

SARS: hospital infection control and admission strategies

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Nosocomial clustering with transmission to health care workers, patients and visitors is a prominent feature of severe acute respiratory syndrome (SARS). Hospital outbreaks of SARS typically occurred within the first week after admission of the very first SARS cases when the disease was not recognized and before isolation measures were implemented. In the majority of nosocomial infections, there was a history of close contact with a SARS patient, and transmission occurred via large droplets, direct contact with infectious material or by contact with fomites contaminated by infectious material. In a few instances, potential airborne transmission was reported in association with endotracheal intubation, nebulised medications and non-invasive positive pressure ventilation of SARS patients. In all SARS-affected countries, nosocomial transmission of the disease was effectively halted by enforcement of routine standard, contact and droplet precautions in all clinical areas and additional airborne precautions in the high-risk areas. In Hong Kong, where there are few private rooms for patient isolation, some hospitals have obtained good outcome by having designated SARS teams and separate wards for patient triage, confirmed SARS cases and step-down of patients in whom SARS had been ruled out. In conclusion, SARS represents one of the new challenges for those who are involved in hospital infection control. As SARS might re-emerge, all hospitals should take advantage of the current SARS-free interval to review their infection control programmes, alert mechanisms, response capability and to repair any identified inadequacies.

Key words: handwashing, infection control, patient isolation, severe acute respiratory syndrome, transmission.

INTRODUCTION

Severe acute respiratory syndrome (SARS) is a newly recognized infectious disease caused by a novel SARS-coronavirus (CoV). The disease initially started in November 2002 in the Guangdong Province of China and subsequently spread to 29 countries. A hallmark of SARS is its predilection for nosocomial transmission, notably to health care workers and to a lesser extent patients and visitors. Of the 8422 persons infected worldwide, 1725 (20%) of them were health care workers.¹ In areas most badly affected by SARS, the proportion of health care worker to all cases was highest in Vietnam (57%), followed by Canada (43%), Singapore (41%), Hong Kong, China (22%), mainland China (19%) and Taiwan, China (13%).¹ In Hong Kong, among 156 persons affected in a major nosocomial

outbreak of SARS, 53 (34%) were patients initially hospitalized for other reasons, and visitors.² Of the 128 identified cases in a nosocomial outbreak in Toronto, 14% were visitors and another 14% were hospital patients.³ In hospital settings, the majority of these transmissions occurred when infection control precautions either had not been adequately instituted or had been instituted but were not meticulously complied with.^{2,4}

HOSPITAL INFECTION CONTROL FOR SARS

Strategies for admission, triage and disposal of patients

There is no doubt that early isolation of patients with probable or suspected SARS is important to prevent nosocomial spread of the disease.⁵ However, a difficulty for front-line clinicians in the months of living with SARS, especially those in Asia, was how to make a clinical diagnosis at the time of patient presentation. At this time, a point-of-care diagnostic tool for

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SARS is still lacking, despite some early optimism on the molecular tests.^{6,7} In the first few days following onset of symptoms, nucleic acid detection by polymerase chain reaction only has a limited sensitivity.⁸ Although it appears that most patients with SARS will mount an antibody response to SARS-CoV, less than half of the patients will have detectable antibody response in the first week of illness. In most patients, the SARS illness begins with a non-specific prodrome of fever, chills, myalgia and cough.⁹ After 3–7 days, the disease evolves into a form of rapidly progressive atypical pneumonia. Unless there is a history of close contact with a person having suspected or probable SARS, it is virtually impossible to be sure whether one is dealing with SARS or an ordinary form of respiratory tract infection.

The strategy for admission and triage of patients with respiratory symptoms at the Queen Mary Hospital during the months of SARS is depicted in Fig. 1. The system was put into effect on 15 March, three days after an outbreak of SARS was found in Hong Kong. As with most public hospitals in this region, there are only a few private rooms for isolation of patients with communicable disease. Hence, one patient floor including five wards was evacuated and designated as triage, SARS and step-down areas. Each of the wards was divided into four or six bays, separated by solid or glass partitions, extending on either side of a central nursing station. A dedicated team of physicians and nurses, led by experienced respiratory and infectious diseases doctors, was established to provide care to all patients admitted to the designated areas.

