CONCISE COMMUNICATION

The Cross-Transmission of 2009 Pandemic Influenza A (H1N1) Infections among Healthcare Workers and Inpatients in a Chinese Tertiary Hospital

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We reported 2009 H1N1 influenza infections among healthcare workers (HCWs) and inpatients and the prevention measures instituted in a large Chinese hospital. In total, 171 HCWs and 89 inpatients tested positive for H1N1. Sixteen HCWs had known hospital exposure, among whom only 7 had working-contact exposure. There was no influenza outbreak.

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Following the spread of 2009 pandemic influenza A (H1N1) virus (2009 H1N1), especially outbreaks in schools and hospitals throughout the world, most hospitals were under pressure to prevent nosocomial infections among inpatients and healthcare workers (HCWs). Previous reports[1,2] described influenza infection of HCWs or inpatients in the early pandemic period. However, the real risk to HCWs and inpatients during the entire pandemic remained uncertain. Here we report 2009 H1N1 infections among HCWs and inpatients and the prevention measures adopted in a Chinese tertiary hospital from the beginning to the end of the pandemic.

METHODS

The study hospital is one of the largest hospitals in Beijing. It has 3,400 beds and 8,143 HCWs and accepts about 9,500 inpatients every month. During the entire pandemic, all patients (inpatients and outpatients) and HCWs with influenza-like illness (ILI) were first screened for 2009 H1N1 by the real-time reverse transcriptase polymerase chain reaction, the World Health Organization (WHO)–recommended assay,[3] at the hospital's fever clinic. Laboratory results were available within 6 hours. Individuals with positive diagnoses were either quarantined at home or referred to a special infection hospital from January 2, 2009, to November 12, 2009; then, from November 13, 2009, to April 30, 2010, they were treated in this hospital according to Beijing government policy.[4] The flowchart of screening and admitting policy in the hospital is shown in Figure 1. Meanwhile, the hospital adopted a series of prevention measures, including a strict visitation regime (distributing surgical masks, screening temperatures of visiting relatives), rapid diagnosis, isolation and cohorting, enhanced hand hygiene (supplying more hand sanitizer), suitable personal protective equipment (PPE), and so on. The PPE used for severe cases with a ventilator was called augmented PPE, including the use of N95 respirators, eye protection, closed endotracheal suction system, and negative-air-pressure rooms. The other type of PPE, called the common PPE, was applied for suspected cases or mild confirmed cases, including wearing surgical masks and gowns and quarantine in an isolated ward. When any HCW or inpatient was confirmed positive, a survey with a standard questionnaire was carried out as soon as possible (within 2 days) by in-person interview or over the telephone.

For inpatients, 2009 H1N1 community-acquired infection was defined as ILI symptoms occurring within 2 days of admission, according to Bin Cao's[5] report. Otherwise, the case was considered hospital-acquired infection. For HCWs, the source of 2009 H1N1 was catalogued into three groups: ILI occurring within 7 days after exposure to a confirmed case in the hospital was (1) known hospital exposure, in the community was (2) known community exposure, and otherwise was (3) presumed community exposure. The type of known hospital exposure was further divided into the medical activity that involved working-contact exposure (such as treatment, physical examination) and the daily-life activity that involved living-contact exposure (such as dining in the office, resting in the duty room). The index case was the confirmed case detected without exposure to any confirmed case in the hospital. Secondary cases were the confirmed cases affected by the index case.

RESULTS

From September 9, 2009, to January 10, 2010, a total of 171 HCWs and 89 inpatients were confirmed positive for H1N1. The peak of case detection was approximately from the 42nd week of 2009 to the 51st week of 2009, which was 5 weeks later than the overall peak in Beijing.[4] The 171 confirmed HCWs (2.1%) among the 8,143 HCWs, distributed in 89 departments, included 102 nurses (59.6%), 30 physicians (17.5%), 15 technicians or pharmacists (8.8%), and 24 others (9.4%). There were 48 males and 123 females, with an average age of 25.2 ± 0.5 years (range, 17–58). The survey showed that 16 (9.4%) HCWs had known hospital exposure, 48 (28.1%) had known community exposure, and the other 107 (62.6%) had presumed community exposure. All confirmed HCWs were mild cases and were asked to undergo self-isolation at home for 1 week, and all recovered quickly. There were 89 confirmed inpatients (0.3%) among the 32,481 inpatients, distributed in 54 departments. There were 58 males and 31 females, with the average age being 40.1 ± 2.4 years (range, 1–87). Four cases were admitted to the intensive care unit and required the use of a ventilator, and 2 inpatients

