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BRIEF OBSERVATION

Transmission of Severe Acute Respiratory Syndrome in an Emergency Department

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Severe acute respiratory syndrome (SARS), an infectious disease (1,2) caused by a novel coronavirus (3,4), was first recognized in Singapore in early March 2003 (5). On March 17, the Singapore Ministry of Health designated Tan Tock Seng Hospital, where the initial nosocomial outbreak had occurred, as the national hospital for SARS cases. However, SARS later surfaced in three of the other four large public hospitals (6). We describe the difficulties associated with recognizing the disease and preventing its transmission in an emergency department of a large teaching hospital.

METHODS

More than 80,000 patients per year present to the emergency department of the National University Hospital; these patients are triaged to three treatment areas: critical care and intermediate care, which are located in a common area with curtains separating the gurneys; and ambulatory care, which has examination rooms and an open waiting area. At the hospital entrance, there are prominent signs highlighting the features of SARS, including fever and respiratory symptoms. Since March 17, all patients have to answer a screening questionnaire, and those meeting World Health Organization (WHO) criteria for SARS (7) are transferred immediately to the national SARS hospital by a dedicated ambulance. Screening involves use of thermal scanners, and a national online database is used to check for contact with previous and current SARS patients.

Since March 27, all staff have routinely used personal protective equipment, including N95 respirators and water-impermeable gowns and gloves. Caps, shoe covers, and eye protection gear were introduced during the peak of the epidemic (the second week of April), but are now optional, except for eye protection during high-risk procedures.

The records of 13 patients with a final diagnosis of SARS who were managed in our emergency department from March 18 until April 22, 2003, were reviewed retrospectively. The study was approved by the hospital's Institutional Review Board.

RESULTS

The mean (± SD) age of the 13 patients was 41 ± 20 years (Table); 11 were women and 6 were health care workers. Clinical features included fever, upper respiratory tract symptoms, myalgia, normal leukocyte counts, and lymphopenia. Only 5 patients had an initial diagnosis of possible SARS and were promptly referred to the national SARS hospital. Because of a lack of fever at presentation, patients 6 and 10 were not diagnosed with SARS initially despite positive contact histories. The remaining patients were not recognized as having contact histories because their index cases had not been diagnosed with SARS at the time or because of a strict adherence to the WHO definition of direct contact. Five patients died.

Two patients transmitted SARS while in the emergency department. The first patient (patient 8) was a 63-year-old man who presented with dizziness and dyspnea on April 8. He was afebrile and had atrial fibrillation. A chest radiograph showed bilateral lower-zone opacities. He had spent almost 4 hours before admittance to a general medical (nonisolation) ward for heart failure. It was later discovered that his brother whom he had visited at another hospital was the then-unrecognized index case for a number of infections there. Patient 8 had been cared for in gurney 19 of the intermediate care area (Figure). He was neither placed in isolation nor given a mask because his admitting diagnosis was heart failure. A visitor to the patient in gurney 18 was infected with SARS, with onset of symptoms on April 13. Eight other patients were in the intermediate care area during this period. The patient in gurney 8 developed SARS symptoms on April 14, and the patient in gurney 11, on April 18; no other source could be identified for their infections. The remaining 6 patients had no evidence of SARS on extended follow-up. Patient 8 was also the source of infection for 4 health care workers from the inpatient unit (patients 9, 10, 11, and 13). He was transferred to the national SARS hospital where he died 3 days later.

The second patient (patient 4) who transmitted SARS in the emergency department was a 43-year-old woman who presented with fever, cough, and dyspnea on March 24. A visitor to the ambulatory waiting area, where patient 4 had waited for 2 hours prior to examination, developed SARS 5 days later. Patient 4 was admitted with a diagnosis of community-acquired pneumonia and was not isolated as she had marked leukocytosis and had no close contact (as defined by the WHO criteria) with SARS patients. She had also waited for 2 hours in gurney 8 of the intermediate care area (Figure) before admission; no patients were infected during this time. She was, however, the source of infection for her son and the intensivist who performed a bronchoscopy on her. She died 8 days after admission.

