Introduction
Psittacosis is a zoonotic disease caused by *Chlamydia psittaci*, an obligate intracellular pathogen belonging to the family Chlamydiaceae. Since its first description in 1879, zoonotic and enzoonotic outbreaks have been reported worldwide.\(^1\) Transmission occurs through direct contact or inhalation of aerosols from dried faeces, feather dust, or respiratory secretions of infected birds. Individuals with occupational or recreational exposure to birds like bird fanciers and veterinarians are at greatest risk of infection. Person-to-person transmission is rare.\(^2\) The disease can range from subclinical infection to fatal pneumonia. Here, we report three cases of atypical pneumonia caused by *C. psittaci* in Hong Kong.

Case reports
Case 1
A 62-year-old retired male presented in March 2014 with fever, headache, myalgia, cough, and yellowish sputum for 6 days. He had underlying diabetes mellitus, hypertension, gout, and renal impairment. He visited the local bird market frequently and had purchased two parrots before onset of symptoms. The parrots were well all along. On presentation, he was alert and stable and his temperature was 38.4°C. The oxygen saturation was 96% on room air. Chest examination revealed left lower zone crepitations. Chest radiograph showed left lower zone consolidation. He was suspected of psittacosis and was treated with ceftriaxone and doxycycline. His sputum was positive for *C. psittaci* by polymerase chain reaction (PCR). Nasopharyngeal swab and sputum were also positive for influenza A virus subtype H3 by PCR. Oseltamivir was commenced. He was afebrile the next day and was discharged after 5 days of hospitalisation. Paired serum collected 12 days apart showed rising *Chlamydia* group titre from 40 to 80 by complement fixation test (CFT). The parrots could no longer be traced as the patient’s son released them.

Case 2
A 55-year-old male construction site worker with hypertension was admitted in February 2014 with a 1-week history of fever, headache, generalised bone pain, and cough. He had travelled to Shanwei in China and bought a live chicken from a wet market 2 weeks earlier. On examination, his vital signs were stable and had a temperature of 40°C. The oxygen saturation was 98% on room air. Chest examination was normal. Chest radiograph showed right upper zone opacities. He was treated as a case of community-acquired pneumonia with amoxicillin-clavulanate, doxycycline, and oseltamivir. Sputum culture showed growth of commensals only. Nasopharyngeal aspirate (NPA) was negative for influenza viruses, *Mycoplasma pneumoniae*, and *Chlamydophila pneumoniae* by PCR. Oseltamivir was stopped. His fever subsided on day 3 and he was discharged after 4 days of hospitalisation. Complement fixation test of paired sera collected 12 days apart showed rising *Chlamydia* group titre from 40 to 80 by complement fixation test (CFT). The parrots could no longer be traced as the patient’s son released them.

Case 3
A 42-year-old female chef was hospitalised in February 2014 with fever, cough, yellowish and
Atypical pneumonia due to psittacosis

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周嘉宜、曹育強、梁華盛、馮秀珍

鸚鵡熱是一種由鸚鵡熱衣原體引起的疾病。本文報告三宗由鸚鵡熱引致的不同嚴重程度的非典型肺炎病例。全部個案曾接觸禽鳥，病人的呼吸道標本經分子化驗後，均證實含有鸚鵡熱衣原體。患者接受鹽酸多西環素治療後經已康復。若能提高警覺，可儘早診斷鸚鵡熱及改善治療效果。

血痰，呼吸困難1周。她沒有基礎疾病。1周前，她曾到中國肇慶旅行，並從當地的街市購買活鵝和鴨。入院時，她在呼吸困難，體溫39.2°C。氧合百分比90%於100%補氧。胸部檢查顯示右側粗細濕音。胸部X光片顯示右中、下區的浸潤性病變，左側浸潤性病變（見圖）。同日，她被轉送到深切治療部。她需要機械通風和體外膜肺氧合（ECMO）。她被視為嚴重的社區性感染，接受哌拉西林-他唑巴坦、多西環素和奧司他韋治療。痰液培養僅見常見菌。痰液、鼻咽拭子及支氣管吸痰均為陰性。血液樣本陰性。她逐漸恢復，於插管後3日撤除呼吸機，ECMO於第7日停止。她於入院後24日出院。第3日的血清學檢查顯示Chlamydia group titre由80增加到640. Chlamydia psittaci的聚合酶链反應為陽性。

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The laboratory profiles of the three cases on admission are summarised in the Table.

Discussion

Psittacosis is an uncommon disease in Hong Kong. Since 2008, this has been made as a statutory notifiable disease. There were 11 confirmed cases and six probable cases reported until 2013. In 2012, there was an outbreak involving six staff working at the New Territories North Animal Management Centre in Sheung Shui.

