. pneumoniae* were reported in China, but with limited information available, the full scale and impact within China are not fully known. The spike in cases occurred during China's first winter without COVID-19 restrictions, yet this trend has been mirrored with reported case upticks in various countries worldwide [4]. With Denmark reporting an epidemic level of 541 cases, it leads over the Netherlands (248 cases), South Korea (226), Singapore (172), and the United States and Sweden (145 cases each). Switzerland reports 132 cases, the UK 49, Slovenia 41, Ireland 15, India 7, and the Philippines 4 [5]. *Figure 1 shows the global distribution of reported M. pneumoniae cases as sourced by local media report*s**.** This global distribution underscores the transmissible nature of the bacterium and highlights the need for international cooperation in surveillance, and public health response to effectively manage and contain the spread of its infections.

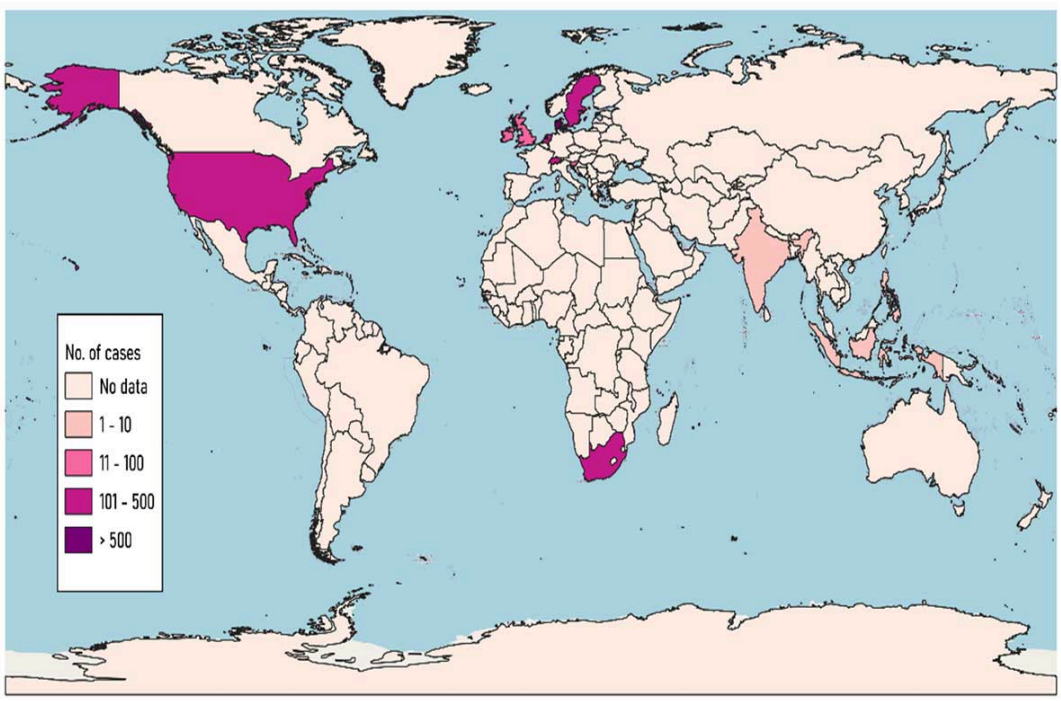

Figure 1: Global distribution of reported M. pneumoniae cases as sourced by local media reports. This figure has been generated using QGIS.

Epidemiological Characteristics and Modes of Transmission of *M. pneumoniae*

Mycoplasma species, notable for being among the smallest self-replicating organisms in nature, include *M. pneumoniae*, a prevalent etiological agent of community-acquired pneumonia. Transmission of *M. pneumoniae* predominantly occurs via respiratory droplets during close interpersonal contact. The incubation period typically ranges from 2 to 3 weeks post-infection [6]. *M. pneumoniae* is characterized by its periodic outbreak cycles, often demonstrating peaks every three to seven years [7]. Recent trends have been influenced by the concurrent circulation of other respiratory pathogens and the relaxation of COVID-19 restrictions, leading to a notable rise in cases, particularly among school-aged populations [8].

The propagation of *M. pneumoniae* is chiefly through respiratory droplets generated by coughing or sneezing of infected individuals. The likelihood of transmission is augmented by prolonged and close contact, a factor contributing to its higher prevalence in communal settings such as schools and military barracks. Despite its infectious nature, it is observed that not all individuals exposed to the bacterium manifest symptoms, indicating variability in host response and potential subclinical infections [9]. Recent changes in the transmission trends of M. pneumoniae, specially in the context

Of various respiratory diseases, have been significant. The COVID-19 pandemic altered these dynamics, initially reducing spread due to behavioral changes like social distancing, but later leading to a resurgence, possibly due to decreased immunity to other pathogens. Co-infections with other respiratory viruses have become more common, challenging traditional diagnostic and treatment approaches. Additionally, the ease of global travel has facilitated rapid cross-regional transmission of the bacterium [10].

Trends in the Past

In the past two decades, there has been a significant global increase in *M. pneumoniae* infections. The incidence of antibiotic-resistant infections, especially Macrolide-Resistant *M. pneumoniae* (MRMP), has shown notable geographical variation, with a pronounced rise over time. The Western Pacific region has been particularly affected. This trend emphasizes the growing concern about the rising resistance to macrolides, which are typically the first-line treatment for *M. pneumoniae* [11]. It highlights the urgent need for alternative treatment strategies and careful monitoring of antibiotic resistance patterns.

Table 1: Reported M. pneumoniae Case Counts Across Countries, sourced from media reports.

