IDCases 33 (2023) e01845

Contents lists available at ScienceDirect

IDCases

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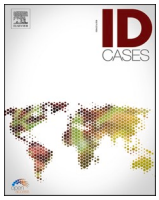

Case report

Epidemiological and clinical characteristics of a family cluster of psittacosis: A case report

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ARTICLE INFO

Keywords:
Psittacosis pneumonia
Family clusters
Diagnosis

ABSTRACT

Psittacosis accounts for 1–2 % of community-acquired pneumonia. In recent years, reports of psittacosis are increasing. Most reported cases of psittacosis are sporadic. Here, we report a familial cluster of five patients infected with *Chlamydophila* in a northwest Chinese region and share our diagnosis and treatment experience. The epidemiological characteristics, clinical features, laboratory examinations of family cluster psittacosis were collected and analyzed. We closely followed up all the family members and analyzed their clinical outcome. Five cases of family clustered pneumonia were mainly characterized by fever, cough and fatigue. mNGS rapidly identified the infecting agent as *Chlamydophila* in case 1 followed by RT-PCR analysis. A newly purchased pet parrot, which had diarrhea, was probably the primary source of infection. The main change of inflammation index in five patients was the decrease of lymphocyte counts. Chest CT showed peripheral or subpleural involvement of patchy high-density shadows with bronchial ventilation signs and blurred edges, mostly unilateral lesions. Five cases were completely cured with moxifloxacin and azithromycin. Our findings suggest that a familial cluster of *Chlamydophila* infection maybe caused by contact with sick pet parrot or human to human transmission in one close family. For this community-acquired pneumonia, epidemiological characteristics and use of mNGS is very important for improving accuracy in the early diagnosis.

Introduction

Psittacosis is a zoonotic infectious disease caused by *Chlamydophila* [1]. Birds are the main host of *Chlamydophila* which can widely infect animals and humans. It has the characteristics of high pathogenicity and diverse of spreading route. *Chlamydophila* can infect humans through the respiratory tract, as well as the human skin, mucous membranes and digestive tract through the feces of infected birds [2]. Recently, Shi et.al identified the first human-to-human transmission of *Chlamydophila* in China through metagenomic next-generation sequencing (mNGS), real-time quantitative polymerase chain reaction (RT-PCR) methods and specific nested PCR [3].

The clinical manifestations of atypical community-acquired pneumonia (CAP) caused by *Chlamydophila* including varying degrees of fever, cough, fatigue, loss of appetite. Severe patients may develop acute respiratory distress syndrome and multiple organ dysfunction [4,5]. Patients can develop severe pneumonia if they are not diagnosed and treated on time. The mortality rate of severe psittacosis reported in the past is 10–20 % [6,7]. Because of its non-specific symptoms and the limitation of current testing methods, fewer cases of *Chlamydophila* pneumonia have been reported in the past. mNGS is a new tool, which can precisely and rapidly identify the potential pathogens [4,8]. With the clinical application of mNGS detection technology, the reports of psittacosis have increased, but most of them are sporadic cases [9–13].

Here we describes a family cluster of psittacosis caused by a sick pet parrot, five cases in total.

Case

Case 1 was a 39-year-old woman, who bought a pet parrot on November 6, 2021. The parrot developed diarrhea from November 7 to 8 and was subsequently cured by oxytetracycline. On November 16, she

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https://doi.org/10.1016/j.idcr.2023.e01845
Received 26 April 2023; Received in revised form 5 July 2023; Accepted 5 July 2023
Available online 6 July 2023

had a fever, chills, fatigue, headache, body aches, cough, expectoration and other discomforts. Four days later, she was admitted to hospital. Case 2 was her daughter who came home and took care of Case 1 on November 16th and brought about clinical symptoms on November 20. Case 3 and case 4 who stayed at home and lived with Case 1 began to develop clinical symptoms such as fever, chills, fatigue, cough, expectoration or muscle aches on November 20. Case 5 is Case 1′s husband who worked during the day and rests at home at night and develop clinical symptoms on November 22. Except for case 2, everyone else of the family had direct contact with sick Parrots. The average time from exposure to onset of symptoms in the 5 patients was 10.8 days. All 5 patients were assigned to the isolation ward after admission (Fig. 1).

