BRIEF REPORT

Surgical Masks for Protection of Health Care Personnel against Pandemic Novel Swine-Origin Influenza A (H1N1)–2009: Results from an Observational Study

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There is ongoing debate about the efficacy of surgical masks versus N95 respirators for protection against pandemic novel swine-origin influenza A (H1N1)–2009. Our hospital, which is designated to manage outbreaks of emerging infection, has robust surveillance systems to detect infection in staff. The incidence of pandemic H1N1-2009 remained low in staff with use of surgical masks.

Health care workers (HCWs) are at increased risk of influenza because of contact with patients and work colleagues [1]. In April 2009, the novel swine-origin influenza A (H1N1) virus emerged in the United States [2], triggering alarm about its pandemic potential [3]. Patient-to-HCW transmission of this virus has been reported in a German nurse who had close contact with an undiagnosed patient [4] and in HCWs in the United States [5]. Transmission may have occurred in situations where the use of personal protective equipment was inadequate [5]. Surgical masks have been shown to be not inferior to the N95 respirator in protecting HCWs against seasonal influenza [6]. However, optimal respiratory protection against pandemic H1N1-2009 (pH1N1) remains controversial, and randomized, controlled trials have yet to be done.

Tan Tock Seng Hospital (TTSH) was the designated hospital for management of severe acute respiratory syndrome (SARS) in Singapore in 2003 and is the first hospital activated by the Ministry of Health for outbreaks of emerging infections. On 25 April 2009, the Ministry of Health activated its pandemic response plan, and TTSH became the designated screening center and isolation facility for pH1N1. We describe the incidence of pH1N1 in HCWs who wore surgical masks 25 April–31 August 2009.

Methods. This observational study was approved by the Chairman of the Medical Board, TTSH, Singapore. The initial strategy was that of containment of this new pathogen. From 25 April through 18 June 2009, when local transmission of pH1N1 had not been reported, travelers who returned from affected countries with a respiratory illness were referred to TTSH for pH1N1 screening. Suspected and confirmed pH1N1 patients were admitted to the isolation facility in TTSH, which comprised individual rooms with attached bathrooms. Infection control guidelines closely matched the interim infection control recommendations provided by the Centers for Disease Control and Prevention [7]. Fit-tested high filtration N95 respirators, eye protection, gloves, and gowns were used in high-risk areas, that is, the emergency department and the isolation facility. Although gloves and gowns were changed between patients, the use of N95 respirators was strictly controlled to preserve supplies: masks were not removed between patients but were changed when soiled or at the end of a work shift. To minimize contamination, HCWs were discouraged from touching their masks and advised to use alcohol-based hand rub if they did so.

Contact tracing involved detailed interviews with confirmed pH1N1 patients on their activities from 24 hours before symptom onset to isolation. Contacts were offered chemoprophylaxis and were quarantined to prevent local transmission.

From 19 June 2009, local transmission of pH1N1 was detected. Universal use of surgical masks was implemented in all clinical areas, whereas HCWs in the emergency department and the isolation facility continued use of N95 respirators. HCWs wore surgical masks from the moment they entered a clinical area, even when not in close contact with patients. This served to reduce donning and removal of masks, which might increase contamination. These were simple instructions that could be easily followed by all levels of HCWs.

On 25 June 2009, the national strategy changed from containment to mitigation. Screening criteria for pH1N1 were revised to include only patients with chronic medical conditions or at high risk of complications, for whom antiviral treatment would be given. Only pH1N1 patients requiring hospital care were admitted. Community contact tracing was discontinued.