At the emergency department, all new cases and transfer-ins from other hospitals were systematically evaluated and were admitted to the triage ward when predetermined criteria were met (Table 1). In the triage ward, patients underwent evaluation for SARS, including SARS tests and repeat CXR or computer tomography. All patients with a clinical diagnosis of community-acquired pneumonia were treated with a β -lactam and a macrolide in accordance with recommended guidelines.¹⁰ To minimize the risk of cross transmission in the triage ward, the number of beds in each bay was reduced to allow for a minimum bed-to-bed distance of 2 m. Furthermore, patients were promptly moved to either the SARS ward or the step-down ward as soon as possible for continued care, observation and isolation. Importantly, an active surveillance was implemented in the general wards to identify and promptly isolate any unrecognized cases of SARS. In the emergency department, triage, step-down and SARS areas, stringent infection control measures recommended for SARS were implemented.¹¹ Standard, contact and droplet precautions were enforced in all other clinical areas in the hospital. Where medically feasible, all admitted patients were instructed to wear a surgical mask. From 15 March, 2003 until Hong Kong was declared SARS-free on 23 June 2003, a total of 710 patients were admitted to the triage wards, including 52 cases subsequently confirmed as having probable SARS. Thus, approximately 14 patients were put into isolation for every case of SARS identified. With this approach, there

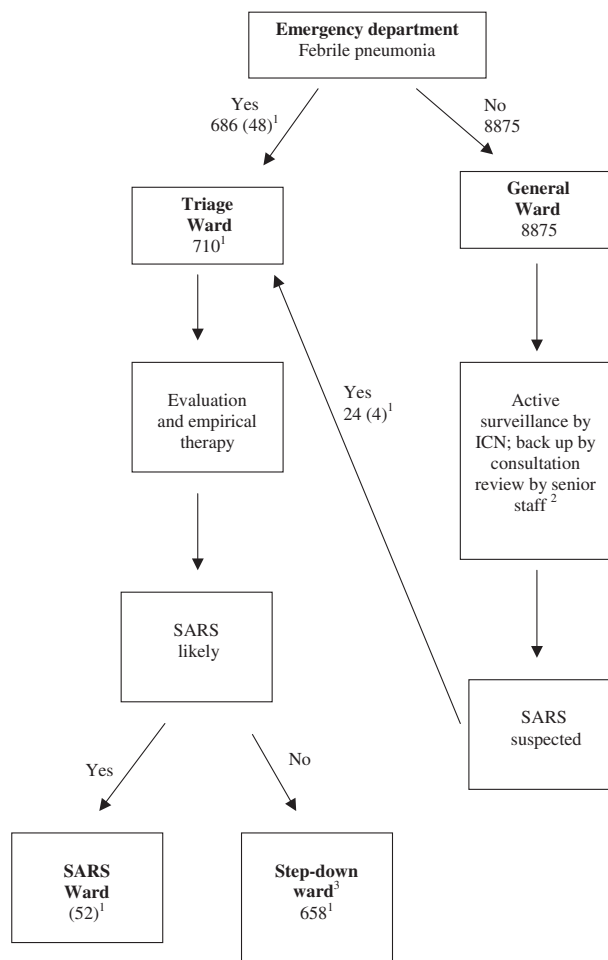


Figure 1 Diagram showing patient flow at the Queen Mary Hospital during the outbreak period of SARS in Hong Kong, March–May 2003. ¹Total number of patients admitted to triage, step-down or SARS wards. Number in brackets refers to number of patients subsequently identified as probable SARS. ²Once a patient was identified as a suspected SARS case, movement of all patients in the same cubicle were frozen (no new admission, no transfers-in and no transfers-out). This group of patients was to be actively monitored for illness (fever and respiratory symptoms \pm CXR), pending SARS clarification in the index patient. If probable SARS was confirmed in the index, active surveillance continued for 10 days.³Patients were kept for a minimum of 3 days in the step-down ward before discharge. To prevent inadvertently sending an elderly person with incubating SARS back to an institute, residents of old age homes were kept in the step-down ward or (after 3 days) in a cohorted area for 10 days before discharge. All patients discharged before the 10-day minimum period of surveillance were monitored daily (by phone calls) for illness (fever and respiratory symptoms).

were no cases of nosocomial transmission to patients hospitalized for other reasons and staff infection was only minimal. Out of 386 infected health care workers in Hong Kong, only two were from the Queen Mary Hospital.

INFECTION CONTROL ISSUES FOR SARS

Mode of transmission

At this time, the transmission of SARS appears to occur predominantly by large droplet, direct contact with infectious material or by contact with fomites contaminated by infectious material.^{3,12} In a study by Seto *et al.* it was shown that practice of droplet and contact precautions is adequate in most clinical settings to significantly reduce the risk of infection after exposures to patients with SARS.⁴ Of 69 staff who reported consistent use of all four measures including mask, gloves, gowns and hand-washing, none were infected, whereas all infected staff had omitted at least one measure.⁴ However, uncertainties continue on whether the disease could be transmitted by the airborne route. In hospital settings, potential airborne transmissions were all reported in association with certain cough-inducing or aerosol-generating procedures. On two occasions, the use of non-invasive positive pressure ventilation and nebulised medications on patients unrecognized as having SARS have been associated with nosocomial outbreaks.^{2,13} In one instance in association with drug nebulization, preliminary investigation indicated that airborne transmission is plausible although alternative explanations have been proposed and are being validated. Concerns have also been raised over possible airborne transmission during cough-inducing procedures. In three instances of patient intubation, transmission to staff occurred when droplet and contact precautions were used.^{3,14}