On admission, All the five patients had elevated C-reactive protein (CRP) and erythrocyte sedimentation rate (ESR) levels, Lymphocyte count decreased in 4 cases. In addition, 4 cases with normal white blood cell count and neutrophil count (Table 1).

The chest imaging of 5 patients showed consolidation shadow with air-filled bronchial shadows, usually unilateral. The maximum diameter of the lesions is 20.6–80 mm, and the average diameter is (50.2 ± 22) mm. Inflammatory lesions are mainly distributed in the periphery or near the pleura, without pleural effusion. Details were shown in Table 2 and Fig. 2.

The bronchoscopy findings were hyperemic tracheal and bronchial mild mucosal congestion (Fig. 3). Three specific *Chlamydophila* sequences that covered 2.17 % of the total *C. psittaci* genome were detected by mNGS in the BALF sample of the first case. The agarose gel electrophoresis analysis of the amplification products of the bronchoalveolar lavage PMP gene in cases 2–5 showed that cases 3 and 5 were positive, but cases 2 and 4 were negative. All cases were positive for *Chlamydophila* serum IgM antibody.

Case 1 was given empirical antibiotic therapy with β-lactamase inhibitor combination admission according to the CAP management guideline, but the treatment was not effective. The mNGS took 48–72 h from the receipt of the samples to the reporting of the results, the antibiotic was changed to Azithromycin when *Chlamydophila* infection was confirmed. The patient's body temperature returned to normal 2 days after the antibiotic was changed. Based on cases 2–5 and Case 1 as family clusters, and Case 1 was diagnosed as psittacosis. Therefore, the remaining patients were treated with moxifloxacin after admission, and their symptoms returned to normal after 1–3 days. Re-examination of chest CT after 10 days, except case 5, the inflammatory lesions decreased and disappeared gradually, with no residual fibrosis.

We then conducted an epidemiological investigation on the close contacts of the five inpatients, including medical staff in the isolation ward and family members of the medical staff. The survey results showed no person with similar symptoms.

Discussion

In this study, Case 1, 3–5 all became ill after contact with sick pet parrots, so sick pet parrots should be considered as the main source of infection of this family cluster of psittacosis. Case 2 was infected and fall ill, probably due to his close contact with her mother. Therefore, both the direct contact with sick birds and human to human transmission are possible for psittacosis. To prevent psittacosis infection, we should try to avoid contact with live birds or fowl. For occupational needs or keeping birds as pets, it is necessary to strengthen hygiene awareness, learn professional knowledge of epidemic prevention, and the breeding environment needs to be disinfected frequently. Wear masks and gloves when touching birds or items that may be contaminated with their

