An Outbreak of Severe Acute Respiratory Syndrome among Hospital Workers in a Community Hospital in Hong Kong

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Background: During outbreaks, hospital workers are at high risk for nosocomial infection with severe acute respiratory syndrome (SARS)-associated coronavirus.

Objective: To examine how hospital workers became infected and whether they transmit the virus to their families.

Design: Retrospective descriptive study.

Setting: 529-bed community hospital in Hong Kong.

Patients: 40 hospital workers infected with SARS-associated coronavirus over a 6-week period (25 March through 5 May 2003).

Measurements: Percentage of infected hospital workers according to job category.

Results: The cumulative incidence was highest among health care assistants, followed by physicians and nurses (8%, 5%, and 4%, respectively). Most hospital workers were infected from direct contact with patients with SARS, who primarily were in general wards and had unsuspected infection. At the time of contact, all hospital workers had used masks but not necessarily other protective devices. Affected hospital workers did not infect their families.

Conclusion: Before isolation of all patients with clinically confirmed or suspected SARS, routine use of several protective devices, and training of staff in infection control, many health care workers were infected with SARS from patients with unsuspected cases.

METHODS

This retrospective study was conducted among all workers at a 529-bed community hospital who developed SARS. This hospital served the Tai Po District in the New Territories. The hospital staff consisted of 1312 persons: 138 physicians, 500 nurses, 144 allied health workers, 126 health care assistants, 131 administrative and clerical workers, and 273 support staff (for example, catering staff and guards). In addition, 93 full-time and 65 part-time employees of a private company were contracted for cleaning the hospital. During the epidemic, the hospital admitted patients directly from the emergency department and from other hospitals of the same regional cluster.

RESULTS

The crude attack rates in hospital workers for each of the successive 6 weeks from 25 March were 6.1, 10.2, 8.8, 2.0, 0, and 0/1000 persons. No infected hospital worker was reported after the week of 22 April. Table 1 shows the cumulative incidence of infection over 6 weeks by job category. The incidence was highest in health care assistants (8%), followed by physicians (5%) and nurses (4%).

Characteristics of Affected Hospital Workers

The mean age of affected hospital workers was 36 years; most affected workers were female (Table 2).
workers were positive for IgG antibodies to the SARS-associated coronavirus.

All hospital workers developed SARS from exposure at work. Thirty-two had direct contact with patients with SARS, 2 had contact with coworkers who subsequently developed SARS, and 3 had contact with both patients and coworkers with SARS. Three workers were cleaners who had no direct patient contact but had worked in a pneumonia triage ward. Of the 32 hospital workers infected as a result of contact with patients, 11 were exposed to patients with suspected SARS and 21 were exposed to infected patients in whom SARS was unsuspected.

None of the hospital workers infected their immediate family members or close friends. Many hospital workers isolated themselves by residing at the hospital when they were assigned to the isolation wards. The average time between symptom onset and hospitalization was 2.7 days.

**Location of Infected Hospital Workers and Patients**

The outbreak centered on 4 wards (wards A through D). On 23 March 2003, 2 patients with fever and an infiltrate on chest radiograph were admitted to ward A. Both patients reported no history of contact with persons with SARS or travel to southern China. The patients infected 9 health care workers before being transferred to an infectious disease hospital.

Ward B received a patient with diarrhea and abdominal pain from another hospital in whom SARS outbreak had started in early March. Three days later, he developed fever and an infiltrate on chest radiograph; he was then transferred to ward C. Sixteen affected hospital workers (4 in ward B and 12 in ward C) and 8 patients in ward C were linked to this patient.

When ward A was closed for disinfection, ward D housed the ward A patients who had had contact with patients with suspected SARS. Seven health care workers developed disease while working in ward D between 7 April and 13 April.

Eight hospital workers were exposed to patients with SARS in other parts of the hospital, but none was infected as a result of working in SARS isolation wards.

**Infection-Control Measures**

At the end of March, hospital areas were classified according to risk for exposure to patients with SARS. Ultra-high-risk areas (isolation rooms in medical wards and the intensive care unit) were provided with N95 masks, gowns, gloves, and eye shields. Workers were instructed to dispose of these materials after one-time use. High-risk areas (medical and pediatric wards) were given the same materials, with instructions to use them for 1 work-shift and then dispose of them. Thus, protective devices were reused at least once in high-risk areas. In low-risk areas (the rest of the hospital), workers were given only surgical masks. All hospital workers, regardless of job title, were given the same protective materials according to where they worked.

