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Psittacosis in Focus: A Review Addressing the Risks and Management Challenges in Outbreak Scenarios

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ABSTRACT

Background and Aim: Psittacosis is a zoonotic disease that mostly affects birds and can infect people. It causes respiratory ailments that can be minor or severe. The disease's importance to public health is shown by the fact that it has been connected to isolated outbreaks in several parts of the world. Comprehending the hazards linked to psittacosis is crucial, given that epidemics may have extensive consequences for public health, especially in environments where people and birds interact closely. Therefore, examining the risks, challenges, and methods for overcoming psittacosis infections is the primary focus of the study.

Discussion: Psittacosis' principal dangers include severe respiratory problems, which are especially dangerous for vulnerable groups. Inadequate diagnostic goods and services, public ignorance, and variances in hospital infrastructure all pose challenges to effective management. Strategies for combating psittacosis must include improved monitoring and reporting systems, better access to diagnosis and treatment, and expanded public awareness on protection. Incorporating biosecurity strategies in flocks and agricultural operations is also critical to lowering transmission risk.

Conclusion: Prioritizing psittacosis control is imperative for global health regulatory organizations to prevent future outbreaks. To promote research, allocate funds, and support public health initiatives aimed at enhancing disease management, quick action is needed. By promoting international cooperation and enhancing healthcare systems, we can effectively address the problems caused by psittacosis and better safeguard populations everywhere from this preventable disease.

1 | Background

Psittacosis is a respiratory disease which is caused by *Chlamydophila psittaci* (*C. psittaci*), an obligate intracellular bacterium. This disease is also known as parrot fever and ornithosis [1, 2]. Psittacosis is a disease that can be transmitted from infected birds to humans, highlighting its zoonotic nature. The disease, when transmitted to humans, is referred to as avian chlamydiosis [1]. *C. psittaci* is a Gram-negative bacterium. This bacterium was first discovered in

1893 by Edmond Nocard from the bone marrow of parrots that had died of psittacosis [3].

In 1929/1930, due to the outbreak of psittacosis, which is also known as Great Parrot Fever Pandemic, an estimated 800 people were infected, and around 100 humans died [1]. During the 20th century, psittacosis mortality was very high, approximately 50% [4]. Over the past 20 years, though the fatality rate has decreased due to the development of medical treatment and medicine such as antibiotics, the disease has long been

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acknowledged as a significant threat to human health and is classified as a global anthroponozoonotic disease (disease transmissible from human to human) [3, 5, 6].

2 | Psittacosis Disease Prevalence

The main cause of chlamydial infections is *C. psittaci*. According to articles from 2000 to 2022 (Figure 1), Chlamydia species are widely distributed, with *C. psittaci* which is the most reported (21%) causative pathogen; where Europe shows the greatest prevalence rate (26%) [7].

3 | Risk of Psittacosis

Currently, cases of psittacosis are typically confined to localized outbreaks, small clusters, or isolated incidents [8]. In the past two decades, multiple human cases of psittacosis have been reported in many nations, including the US, Japan, Australia, Sweden, and Belgium [9, 10]. According to the World Health Organization (WHO), there was a psittacosis outbreak in five European countries in 2023 and at the beginning of 2024 [11].

The intracellular existence of this pathogen complicates diagnosis. The death rate in untreated patients typically ranges from 5% to 40%. However, it may exceed this range in instances of co-infection [3]. Endocarditis may cause potentially fatal inflammation of the inner lining of the heart's chambers and valves if the infection is left untreated. Human infections mostly occur as community-acquired pneumonia (CAP) [4]. Headache, malaise, fever, chills, and myalgia are the symptoms of psittacosis [6]. Most commonly, there is a nonproductive cough that may be accompanied by tightness in the chest or difficulty breathing [5]. The clinical manifestations of psittacosis can range from mild flu-like symptoms to severe, life-threatening conditions, including acute respiratory distress syndrome and rhabdomyolysis (leads to muscle death), Guillain-Barré

syndrome (the person's immune system attacks peripheral nerves), and multiple organ dysfunction [9].