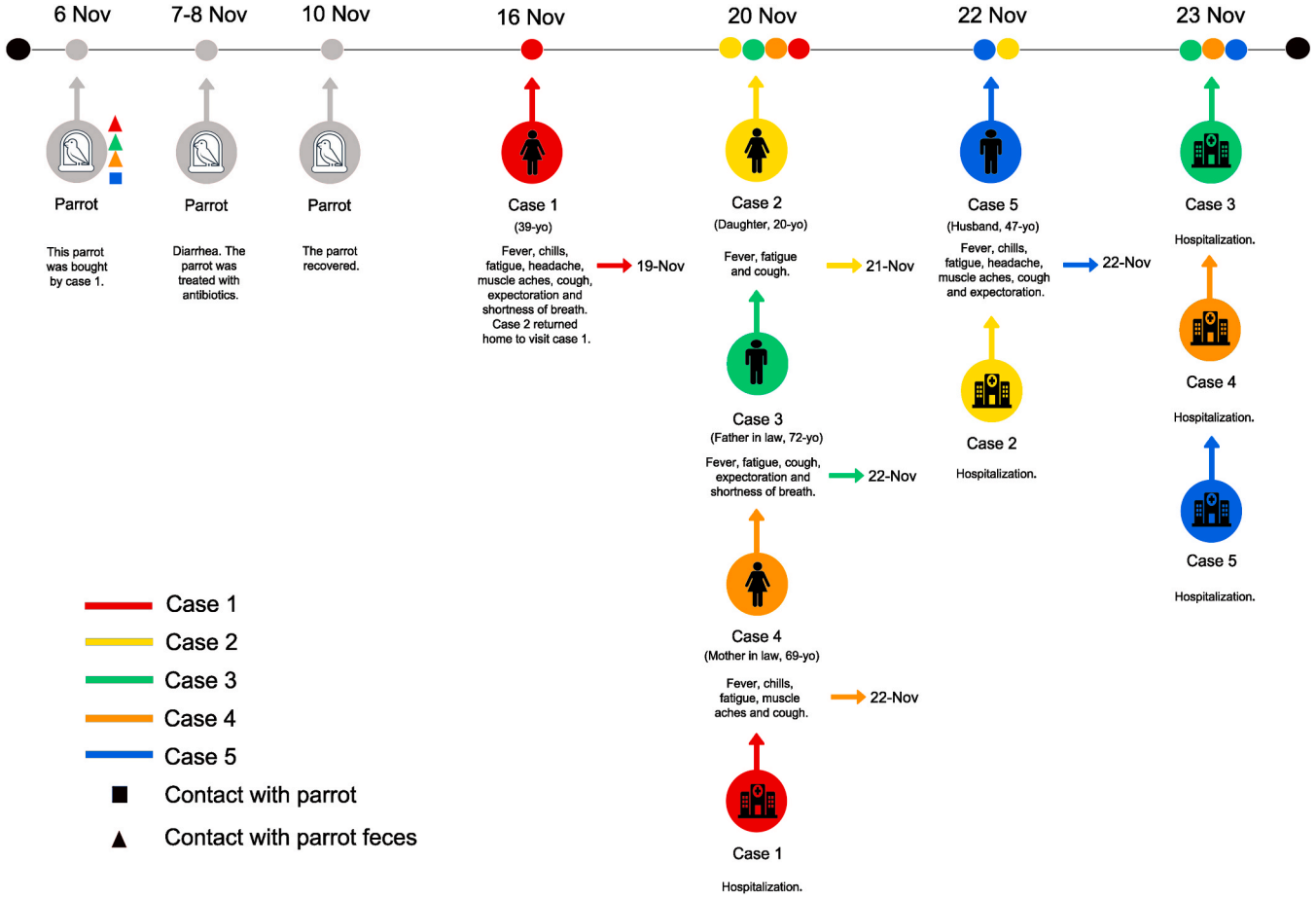

Fig. 1. The timelines for a family cluster of psittacosis.

Table 1
Clinical characteristics of the psittacosis cases.

	Case 1	Case 2	Case 3	Case 4	Case 5	Patients, n (%)	Median value
Sex	Female	Female	Male	Female	Male		
Age (years)	39	20	72	69	47		47
Occupation	Office worker	student	Retired person	Retired person	Civil servant		
Medical history	NO	NO	COPD	NO	Hypertension	2/5(40 %)	
Clinical characteristics							
Fever	Yes	Yes	Yes	Yes	Yes	5/5(100 %)	
Chill	Yes	No	No	Yes	Yes	3/5(60 %)	
Fatigue	Yes	Yes	Yes	Yes	Yes	5/5(100 %)	
Headache	Yes	No	No	No	Yes	2/5(40 %)	
Myalgia	Yes	No	No	Yes	Yes	3/5(60 %)	
Cough	Yes	Yes	Yes	Yes	Yes	5/5(100 %)	
Expectoration	Yes	No	Yes	No	No	2/5(40 %)	
Dyspnea	Yes	No	Yes	No	No	2/5(40 %)	
Diarrhea	No	No	No	No	No	0/5(0 %)	
Laboratory examinations							
WBC (4–10 × 10^9/L)	5.4	9.6	3.8	7.7	7.2		7.2
Neutrophil (1.7–7.7 × 10^9/L)	4.7	7.83	2.09	6.25	5.69		5.69
Percentage of neutrophils (50–80 %)	85.7	81.6	55.3	81.5	79.4		81.5
Lymphocyte (0.8–4.1 × 10^9/L)	0.5	0.79	1.01	0.68	0.72		0.72
CRP (0–5 mg/L)	127	162	22	145	61		127
ESR (0–20 mm/h)	88	43	30	55	24		43
PCT (0–0.094 ng/ml)	0.076	0.51	0.072	0.3	0.072		0.072

CRP: C-reactive protein, ESR: Erythrocyte sedimentation rate.