From 22 July 2009, we revised our guidelines to recommend

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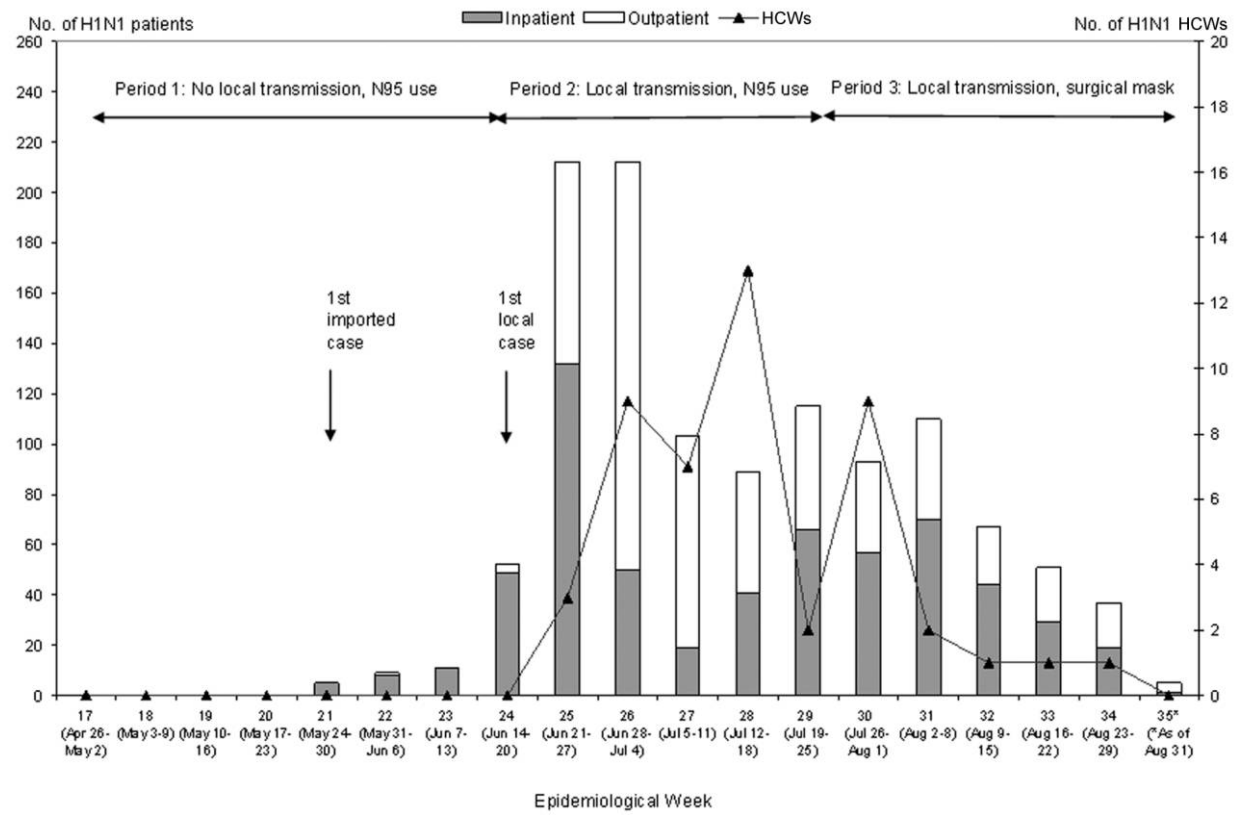

Epidemiological wk	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
% of influenza samples positive for A(H1N1)-2009	0		0	0	0	0	29	47	93	91	96	100	97	93	96	95	94	81

Figure 1. Weekly number of confirmed cases of pandemic novel swine-origin influenza A (H1N1)–2009 among patients and health care workers (HCWs) at Tan Tock Seng Hospital, Singapore, 26 April–31 August 2009.

use of surgical masks for routine care of pH1N1 patients and use of N95 respirators only for aerosolizing procedures [8, 9]. Personal protective equipment guidelines were communicated to HCWs via e-mails and departmental briefings and closely monitored by department chiefs and nursing managers.

After our SARS experience, systems for monitoring clusters of sick staff were established. Sick HCWs entered their temperature readings, symptoms, diagnoses, and days of medical leave into Web-based surveillance systems. The Department of Clinical Epidemiology monitored data from these systems, investigated clusters, and performed contact tracing, together with the Infection Control Unit. During the pH1N1 outbreak, all HCWs, whether well or sick, had to measure and had to log their temperatures at the beginning of each workday.

HCWs who had fever (the threshold for fever was deliberately set very low at $\geq$37.5°C) and acute respiratory illness (ARI) (ie, cough, sore throat, or rhinorrhea) were screened for pH1N1. A gel-based polymerase chain reaction (PCR) assay for influenza A, H1, H3, H5, N1, and N2 was performed on combined nasal and throat swab samples. Each H1N1-positive specimen underwent a probe-based H1N1-2009 PCR assay and was confirmed with partial sequencing of the matrix gene. Contact tracing for HCWs with pH1N1 mirrored community contact tracing.