Often, *C. psittaci* infection shows neurological symptoms such as dizziness, headache, and delirium, which are probably related to its effect on the central nervous system (CNS). The infection might set off an inflammatory reaction in the CNS, upsetting normal neural activity and causing symptoms including headache and delirium [12, 13]. *C. psittaci* might either directly or indirectly, via infected immune cells, breach the blood-brain barrier (BBB), hence generating localized infections or inflammation in the CNS [13]. Cytokine and other inflammatory mediator production by the immune system in reaction to the illness might unintentionally damage brain structures [12]. The pathogen might resemble brain proteins in structure, hence prompting the immune system to erroneously assault the body's own neural tissues [13]. Though not well-documented for *C. psittaci*, some bacteria create poisons that can impair neurological function and hence need more research [14]. Infection's systemic consequences—fever, hypoxia, or metabolic abnormalities—could possibly help explain neurological symptoms [14].

Mainly, pet shop staff, veterinarians, poultry farm workers, diagnostic lab technicians, zoo employees, owners and breeders of pet birds, and wildlife workers who come in close contact with infected birds are at high risk [3, 5]. As wild birds are the natural reservoir for *C. psittaci* infection, they can be responsible for the transmission of this disease by crossing international borders [7].

4 | Transmission

Avian species, including poultry, domestic birds, and wild birds, serve as the principal hosts for *C. psittaci*, with humans acting as accidental hosts. Inhalation is the principal mode of transmission of infection from sick birds to people. Moreover, desiccated infectious excreta, inadequate disposal of contaminated

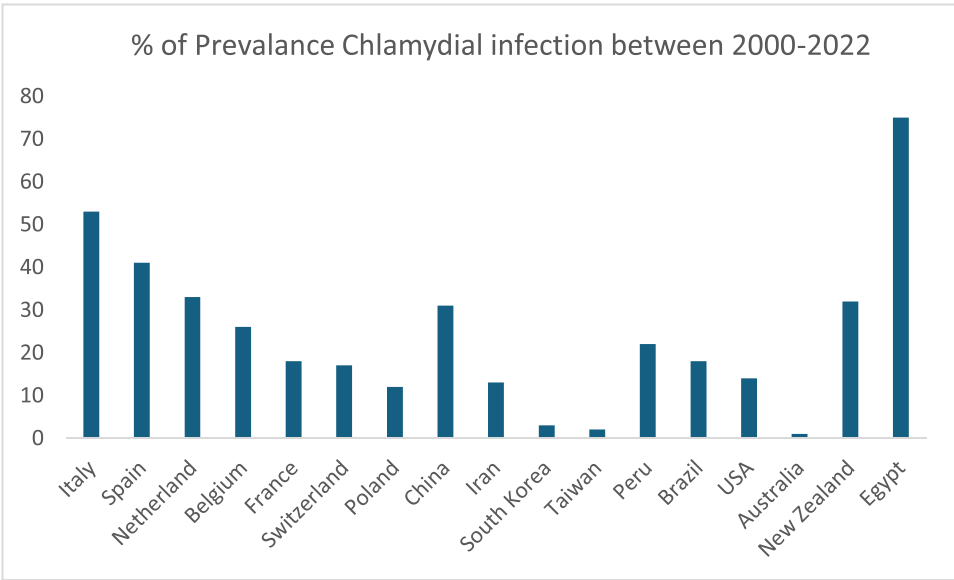


FIGURE 1 | Prevalence of Chlamydia infections in wild birds in different countries between 2000 and 2022.

corpses, bite injuries, aborted fetuses or placentas, and secretions or particulate matter from feathers might result in infection. The Centers for Disease Control and Prevention (CDC) states that the incubation period ranges from 5 to 14 days and may extend to humans [3].

Transmission can occur from birds to mammals (cattle, horses, sheep etc.). Mammalian animals do not serve as the disease reservoir but function as intermediary hosts in its transmission to humans [8].

5 | Challenges in Patients With Comorbidity

The existence of multiple disorders in a person within a specified time frame is known as comorbidity [15]. Psittacosis is a systemic infectious disease that can quickly cause failure of multiple organ systems [16].

Psittacosis can present as pneumonia, acute respiratory distress syndrome (ARDS), or a common upper respiratory tract infection when it affects the respiratory system. Psittacosis can cause myocarditis, pericarditis, and endocarditis that are culture-negative when they affect the heart. *C. psittaci* can be identified in the blood, mitral valve tissue, and aortic valve. There have been reports of arterial embolism. Psittacosis can cause acute renal failure and interstitial nephritis when it affects the kidneys. The condition might present as rose rash, polytype erythema, nodular erythema, urticaria, or Horder's spots when psittacosis affects the skin. In the acute phase of blood system involvement, white blood cell counts are often normal or slightly lower. In rare cases, the infection may progress to leukopenia, hemolytic anemia, or disseminated intravascular coagulation [17].