Table 2
Chest CT manifestations of the psittacosis cases.

Chest CT	Case 1	Case 2	Case 3	Case 4	Case 5
Distribution	Subpleural	Peripheral, subpleural	Subpleural	Subpleural	Peripheral, subpleural
Consolidation	Yes	Yes	Yes	Yes	Yes
Air-filled bronchial shadows	Yes	Yes	Yes	Yes	Yes
Bilateral lesions	Yes	No	No	No	No
Single lung involved	No	Yes	Yes	Yes	Yes
Lymphadenopathy	No	No	Yes	Yes	No
Emphysema, bullae	No	No	Yes	No	No

excretions, and perform strict hand hygiene after contact them. When birds are found to have suspicious symptoms, including lack of energy, loss of appetite, loose feathers, diarrhea, etc, they should be isolated in time and treated scientifically. Psittacosis in humans may include fever, malaise, cough myalgia, headache and chills. When patients have similar symptoms, they should go to the hospital for treatment in time, and conduct epidemiological investigation to find the sources of infection [14].

Although studies have confirmed the existence of human-to-human transmission of *Chlamydophila* [15], the direct contacts of the five patients in this article in social activities did not have clinical symptoms similar to atypical pneumonia. However, close contact between family members is more frequent in daily family life, and the risk of cross-infection is likely to be higher. In this study, case 2 went home to visit and take care of Case 1 with pneumonia symptoms, and at this time the pet parrot had recovered from diarrhea, so it is considered that case 2's infection with *Chlamydophila* may also be caused by close contact with Case 1.

The lesions of psittacosis can be distributed unilaterally or in multiple lobes of both lungs. Some follow-up observation studies of cases have reported that the origin of the lesions is mostly unilateral lobe. Because the initial diagnosis is unclear or treatment is not timely, it can rapidly progress to the distribution of multiple lobes in both lungs. The most common sign on chest CT shows consolidations with bronchograms. Sometimes CT scan also shows bilateral nodular, miliary or interstitial changes. Consolidation or ground-glass opacities along with the subpleural distribution and thickened bronchial vascular opacities could be detected on CT scan. The main manifestations of CT in this study were peripheral and subpleural consolidation of the lung, with air bronchus sign inside [16,17]. Bacterial CAP mainly involves the lung parenchyma, and it is easy to form large areas of consolidation along the lobe segment, which is similar to the CT appearance of psittacosis. Mycoplasma pneumonia often causes thickening of the bronchial wall with tree buds and a "tree fog" sign, whereas psittacosis rarely has tree buds and is rarely distributed along the distal bronchial contour.

In our study, the percentage of neutrophils in the peripheral blood of three patients was increased, but the neutrophil count was normal. In addition, the lymphocyte count decreased significantly for psittacosis pneumonia, which was different from the increase in the percentage of neutrophils in bacterial pneumonia.

In order to prevent relapse, the recommended treatment course for psittacosis is 10–14 days. *Chlamydophila* lacks cell wall and is insensitive to β-lactam antibiotics. The recommended first-line drugs for psittacosis are tetracyclines, including minocycline, tigecycline, etc [18]. Most patients can have normal body temperature after 48 h of treatment. Other treatments include macrolides and quinolones, with macrolides being the first choice for pregnant women or children under 8 years of age [19]. Quinolones have a broad antibacterial spectrum and are commonly used drugs for CAP. It has been reported that patients with psittacosis have achieved good results after being treated with