Results. The first case in Singapore was identified on 26 May 2009, in a student returning from New York [10]. In period 1 (25 April–18 June 2009), when there was no local transmission of pH1N1, a total of 2154 patients with ARI and 58 with confirmed pH1N1 were treated in TTSH. Among HCWs, 573 reported having ARI; none had pH1N1. During this period, influenza A/H3N2 was the predominant influenza strain [11].

In period 2 (19 June–21 July 2009), local transmission of pH1N1 had occurred, and HCWs were using N95 respirators in the emergency department and the isolation facility. Another 5301 patients with ARI and 689 with confirmed pH1N1 were treated at TTSH. During this period, 1065 HCWs reported having ARI.

Our first HCW with pH1N1 was identified on 22 June 2009. A total of 33 HCWs were confirmed during period 2; of these, 6 (18.2%) reported having close contact with someone outside work who had a diagnosis of pH1N1.

None of the HCWs had cared for pH1N1 patients. None were from the isolation facility. Five worked in the emergency department but not in the pH1N1 screening areas. In 2 of the 5 HCWs from the emergency department, transmission likely occurred during a departmental retreat at a country club. Two other HCWs had been infected by a symptomatic roommate who had returned from a pH1N1-affected country. During this time, the circulation of pH1N1 in Singapore had increased rapidly, contributing to 100% of all positive influenza specimens by the end of period 2 [11].

In period 3 (22 July–31 August 2009), when there was continued local transmission of pH1N1 and when HCWs in the emergency department and the isolation facility were using surgical masks, 2694 ARI patients and 424 pH1N1 patients were treated in TTSH. There were 955 HCWs with ARI, and 15 were confirmed with pH1N1 (Figure 1); none had been in contact with pH1N1 patients.

On 27 July 2009, our surveillance systems identified a cluster of ARI among HCWs working in an orthopedic ward. Epidemiological investigation and active case finding revealed 12 HCWs with ARI (clinical attack rate, 23.5%) and with symptom onset ranging 24–27 July. Six of these HCWs were confirmed with pH1N1, and 4 were negative for all subtypes of influenza. The remaining 2 HCWs were not tested, because they were already asymptomatic at the time of investigations. All were nurses except for a health care attendant who had not come into contact with any of the nurses. No patient with pH1N1 had been admitted to this ward. Staff interviews revealed that only 2 HCWs had had close contact with each other without masks, during dinner breaks in the staff room. It was likely that the other HCWs had acquired infection outside TTSH, because pH1N1 was widespread in the community then.

Importantly, there were fewer staff with ARI and pH1N1 in period 3 than in period 2 (period 2: staff with ARI, 1065, and staff with pH1N1, 33; and period 3: staff with ARI, 955, and staff with pH1N1, 15), although we had switched to use of surgical masks for protection against pH1N1. There had been no change in staff strength in the hospital.

Throughout the study period, there were a total of 12 incidents in which pH1N1 patients were not admitted to isolation rooms. Initially, they were not suspected to have pH1N1 but subsequently, they were confirmed to have the virus. The nonisolation period ranged 5–75 hours. In these situations, HCWs wore surgical masks when caring for these patients. Our surveillance systems did not identify any infections among staff that resulted from these exposures.

Discussion. Although this is an observational study, nonetheless our findings show that surgical masks and N95 respirators do not appear to differ in efficacy in the prevention of the acquisition of pH1N1 by staff. Our findings also highlight the importance of a robust HCW surveillance system for the detection of nosocomial transmission of pathogens, including novel pathogens.

A limitation of our study was the absence of data on adherence to guidelines for personal protective equipment during the various periods. However, on the basis of our SARS experience, in which adherence to infection control practices and guidelines for personal protective equipment ensured no staff acquisition of SARS, we are confident of similar adherence among our HCWs. Hand hygiene audits revealed similar compliance rates throughout the 3 periods. Another limitation was the lack of serological data for exposed staff. However, with our extremely sensitive surveillance systems and deliberately low threshold for identifying HCWs with ARI, we are confident that we would have detected any pH1N1 that existed in our staff, because the majority of cases are symptomatic [2].

Conclusion. Our surveillance systems were effective in detecting infection among HCWs. None of the HCWs who cared for pH1N1 patients acquired infection from them. Those HCWs who did acquire pH1N1 appeared to have been infected from community exposure or in social settings with colleagues. The incidence of pH1N1 remained low in exposed staff, even when staff used surgical masks.

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