C. psittaci pneumonia patients, with the liver being one of the most affected organs in addition to the lungs, have been observed to have variable levels of both aspartate and alanine aminotransferase (ALT and AST) [18].

Respiratory pulmonary lesions frequently start in the lung's hilum and progress outward, causing interstitial and lobular pneumonia. Both lobular pneumonia and acute respiratory failure are common. In severe cases, pleurisy may be accompanied by lung tissue necrosis. In addition to the lung, the liver, spleen, kidney, meninges, cardiac muscles, and endocardium are among the other organs that are affected [19].

6 | Economic Challenges

Based on the income categorization method used by the World Bank, there are now 26 economies classified as low-income, 108 as middle-income, and 83 as high-income [20].

Low and middle-income countries (LMICs) bear a disproportionately high burden of chronic respiratory diseases (CRDs) related morbidity and mortality worldwide [21]. A significant portion of the population in low- and middle-income countries resides in rural areas without access to mass

media [22] where implementation of effective public health interventions to prevent transmission, identification, and isolation of infected people may be more challenging than in high-income-countries (HICs) especially in the poor, crowded areas [23].

In LMICs, access to quality healthcare is also a significant socioeconomic challenge. The number of the population and the number of hospital beds available are lower in LMICs, which makes healthcare less accessible to the underprivileged people. Evidence indicates that in poorer countries, most of the health financing is usually out-of-pocket expenditure [24].

Challenges in low- and middle-income countries (LMICs) include insufficient resource availability, substandard transportation infrastructure for vaccination distribution, inadequate cold-chain and storage facilities, lack of cooperation with a substantial private healthcare sector, and restricted funding for monitoring, among other concerns. Vaccine rejection and reluctance are more prevalent among rural, semi-urban, slum, elderly, and low-educated people owing to adverse side effects, misinformation about vaccinations, insufficient information, and a lack of faith in government and pharmaceutical entities [25].

7 | Diagnostic Challenges

C. psittaci is not part of standard clinical laboratory screening protocols [10]. Psittacosis is classified as a notifiable disease, requiring reporting to authorities within 48 h. However, many countries in the Global South, including China, India, and Indonesia, have yet to designate psittacosis as a notifiable infectious disease. Asymptomatic transmission, lack of awareness about the potential risk of this disease, and scarcity of proper clinical and laboratory opportunities are some major reasons for this underestimation [1].

Both the public and physicians possess limited knowledge and awareness regarding this disease, often overlooking the diagnosis of *C. psittaci* infection due to its clinical manifestations resembling those of other respiratory diseases. This results in underdiagnosis or misdiagnosis [26]. The misdiagnosis rate is as high as 50% [10]. Diagnostic tests for *C. psittaci* are rarely done when patients are present with Community Acquired Pneumonia [27].

Routine diagnostic techniques such as PCR, serological testing, and culture, have limitations in terms of diagnosis timeliness and accuracy. The traditional culture of *C. psittaci* may take a long time and usually be negative. Metagenomic next-generation sequencing (mNGS) has emerged as a nontargeted testing technique in recent years, which does not require specific amplification and has the potential to identify uncommon pathogens. This allows for the diagnosis of atypical pathogens with the advantages of high throughput, high sensitivity, and quick detection. Several studies have emphasized its importance and benefits in pathogen identification over routine diagnosis techniques [26], but the cost is significantly greater than the other routine diagnostic techniques. It is still necessary to improve this technology. Physicians also need to improve their comprehension of the outcome [28].

8 | Pet Bird Trade and Poultry Industry Challenges

Psittacine birds, finches, canaries, and pigeons are the most common pet birds that cause psittacosis in humans [11]. According to research findings, at least 465 bird species from 30 different orders have been identified to have psittacosis [1, 7]. In tested birds, the prevalence of *C. psittaci* ranges from 16% to 81% [1].

Diseases may spread in any situation where people and animals are in close contact, such as a bird market or poultry farm [1].