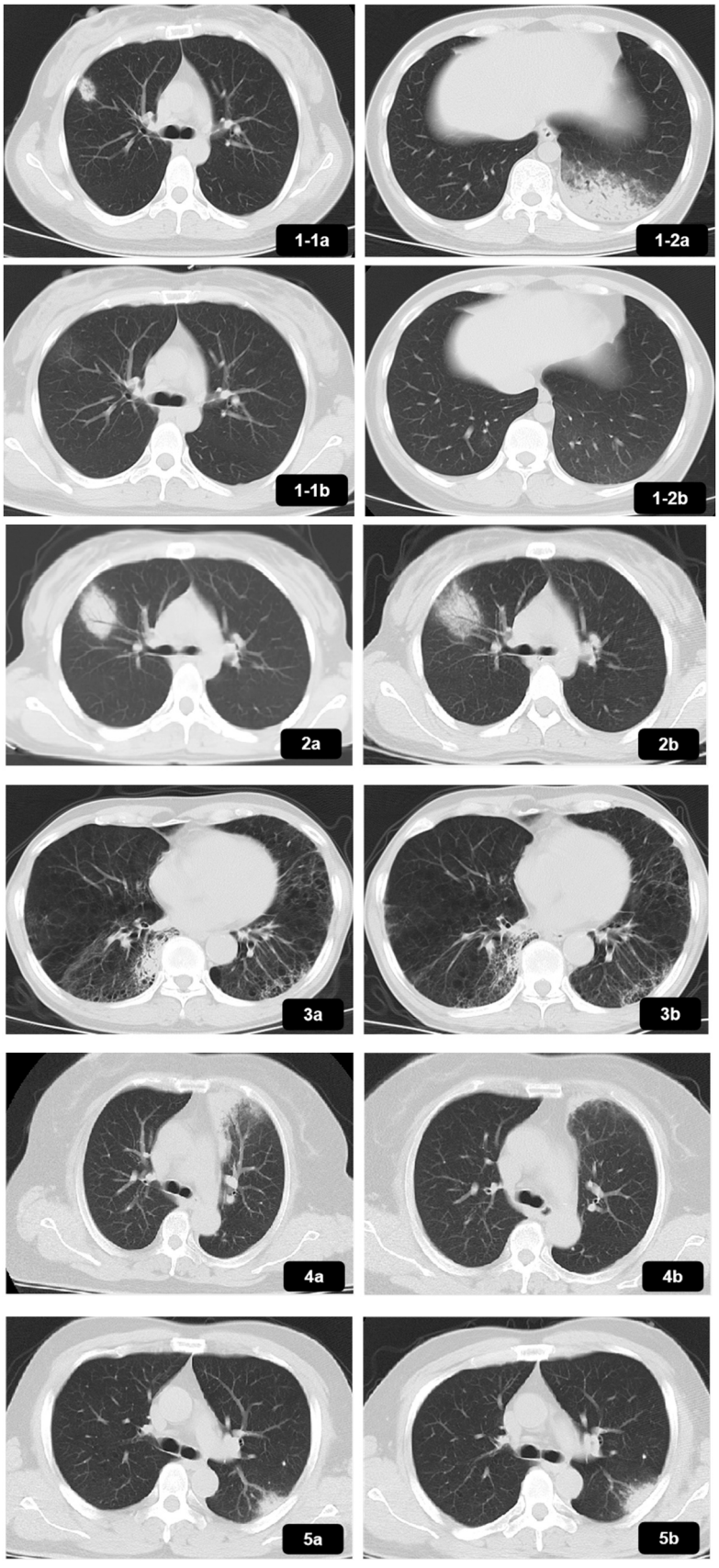

Fig. 2. Serial chest CT scans of the 39-year-old female with psittacosis pneumonia (Case 1). The initial CT scan (4 days after the onset) shows consolidations with bronchograms in the right upper lobe (1–1a) and left lower lobe (1–2a). The follow-up CT scan (10 days after the onset) shows the area of consolidation in the right upper lobe (1–1b) and the left have both disappeared (1–2b). Serial chest CT scans of the 20-year-old female with psittacosis pneumonia (Case 2). The initial CT scan (1 days after the onset) shows consolidations with bronchograms in the right upper lobe (2a), The follow-up CT scan (10 days after the onset) shows the area of consolidation in the right upper lobe has decreased (2b). Serial chest CT scans of the 72-year-old male with psittacosis pneumonia (Case 3). The initial CT scan (3 days after the onset) shows patchy hyperdense shadows in the right lower lobe (3a). The followup CT scan (10 days after the onset) shows the area of patchy hyperdense shadows in the right lower lobe has decreased obviously (3b). Serial chest CT scans of the 69-year-old female with psittacosis pneumonia (Case 4). The initial CT scan (3 days after the onset) shows infiltrates and consolidations with bronchograms in the left upper lobe (4a), The follow-up CT scan (10 days after the onset) shows the area of infiltrates and consolidations in the left upper lobe has partially absorbed (4b). Serial chest CT scans of the 47-year-old male with psittacosis pneumonia (case 5). The initial CT scan (1 days after the onset) shows high-density opacity with blurred margins in the left lower lobe and left pleural thickening (5a). The follow-up CT scan (10 days after the onset) shows the consolidations in the left lower lobe only changed a little (5b).