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Table. Characteristics of the 13 Patients on Presentation and Outcomes

Patient No.	Age (years)	Sex	Health Care Worker	Initial Contact History	History of Fever	Cough	Myalgia	Comorbid Conditions	Temperature (°C)	Leukocyte Count ($\times 10^3/\mu L$)	Lymphocyte Count ($/\mu L$)	Chest Radiograph	Emergency Disposition	Outcome
1	27	M	Y	N	Y	N	Y	N	38.4	ND	ND	Normal	Discharged	Died
2	71	F	N	N	Y	N	N	Ischemic heart disease	38.7	4.5	800	Right basal infiltrates	Referred to SARS hospital	Survived
3	43	F	Y	N	Y	Y	Y	N	36.9	2.2	500	Normal	Discharged	Survived
4	43	F	N	N	Y	Y	N	Hypertension	38.9	19.3	900	Bilateral infiltrates	Admitted; isolated	Died
5	20	F	N	Y	Y	Y	Y	N	38.5	3.6	800	Normal	Referred to SARS hospital	Survived
6	78	F	N	Y	N	N	N	Interstitial lung disease	36.3	14.7	1000	Bilateral infiltrates	Admitted; isolated	Died
7	52	F	N	N	Y	Y	N	N	39.6	5.4	500	Bilateral infiltrates	Admitted; isolated	Died
8	63	M	N	N	Y	Y	Y	Ischemic heart disease	35.1	9.3	600	Bilateral infiltrates	Admitted; general ward	Died
9	28	F	Y	Y	Y	N	Y	N	38	ND	ND	Normal	Referred to SARS hospital	Survived
10	21	F	Y	Y	Y	N	N	N	37.8	6.8	900	Normal	Admitted; isolated	Survived
11	28	F	Y	Y	Y	N	N	N	38.3	ND	ND	Normal	Referred to SARS hospital	Survived
12	30	F	N	N	Y	N	N	N	38.2	3.2	500	Right middle lobe infiltrate	Admitted; isolated	Survived
13	24	F	Y	Y	Y	N	N	N	38	4.9	2100	Upper lobe pneumonia	Referred to SARS hospital	Survived
Summary (number or mean ± SD)	40.6 ± 19.7	11 F	6 Y	6 Y	12 Y	5 Y	5 Y	4 Y	37.9 ± 1.2	7.4 ± 5.6	900 ± 500	7 abnormal	5 referred	5 died

F = female; M = male; N = no; ND = not done; SARS = severe acute respiratory syndrome; Y = yes.

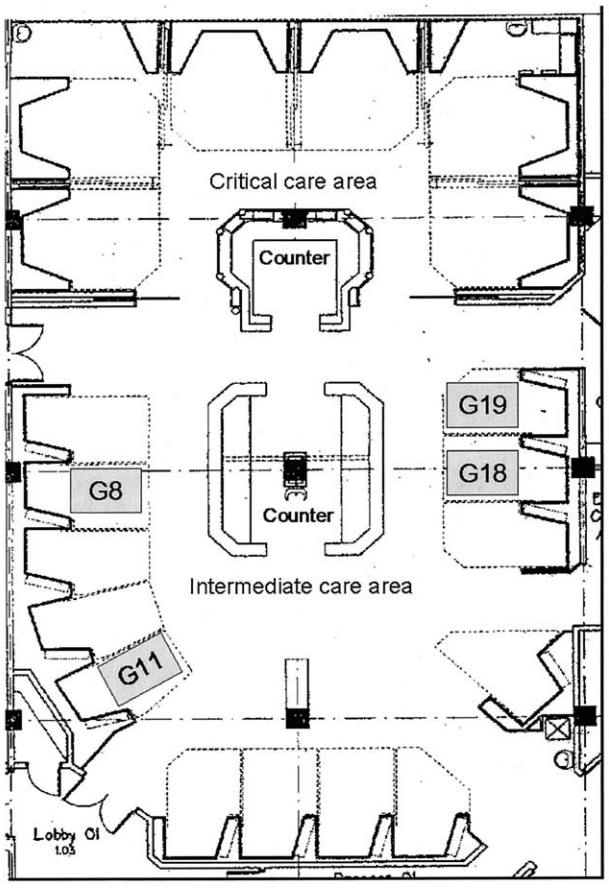

Figure. Layout of the emergency department critical care/intermediate care area. Gurneys 8,11,18, and 19 are marked.