Major challenges in poultry production include high chicken mortality and morbidity, high medication costs, inadequate disease control and prevention interventions, inadequate farm biosecurity and hygiene, subpar poultry keeping practices, and a lack of scientific knowledge and expertise among poultry producers [29]. Breeding birds are susceptible to reproductive loss and newborn mortality [5].

Psittacosis may result in financial detriment to the poultry sector and the pet avian commerce. Egg output may decline by 10%–20% [3].

According to the CDC, there is no evidence that the bacteria spread by preparing or eating poultry [30].

9 | Medication Challenges

Tetracycline hydrochloride or doxycycline oral tablets are commonly used to treat mild to moderate infections [5]. All tetracyclines have a variable reduction in bioavailability when used with drug products that contain iron, magnesium, aluminum, or calcium. Additional medications that have been shown to decrease tetracycline bioavailability include colestipol, cholestyramine, and bismuth subsalicylate. Oral contraceptives may not work properly while taking tetracyclines [31].

Tetracyclines bind to different antacids by metal ion chelation, forming insoluble complex compounds that can reduce tetracycline absorption by over 90%. When magnesium hydroxide and aluminum hydroxide-containing antacids are present, the absorption of Ciprofloxacin and Ofloxacin, two members of the new class of quinolone antibiotics, is lowered by 50%–90% [32].

Intravenous doxycycline can be used in cases where antibiotics cannot be administered orally [33]. Cytochrome P450 3A4 inducers such as rifampicin can decrease serum levels of doxycycline due to increased hepatic metabolism. The plasma levels of doxycycline can also be decreased by barbiturates, acetazolamide, sodium bicarbonate, and anticonvulsants (phenytoin, carbamazepine) [34].

A new aminomethylcycline antibiotic derived from tetracycline, omadacycline, showed promise in treating severe instances of *C. psittaci* infection, including pneumonia. Recent research has underlined its efficacy in situations exacerbated by acute respiratory distress syndrome (ARDS) and multiple organ failure [9, 16]. Especially when conventional therapies like

doxycycline or moxifloxacin fail, omadacycline's broad-spectrum efficacy against atypical infections, including *C. psittaci*, makes it a desirable choice [35].

Among its benefits are a good safety record, minimal need for dosage changes in particular groups, and quick relief of severe symptoms, including respiratory failure and systemic problems [16, 35]. Metagenomic next-generation sequencing (mNGS) has also been quite helpful in early psittacosis diagnosis, thereby allowing quick start of omadacycline treatment [9].

Though further clinical research is required to fully verify its effectiveness, these results imply that omadacycline could be a good substitute for severe psittacosis patients.

10 | Prospects of Disease Management and Recommendations

Though PCR, isolation, direct immunoenzymatic testing, and serological methods are some of the techniques used to detect *C. psittaci* [36], today, the integration of emerging metagenomic data from mNGS with Next-Generation PCR has the potential to greatly enhance the specificity and sensitivity of psittacosis detection. This approach not only enhances efficiency but also boosts the detection rate, enabling clinicians to address the underlying cause swiftly [10].

Tetracycline treatment in humans should be maintained for 10–14 days. When tetracycline is prohibited for use in pregnant women and children, macrolide antibiotics such as azithromycin or erythromycin are a preferable option. With therapy, the case fatality rate will be 1%–5%, but without treatment, it would be 10%–20% [3]. Omadacycline is a new tetracycline antibiotic demonstrating enhanced efficacy and consistent safety in treating severe *C. psittaci* pneumonia [9].

Vaccines against this infection are currently unavailable. Therefore, at this point, the only approach to manage the illness is to implement tactics that reduce the spread of this disease. When in doubt about the birds' ability to transport the Pathogen, veterinarians and medical professionals should be consulted as soon as possible [33]. Staff and visitors should be informed about psittacosis and its modes of transmission. There should also be proper treatment of ill birds and an open circulation system in hot houses. Adequate quarantine and isolation of birds are recommended [37].

Employees must don protective attire, including a smock or coveralls, gloves, eyeglasses, specialist footwear or shoe coverings, and a disposable surgical hat, while managing infected birds or sanitizing their enclosures. Wearing a disposable particulate respirator is also recommended [5].