At the time of SARS contact, all infected workers had used surgical or N95 masks. Some had used gowns (55%) and gloves (58%). Only 28% of infected workers had used eye shields (available on 7 April) because of limited supply, and 73% regularly washed their hands (Table 2). Protective device did not differ between job categories.

All hospital workers were trained in infection-control measures by the beginning of April. Two isolation wards were established for patients with SARS on 14 April. No new infection of hospital staff occurred after 22 April.

**DISCUSSION**

During an outbreak, hospital workers are at high risk for developing SARS from nosocomial infection (1, 8–10). In this outbreak in a community hospital in Hong Kong, most infected staff (35 of 40) were infected from direct patient contact and 2 were infected from contact with coworkers. Only 3 (who were cleaners) had no direct patient contact. The outbreak was contained after isolation of patients with clinically confirmed and suspected SARS; use of several protective devices, frequent hand washing, and training in infection-control measures. Our findings were similar to those reported locally (14) and in Canada (15).

**Table 1. Estimated Cumulative Incidence of Severe Acute Respiratory Distress Syndrome over a 6-Week Period in Health Care Workers by Job Category**

<table>
<thead>
<tr>
<th>Job Category</th>
<th>Health Care Workers</th>
<th>Health Care Workers with SARS</th>
<th>Estimated Cumulative Incidence</th>
<th>Proportion of all SARS Cases in Hospital</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physicians</td>
<td>138</td>
<td>7</td>
<td>5</td>
<td>18</td>
</tr>
<tr>
<td>Nurses</td>
<td>500</td>
<td>19</td>
<td>4</td>
<td>48</td>
</tr>
<tr>
<td>Health care</td>
<td>126</td>
<td>10</td>
<td>8</td>
<td>25</td>
</tr>
<tr>
<td>assistants</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cleaners</td>
<td>158</td>
<td>3</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Clerical staff</td>
<td>131</td>
<td>1</td>
<td>8</td>
<td>2</td>
</tr>
</tbody>
</table>

* SARS = severe acute respiratory syndrome.
Hospital wards in Hong Kong were categorized into ultra-high-risk, high-risk, and low-risk areas according to whether the ward had patients with SARS. The types of protective devices that were dispensed depended on the risk category. The outbreak resulted from staff exposure to patients with unsuspected SARS in low-risk general wards. These findings indicate that during an outbreak, physicians must have a very high index of suspicion for SARS in patients presenting with fever and a lung infiltrate. Unless hospitals use meticulous screening to exclude patients with suspected SARS from admission to general wards, hospital workers should regard every patient area as high-risk and be assiduous in their infection-control measures. Moreover, none of the hospital workers was infected from working in the ultra-high-risk SARS isolation wards, where infection-control measures were strictly enforced.

Health care assistants had the highest crude attack rate of SARS, perhaps because of their close contact with patients. The 3 cleaners, who developed SARS from cleaning an isolation room, had no direct patient contact. They were probably infected as a result of fomite transmission. The SARS-associated coronavirus is primarily transmitted by droplets and by direct contact. In our retrospective study, all infected hospital workers claimed that they had used masks during contact. This conflicts with the findings of Seto and colleagues, who reported a 13-fold increased risk for infection when workers did not use masks, either surgical or N95. In our community hospital, workers were not fit-tested for N95 masks, which were available toward the end of March. The use of surgical masks alone may be inadequate protection.

Hospital workers in this study did not infect any of the patients, and all infections were nosocomial. This is consistent with earlier reports from China and Singapore (15), but the precise role of hospital staff in sustaining the outbreak is unclear. In contrast to SARS in southern China, where the infection source was unknown (15), this outbreak apparently resulted from patients with unsuspected SARS in general wards. The outbreak was strictly limited to a single hospital in Hong Kong, which reinforces the importance of institutional isolation and containment. The experience in Asia underscores the need to develop standard hospital guidelines to prevent nosocomial transmission of this and other emerging infections.
In summary, this retrospective case series suggests that nosocomial SARS among hospital workers is a possible cause of severe acute respiratory syndrome. Lancet. 2003;361:1319-25. [PMID: 12711465]

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References