Country	Cases
Denmark	541
Netherlands	248
South Korea	226
Singapore	172
United States	145
Sweden	145
Switzerland	132
United Kingdom	49
Slovenia	41
Ireland	15
India	7*
Philippines	4

* Note: The case count for India is subject to further validation and may be revised upon confirmation of data accuracy.

Pathophysiology of *M. pneumoniae*

M. pneumoniae adheres to respiratory tract epithelial membranes using specialized proteins. It then releases hydrogen peroxide and superoxide, which damages epithelial cells and cilia. The antibodies generated against this bacterium can mistakenly target human brain cells and RBCS. Its pathogenesis involves triggering inflammatory cytokines. The bacterium's unique gliding movement and tip organelles allow it to navigate through the respiratory epithelium, disrupting ciliary functioning and leading to respiratory epithelial cell loss, contributing to a persistent cough. Besides respiratory infections, *M. pneumoniae* is associated with various extrapulmonary conditions, such as immune thrombocytopenic purpura, acute hepatitis, autoimmune hemolytic anemia, arthritis, and transverse myelitis. The increase in cases post-COVID-19 restrictions could signify a heightened risk of trans-border spread, particularly in regions with close geographical and socio-economic ties to China [12].

Clinical Diagnosis, Treatment, and Public Health Strategies for *M. pneumoniae* Infections

Clinical Diagnosis

The diagnostic approach to *M. pneumoniae* infections encompasses a range of methodologies, including cultures, radiological assessments (such as chest X-rays and CT scans), serological testing, and molecular techniques. Serological testing, which includes complement fixation tests and enzyme immunoassays, is the most frequently employed method for diagnosing *M. pneumoniae* infections [3,13]. Surveillance methods for tracking the global spread of *M. pneumoniae* include population-based surveys and outbreak investigations. These approaches are crucial in pinpointing regions with high disease prevalence and identifying potential risk factors for infection. Consistent monitoring of these surveillance methods and data is vital in preventing the spread of *M. pneumoniae*, as it enables timely identification and response to outbreaks, and informs public health strategies and interventions [3].

Treatment Modalities

While many cases of *M. pneumoniae* infection resolve spontaneously without antibiotic intervention, clinical management often involves antibiotic therapy. The absence of a cell wall in *M. pneumoniae* renders it inherently resistant to beta-lactam antibiotics, such as penicillin. Treatment generally involves the use of macrolides, tetracyclines, or fluoroquinolones, selected based on the patient's age and local patterns of antibiotic resistance [14]. Despite macrolides being the preferred treatment option, rising incidence of macrolide resistance, particularly in regions like China, presents a significant clinical challenge [3].

Preventive Strategies

Currently, no vaccine is available for *M. pneumoniae*. Therefore, prevention strategies focus on the implementation of effective hygiene practices [15]. These practices include regular hand washing, using a tissue or elbow to cover the mouth and nose when coughing or sneezing, avoiding close contact with infected individuals, and maintaining cleanliness in communal areas. The World Health Organization (WHO) recommends additional precautions: maintaining a safe distance from sick individuals, self-isolating if experiencing symptoms, seeking testing and medical care when necessary, wearing face masks in appropriate settings, ensuring proper ventilation, and adhering to hand hygiene protocols [8,16].

However, managing *M pneumoniae* presents key challenges. These include the need for more accurate and accessible diagnostics, addressing the growing issue of antibiotic resistance, and increasing public awareness. While global collaboration and robust surveillance systems are crucial, the lack of a vaccine and the complexities of dealing with co-infections present significant obstacles in developing effective public health strategies.

Public Health Response

Effective public health responses to *M. pneumoniae* include heightened surveillance, particularly during outbreaks, and public education campaigns emphasizing preventive measures. There are ongoing efforts to strengthen healthcare systems' capabilities in managing and treating affected patients. Organizations like the WHO and various national health agencies are actively engaged in monitoring infection trends and issuing guidelines for outbreak management and containment strategies [17].

Comparing the effectiveness of current strategies against *M pneumoniae* with those used for respiratory diseases like COVID-19, influenza, or Respiratory Syncytial Virus (RSV) can offer a deeper understanding. Factors such as the speed and extent of the response, public education efforts, the adequacy of diagnostic and treatment resources, and preventive measures should be considered. Insights from surveillance and vaccination strategies used in other respiratory illness outbreaks, as well as adaptations to antibiotic resistance, could inform improvements in managing *M. pneumoniae* and highlight best practices for future respiratory disease outbreaks [18].

Conclusion

M. pneumoniae poses significant public health challenges, particularly affecting children and causing outbreaks in densely populated areas. Its ongoing prevalence post-COVID-19 and rising cases globally, notably in Denmark, call for enhanced international surveillance and coordinated public health responses. Managing this pathogen is complicated by its varied transmission methods,

Diagnostic complexities, and evolving treatments amid growing antibiotic resistance. Emphasizing hygiene, public awareness, and strengthening healthcare systems are crucial in addressing the impact of *M. pneumoniae* infections worldwide.

Future research in managing *M. pneumoniae* infections should focus on developing rapid, accurate diagnostics, vaccines, and new treatments, particularly against antibiotic-resistant strains. A deeper understanding of the pathogen's transmission and host interactions will enhance prevention and control. Integrating emerging technologies like AI and big data in surveillance could revolutionize management strategies. Continued research and innovation are essential for breakthroughs in combating this challenging respiratory pathogen.

Supporting information

None

Ethical Considerations

None

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Declaration of competing interest

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