Minimum biosecurity measures should be taken by wearing masks and hand gloves at the time of handling infected pet birds and poultry. To reduce the exposure of the bacterium, detergent antiseptic can be applied to wet the feathers of dead birds [3]. *C. psittaci* is sensitive to heat, a variety of detergents, and disinfectants. 1% newly produced Lysol Effective disinfectants include 1:32 dilutions of home bleach (one-half cup/

gallon) or other oxidizing agents (such as accelerated hydrogen peroxide-based disinfection) [5]. At the temperature of 56°C for 5 min and exposure to ultraviolet light for 3 min the organism may die [3].

C psittaci may infect both domestic birds and people if they are introduced illegally [5]. So, birds should only be purchased from licensed pet stores or breeders. Before and after handling pet birds, wash your hands for ten seconds with soap and running water. Avoid kissing your pet bird (making mouth-to-beak contact). Clean cages that are large enough and lined with newspaper so that it may be replaced often are ideal for housing birds. Droppings should not be permitted to dry out or become airborne in cages [38].

To avoid disease outbreaks, it is best not to mix birds from different sources. Testing is also necessary before selling birds whose *C psittaci* status is unknown [5].

11 | Discussion

According to the study's results, psittacosis prevention should be a top priority for health regulatory bodies across the world. Countries with an unknown potential patient population, particularly those with low per capita income, should undertake surveys to learn more about this illness. Healthcare providers may face a formidable obstacle while attempting to treat this condition in individuals who are also experiencing multiple organ failure. Therefore, taking the necessary precautions to prevent the spread of this infectious agent, both directly and indirectly, would be the single most effective way to reduce the infection and mortality rates. To find out, further study is needed to determine the feasibility of a vaccination or a particular medicine. The best way to stop the spread of psittacosis is to implement effective diagnostic and awareness-raising measures. Psittacosis diagnosis has been transformed by metagenomic next-generation sequencing (mNGS), which makes it possible to objectively identify a broad range of pathogens straight from clinical samples. The capabilities of mNGS have been considerably improved by recent developments in 2024, especially in the diagnosis of psittacosis. The successful use of mNGS in the diagnosis of a severe case of *Chlamydia psittaci* pneumonia was shown in a research published in 2024 [39]. This study demonstrated the use of mNGS in early and accurate pathogen identification, which is essential for prompt and focused antimicrobial treatment.

Another study emphasized the importance of epidemiological investigations and the application of mNGS for the early detection and diagnosis of psittacosis. The study indicated that mNGS effectively identified *C. psittaci* DNA in bronchoalveolar lavage fluid, facilitating timely and efficient treatment [39]. By providing a more thorough and effective method of detecting infections like *C. psittaci*, these advancements highlight the expanding significance of mNGS in clinical diagnostics and enhance patient outcomes through prompt and focused therapies.

Our research was limited to just a few countries due to a scarcity of particular data on psittacosis epidemics. Consequently, we recommend only a limited number of sites and certain years when

healthcare services are insufficient or in areas with a high vulnerability to illness. Simultaneously, WHO, UNICEF, and other developed nations are actively investigating opportunities to address the potential migration of this illness via human and bird migration. The transmission of this disease has the potential to cause a pandemic similar to COVID-19, so it is crucial to take proactive actions. Psittacosis is not the only illness that requires rapid attention from each nation. It is crucial to identify the underlying causes of disease development and promptly establish healthcare policies to address these concerns.

12 | Conclusion

Despite *Psittaci* being a zoonotic bacterium that is found worldwide and has been increasingly expanding in recent times, there is still a lack of widespread recognition about the public health risks associated with it. In relation to the present circumstances, it is essential for international health regulatory organizations to implement efficient public health protocols for monitoring the transmission of diseases and providing assistance to nations requiring support. Timely reporting of up-to-date information by researchers and global health organizations is essential for limiting the psittacosis epidemic.

Author Contributions

Himel Ghosh: conceptualization and writing – original draft. **Sejuti Reza:** conceptualization and writing – original draft. **Md Abdul Mazid:** writing – review and editing. **Syed Masudur Rahman Dewan:** conceptualization, writing – review and editing, and supervision.

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Ethics statement

No ethical approval has been given because the study did not involve samples from humans or animals for any experiments.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The authors have nothing to report.

Transparency Statement

The lead author Syed Masudur Rahman Dewan affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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