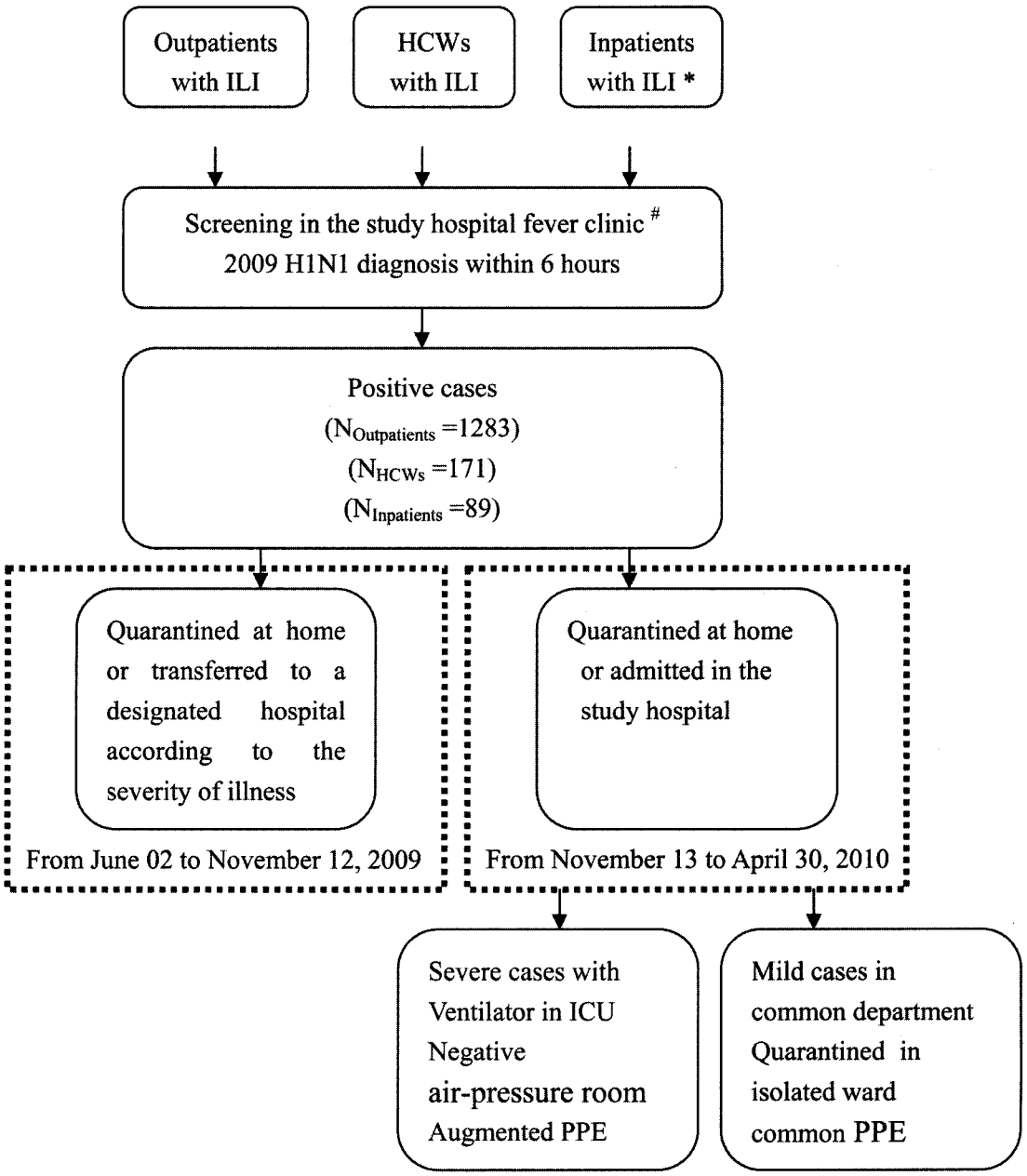

FIGURE 1. Flowchart of screening and admitting policy on 2009 pandemic influenza H1N1 in the study hospital, Beijing, China. HCWs, healthcare workers; ILI, influenza-like illness; 2009 H1N1, 2009 pandemic influenza H1N1 virus; PPE, personal protective equipment; ICU, intensive care unit.

died. The survey showed that 26 (29.2%) inpatients had community-acquired infection, and the other 63 (70.8%) were considered to have hospital-acquired infection.