A total of 105 emergency department staff at our hospital have had their temperature monitored, initially three times a day until late August 2003, and now twice daily. Eleven staff members had blood counts and radiographs taken, all for low-grade fevers, and only 1 person was found to have evidence of SARS much later when serologic testing became available. She had a mild febrile illness and there were no changes on five serial chest radiographs.

DISCUSSION

Our case series of 13 SARS patients seen at a general emergency department, with 2 patients causing disease transmission and only 5 recognized immediately as having SARS, illustrates some of the problems associated with the primary care of patients with this emerging infectious disease.

The WHO definition of SARS requires a fever >38°C, respiratory symptoms, and close contact with a person with SARS, defined as having cared for, having lived with, or having had direct contact with respiratory secretions and body fluids of an infected person (7). The transmission of SARS to patients in gurneys 8 and 11 was possibly by fomites or the gloved hands of a health care worker, as these patients had no direct contact with patient 8 (who was in gurney 19). Close contact was only evident in 6 patients, 2 of whom did not have notable fevers and thus were not identified immediately although they were isolated. Hence, during an epidemic, the index of suspicion should be high even without a positive contact history. In an unaffected area, a detailed travel history is likewise critical.

We found that the presentation of SARS was very nonspecific (1,2,8), especially in patients with chronic comorbid conditions (9). Patient 6 may have been afebrile because of chronic steroid therapy. Heart failure and bilateral pneumonia are often difficult to distinguish, as observed with patient 8. Similarly, leukocytosis, which is more characteristic of bacterial pneumonia, is observed occasionally, as in patients 4 and 6. During the peak of the epidemic, all patients with either unexplained fever or respiratory symptoms were isolated for monitoring even if they did not meet criteria for transfer to the national SARS hospital.

We also observed infection of other patients and staff in a crowded emergency department by unrecognized, nonisolated SARS patients, similar to reports in Canada (10,11). While the 5 diagnosed patients were promptly isolated and were not associated with nosocomial transmission, 6 of the remaining unrecognized patients (only 2 of whom were isolated) were not associated with transmission of SARS. Only 2 undiagnosed patients were associated with transmission, which may have been related to the severity of their illness and viral load (3), or to the so-called super-spreader phenomenon (6), wherein the majority of SARS patients do not transmit, but a small minority go on to infect large numbers of persons.

Even though the SARS outbreak is contained, we still use a "fever tent" with a self-contained radiographic unit in front of the ambulatory area, which is divided into a "red" area for febrile patients who have had contact with an infected person or a history of travel to SARS-affected areas and a "green" area for other patients. Staff at the hospital still use full personal protective equipment. Powered air-purifying respirators are still used for all intubations. One emergency department staff member had a mild seroconversion illness, but there were no clinical cases of SARS, confirming the observations of others that infection control can protect staff effectively (12,13). We initially had a no-visitor rule to the emergency department to prevent the spread of SARS to the community. This rule is currently limited to the critical and intermediate care areas; the few visitors to these areas are required to wear disposable gowns, N95 masks, and gloves. We also have an electronic surveillance system for all staff, patients, and visitors for contact tracing.

The Centers for Disease Control and Prevention have issued new guidelines for responding to SARS, which are supported by our experience (14). Emergency departments should design their own protocols for promptly isolating all patients with fever or respiratory tract symptoms during an epidemic. Concerns about a resurgence of SARS have let to continued screening and enhanced infection control precautions in previously affected areas, such as Singapore.

With proper staff protection, effective triage and isolation of patients, and control of visitors, we managed to limit the transmission of SARS in our emergency department. However, the sustained effectiveness of these measures remains to be seen as this emerging pathogen evolves worldwide.

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