*Chlamydophila psittaci* is classified into nine genotypes (A to F, E/B, M56, WC) based on outer membrane protein A gene sequences, with differential host preference and virulence among the genotypes. It has been described in at least 460 bird species from 30 orders. Birds can shed the organisms when apparently healthy or overtly ill. Patient 1 had been exposed to asymptomatic parrots, belonging to the classic culprits, the psittacine birds (parrots, parakeets, budgerigars, cockatiels). Other domestic species—for examples, turkey, pigeon, goose, duck, chicken—can be affected and are often overlooked as potential reservoirs of infection. In patients 2 and 3, psittacosis was not suspected initially although the patients had been exposed to poultry in China. *Chlamydophila psittaci* is an emerging pathogen among chicken. In China, the prevalence of infection among market-sold chickens, ducks, and pigeons has been reported to be 13.32%, 38.92% and 31.09%, respectively. The substantial zoonotic transmission risk from domestic species should also be recognised.

Psittacosis is a systemic illness that affects several organ systems, and atypical pneumonia as in our cases is the most common manifestation. Patients typically present with influenza-like symptoms, which include high fever, headache, myalgia, and dry cough. Patient 3 complained of blood-stained sputum, which may occur occasionally. The headaches can be so severe as to suggest menigitis on presentation. Diarrhoea is common and can be the chief presenting complaint. Relative bradycardia,
Horder’s spots, and splenomegaly are characteristic physical signs. There may be disparity between the auscultatory findings and radiographic changes of pneumonia. Segmental consolidation in lower lobe is the most common radiographic abnormality although normal chest radiograph has been reported in over 20% of cases. Hilar lymphadenopathy and pleural effusion are rare. The white cell count is usually normal or slightly raised, with mildly abnormal liver function. Our case presentations were consistent with psittacosis. However, it is indistinguishable clinically from other causes of atypical pneumonia like C pneumoniae. The severity ranged from mild-to-severe pneumonia requiring intensive care management and ECMO in our cases. Patient 1 had mild illness although co-infected with influenza A. This diversity of presentation is in agreement with other case series. The mortality rate can be approximately 15% to 20% without appropriate treatment but if properly treated, it is rarely fatal. Extrapulmonary complications such as endocarditis, myocarditis, renal disease, hepatitis, keratoconjunctivitis, arthritis, and encephalitis have also been described.

Chlamydophila psittaci is not covered during routine bacterial or viral workup. Definitive diagnosis can only be established by culture, serology, or PCR specifically targeting on C psittaci. Culture is time-consuming and requires level-3 biosafety facilities. Common serological assays include CFT, enzyme-linked immunosorbent assay, and microimmunofluorescence (MIF) test. The assays are neither sensitive nor specific but MIF test is regarded as more specific. However, there are still considerable cross-reactions between different species of the Chlamydiaceae family. Besides, a convalescent serum obtained at least 2 weeks apart is required to demonstrate the 4-fold rise in titre. In patient 1, the elevation in CFT titre was not significant and therefore diagnosis may be missed if relying on serology alone. Early use of doxycycline in this patient might have blunted the antibody response. In patients 2 and 3, serology results were available only retrospectively; PCR for C psittaci was performed subsequently to confirm the diagnosis. In our cases, a nested PCR based on 16S rRNA gene was used. The first-step PCR is genus-specific, followed by the second-step PCR that can detect C psittaci specifically. This method was demonstrated to be sensitive and specific for detection of C psittaci. When encountering respiratory illness with suspicion of psittacosis, PCR testing on respiratory specimens can offer a rapid and specific diagnosis.

Tetracyclines, in particular doxycycline, are considered to be the treatment of choice. In patients presenting with community-acquired pneumonia, addition of doxycycline to a beta-lactam–based empirical regimen can provide coverage for both psittacosis and other atypical pathogens. Defervescence usually takes place within 48 hours of treatment. Our patients showed significant improvement by day 3 of doxycycline treatment. The commonly recommended duration of treatment is at least 10 to 21 days to prevent relapse. Macrolides can be used as alternative therapy, but may be less efficacious in severe cases and gestational psittacosis. Although quinolones have in-vitro activity against C psittaci, their clinical effectiveness remains to be determined.

### Conclusion
Psittacosis often goes unrecognised because of the lack of distinctive symptoms and clinical suspicion. In patients with atypical pneumonia, a history of exposure to birds gives a very valuable diagnostic clue. Early diagnosis with PCR testing and timely initiation of appropriate antibiotics can reduce patient morbidity and mortality.

### Acknowledgement
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References