The study indicated that there were 19 instances of probable hospital cross-transmission among 25 HCWs and 11 inpatients. Sixteen HCWs and 3 inpatients were secondary cases in the hospital, including 12 (63.2%) living-contact exposures and 7 (36.8%) working-contact exposures. The incubation period in the hospital cross-transmission cases varied from 1 to 5 days, with an average time of 1.68 days. The cross-transmission pattern in this hospital is shown in Figure 2.

DISCUSSION

The hospital confirmed that 171 HCWs accounted for approximately 6% of the confirmed 2009 H1N1 cases reported to the local district Center for Disease Control and Prevention

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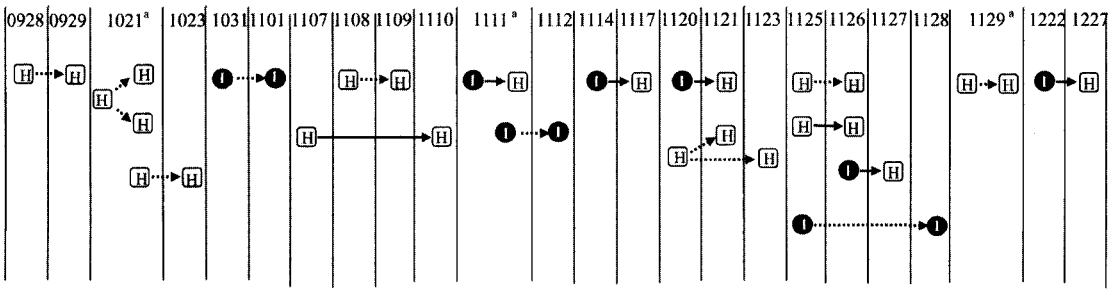

FIGURE 2. Spider diagram showing the probable 2009 pandemic influenza H1N1 transmission between healthcare workers (H) and inpatients (I) with known hospital exposure. Indicated date is the date for case confirmation. A superscript letter a indicates that the confirmation date of index and secondary case occurred on the same day; however, some occurred in the morning and others in the evening. Dotted arrows indicate the probable transmission with known daily-life activity involving living-contact exposure in the hospital (living-contact exposure). There were 12 living-contact exposures, including 3 inpatient-inpatient exposures and 9 healthcare worker–healthcare worker exposures. Solid arrows indicate the probable transmission with known medical activity involving working-contact exposure in the hospital (working-contact exposure). There were 7 working-contact exposures, including 2 healthcare worker–healthcare worker and 5 inpatient–healthcare worker exposures.

(Haidian District, Beijing).[6] The infection rate (2.1%) of HCWs was higher than that of the 18- to 30-year-old Chinese community group (1%–1.5%) reported by Jiang Wu.[7] The reasons may be as follows: The HCWs were exposed both in the hospital and in the community every day; therefore, they faced a higher risk of infection. Second, because of the active surveillance and the ability to laboratory test 2009 H1N1 in the study hospital, HCWs had more access to laboratory diagnosis than did the ordinary person or HCWs in other hospitals.

Many reports indicated that outbreaks occurred in various hospitals among inpatients and HCWs. Apisarnthanarak[8,9] reported that 74% (51/69) of HCWs met the criteria for hospital-acquired H1N1 influenza in a 500-bed tertiary Thailand hospital. Perhaps the unprotected exposure to suspected cases caused the outbreak among HCWs in that hospital. In China, Jian-dong[10] reported a 2009 H1N1-influenza outbreak involving 35 confirmed cases in 1 week among inpatients and HCWs in a pediatric surgery ward. The major reason was the absence of influenza screening both for patients before admission and for confirmed HCWs working in the hospital.

The study hospital, however, adopted effective nosocomial infection prevention measures during the influenza pandemic. Those measures were carried out by the HCWs and supervised by the infection control specialists, which is crucial for decreasing influenza risk for HCWs and inpatients. Those measures may also contribute to decreasing the hospital-acquired infection rate in HCWs (9.4%; 16/171) and to the absence of tertiary cases and outbreak of 2009 H1N1 in our hospital. In fact, it was difficult to estimate the benefit of prevention measures because there was no control group.

Our study has several limitations. First, some asymptomatic HCW infections were lost. Second, the exposure information was collected retrospectively, and it may have caused a recall bias. However, the data reflected the 2009 H1N1 infections among HCWs and inpatients in a tertiary hospital. We hope this information could be useful while planning control measures to prevent influenza nosocomial infections.

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