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Original Research

Epidemiological and clinical characteristics of the outbreak of 2009 pandemic influenza A (H1N1) at a middle school in Luoyang, China

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SUMMARY

Objectives: To describe the epidemiological and clinical characteristics of 2009 H1N1 influenza, particularly the incubation period and the duration of symptoms, and to assess the public health response to this outbreak.

Study design: A retrospective cohort study was conducted among all students and employees in a middle school by telephone survey and laboratory inspection.

Methods: Nasopharyngeal specimens were collected and tested, and real-time reverse transcriptase polymerase chain reaction testing was performed to confirm the viral infection. The epidemiological and clinical characteristics were obtained through a telephone survey, and the incubation period and the duration of symptoms associated with 2009 H1N1 influenza were estimated by parametric distribution.

Results: In total, 253 cases of influenza-like illness were found among students and employees, and 79 of these cases were confirmed as H1N1 infection through laboratory inspection. The response rate for the telephone survey was 93.48% for the students (2586/2768) and 85.87% for the employees (158/184). The average attack rate was 9.22% (253/2744). The main reported symptoms were fever (100%), cough (74.68%), sore throat (59.49%), headache (56.96%) and myalgia/arthralgia (51.90%). No complications were reported and no deaths occurred. The confirmed and suspected cases had no associated travel history or contact with a confirmed or probable case. The estimated median incubation period was 1.6 days [95% confidence interval (CI) 1.2–2.3]. The duration of symptoms was 3–11 days, and the median duration of symptoms was 7.5 days (95% CI 4.5–10.5).

Conclusions: The results suggest that the outbreak of 2009 H1N1 influenza in this middle school was widespread but not severe. The natural history of 2009 H1N1 influenza virus appears to be similar to that of previously circulating pandemic and interpandemic influenza viruses. The public health response indicates that school closure could have a substantial impact on the spread of 2009 H1N1 influenza.

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Introduction

In April 2009, human cases of infection with 2009 pandemic influenza A (2009 H1N1 influenza) virus were first identified in Mexico and the USA,[1–3] and the virus then spread rapidly to other parts of the world.[4,5] The first case of 2009 H1N1 virus infection in China was documented on 10 May 2009. Following this initial report, the number of confirmed cases rose steadily for several months.[6] One of the earliest and largest clusters of H1N1 infection identified in China was an acute outbreak at a middle school in Luoyang, a city in Henan province. This outbreak prompted an immediate and rapid investigation by Henan Provincial Center for Disease Control and Prevention (CDC) and Zhengzhou University.

In August 2009, a confirmed outbreak of H1N1 influenza occurred at a middle school in China. On 23 August, some students and employees in this middle school reported fever and other respiratory symptoms. On 27 August, the local CDC and health authority requested nasopharyngeal specimens for viral testing from these students and employees. Following the identification of positive cases, the local health authority declared the outbreak of H1N1 influenza in this middle school on 29 August. Up to 5 September, a total of 253 cases of influenza-like illness were reported in this middle school, 79 of which were confirmed to be H1N1 infection through laboratory inspection. An investigation was conducted to describe the outbreak and to identify the natural history of the virus. The purpose of this paper is to describe the epidemiological and clinical characteristics of 2009 H1N1 infection, and to assess the public health response to this outbreak.

Methods

Case definition

A retrospective cohort study was conducted among all students and employees of the middle school when the first case was reported. The following definitions of suspected case and confirmed case were used, in accordance with the World Health Organization (WHO) guidance on global surveillance of 2009 H1N1 virus infection in humans[7]:

- a suspected case was defined as an influenza-like illness (temperature $\geq$38 °C and at least one of the following symptoms: sore throat, cough, rhinorrhoea or nasal congestion) and either a history of travel to a country where infection had been reported in the past 7 days or an epidemiological link to a person with confirmed or suspected infection in the past 7 days;
- a confirmed case was defined as a person with a severe case of influenza-like illness and who tested positive for H1N1 virus by real-time reverse transcriptase polymerase chain reaction (RT-PCR) analysis.

Detection of confirmed and suspected cases

From 27 August to 5 September, nasopharyngeal samples were collected from individuals with severe cases of influenza-like illness, and tested for 2009 H1N1 virus at the CDC Public Health Laboratory using RT-PCR assay.[8] As the testing was part of an active public health response, the CDC allocated resources on a priority basis to test individuals who were severely ill; not all of the middle school students and employees were tested due to resource constraints. Severe cases had the following clinical signs and symptoms: persistent high fever, severe cough, purulent sputum, and other severe symptoms beyond 3 days.[9] Other individuals who had an influenza-like illness were visited by a physician, but nasopharyngeal specimens were never tested for these individuals, classifying then as suspected cases.

Investigation of epidemiology

A telephone survey was administered to 2768 students and 184 employees in this school (including the confirmed and suspected cases) from 29 August to 15 September. Information on demographics (sex, age, etc.), potential exposure to H1N1 virus since 15 August (personal or close family, travel history, infected relatives, social gatherings) and medical data for symptomatic cases (fever, cough, sore throat, headache, nasal discharge, etc.) were collected. All information from the telephone survey, as well as tracking data for specimens, was input into a secure database and kept confidential.

Natural history of 2009 H1N1 influenza

Incubation period

The incubation period of 2009 H1N1 influenza (i.e. the time between infection and symptom onset) was estimated by identifying the earliest and latest possible dates of exposure and the onset date of symptoms in confirmed cases.[10] A log–normal distribution was fit to the resulting data with the use of regression techniques for the analysis of time-to-event data.

Duration of symptoms

The duration of symptoms was estimated with the use of information regarding dates of onset and recovery reported by confirmed cases. In the case of individuals who reported that they still had symptoms at the time of the interview, the data were treated as right censored (i.e. censoring when the event had not yet occurred at the time of measurement). Individuals who had recovered but who did not provide a recovery date were categorized as left censored (i.e. censoring when the event had occurred before the time of measurement but the exact time it had occurred was unknown). A non-parametric Kaplan–Meier distribution was fit to the data using techniques for left- and right-censored data.[11,12] A parametric log–logistic distribution was fit to the interval-censored data for comparison.

Statistical analysis

Data collection and analysis were coordinated by the local CDC and school hospitals in Luoyang. Data were reviewed by a trained team of physicians and medical students, and