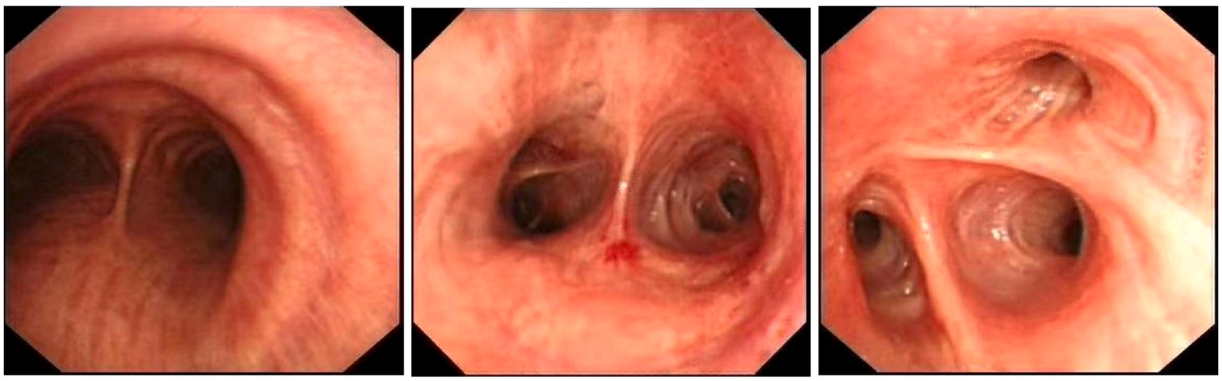

Fig. 3. Bronchoscope imagings of Case 1.

quinolones, but they have poor efficacy in severe patients [20], and need to be combined with tetracycline antibiotics. In this study, among the five patients, moxifloxacin was used in four cases, and azithromycin was used in one case, all of which were effective. However, most of the previous studies on the efficacy of drugs on *Chlamydophila* were case reports, and there is no prospective case-control study on selection and use of antibiotics for psittacosis.

The case expands the understanding of clustering infection of psittacosis and highlighted the importance of early identification of the source of infection.

Ethical statement

This article has been approved by ethics committee

CRediT authorship contribution statement

Conceptualization, Jing Cao; Methodology, Jing Cao; Formal analysis, Jing Cao and Shuangshuang Li; Investigation, Jing Cao and Yan Lei; Data curation, Jing Cao; Yan Lei; Shuangshuang Li and Xuan Song; Writing – original draft, Jing Cao and XiaoYan Xie; Writing – review & editing, Jing Cao and Yingfeng Lei; Supervision, Binghua Zhang; Project administration, Binghua Zhang; All authors have read and agreed to the published version of the manuscript.

Funding statement

This work was supported by the 2021 Annual Discipline Boost Plan of the First Affiliated Hospital of Air Force Military Medical University [Grant no. XJZT21CM48].

Conflict of interest statement

The authors declare that there are no conflicts of interest.

Acknowledgement

The authors thank all the patients for giving consent to use their data for research purposes, and specifically, for publication of this report.

Consent

All patients provided written consent for use of their data for research purposes, and specifically, for publication of this manuscript.

Author Agreement

We the undersigned declare that this manuscript entitled “Epidemiological and clinical characteristics of a family cluster of psittacosis” is original, has not been published before and is not currently being considered for publication elsewhere.

We confirm that the manuscript has been read and approved by all named authors and that there are no other persons who satisfied the criteria for authorship but are not listed. We further confirm that the order of authors listed in the manuscript has been approved by all of us.

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