Table 1 Criteria for admission to triage ward

Two or more of the following
Fever (38 C or history of fever in the recent few days)
Clinical or radiological evidence of consolidation
History of close contact to patient with suspect or probable SARS (i.e. having cared for or lived with or had direct contact with respiratory secretions or other body fluids of a person with SARS)
History of contact with a cluster (≥ 2) of persons with respiratory symptoms or fever

Table 2 Basics in infection control

1. An ongoing surveillance programme for nosocomial infections is important.
2. Most nosocomial infections are related to inappropriate patient-care practices (most important is hand washing).
3. Good environmental hygiene is needed.
4. Ordinary physical cleaning must be first appropriately done before chemical disinfection or sterilization is considered.
5. An effective staff health programme is important for infection control.
6. Isolation precautions should be carefully implemented and used when needed.
7. All clusters of infection must be evaluated and dealt with by the appropriate investigative response.
8. Education and communication for staff compliance to infection control practices is critical.
9. Sufficient full time infection control nurses must be provided in the hospital.
10. The appropriate infrastructure including supervision by an infection control doctor is important.

Back to the basics

One important lesson from SARS concerns the need to enhance infection control programmes in hospitals. In the longer term, planning for SARS should be put into a larger context, to include not only SARS but also other emerging infections such as avian influenza, dengue and the results of bioterrorism. In Asia, the state of development of infection control programmes varies among the countries. In some hospitals, the infrastructure for such programmes is still inadequate. The problem is not simply the lack of resources, as we have seen how countries could respond quickly by mobilizing and deploying means to contain SARS. Rather, it is a lack of awareness of the importance of preventing nosocomial infections and a lack of health care commitment to make such programmes an essential element of quality practice.

The high nosocomial transmission rate of SARS has highlighted the need for us to re-visit a few basic principles in the practice of infection control (Table 2). Surveillance has been defined as the continuing scrutiny of all aspects of the occurrence and spread of disease that are pertinent to effective control.¹⁵ It consists of data collection, analysis of the data and feedback of the results to staff and others involved in decision-making. A good programme is essential to recognise SARS, detect disease trends, clarify rumours and to assess the efficacy of control measures. Given the fact that clustering of respiratory tract illness among hospital staff is a prominent feature of SARS, there is a need to enhance surveillance of infection in staff. Before the era of SARS, few hospital staff would bother to report minor respiratory illness; wear a mask or take a day off for what appears to be a common cold. This attitude will need careful reconsideration as Taiwan's experience clearly demonstrated that a SARS-CoV infected staff member remaining on duty, while the disease was still mild and non-specific and couldn't be recognized as SARS, could initiate a large health-care outbreak.¹⁶

The risk of nosocomial infections is increased if patient care procedures are not properly performed and notably if infection control measures are not adequately followed. The same probably holds for SARS.⁴ The importance of hand hygiene cannot be over-emphasized. Yet, compliance with hand

hygiene has often been low, being practiced only 40–50% of the times when it is indicated.¹⁷ In the context of SARS, each institute should review their hand hygiene policies and introduce means to ensure a high compliance among staff. Moreover, our experience with handling SARS indicates that lesser informed staff can lapse into inappropriate practice when facing the unknown issues that surround SARS. Personal protective equipment should be properly worn and discarded carefully after use. Gloves should not be washed and reused between patients. Washing gloved hands is not effective for decontamination.¹⁸ Five to 50% of hands were contaminated after gloves were removed. Hence, hand-washing after glove removal is important. We consider a 'glove all the time' policy in providing care for probable SARS case as suboptimal. If staff wear gloves all the time, they will wash their hands less often. Instead, we have been recommending a 'gloves when needed but wash hands at every opportunity' policy. By putting emphasis on face-to-face interactions with staff and with constant reinforcement, we are able to keep hand-washing compliance at high levels in our hospital, being 100% in the isolation wards throughout and 78% to 95% in the general wards (unpubl. data).

Most outbreaks of nosocomial SARS have been associated with delays in recognizing the disease as SARS, usually this occurred for the very first cases in a hospital. This provides a reminder of the need to be vigilant and that hand washing standards, either singularly or in combination with transmission-based precautions, should be empirically implemented in the care of all patients. In areas where SARS might re-emerge, contact and droplet precautions should be implemented for the care of all patients with undiagnosed upper and lower respiratory tract infections. Patient care procedures, particularly those that might induce patient coughing or generate infectious aerosols should be carefully assessed and planned before implementation, and be evaluated afterwards. A good infection control programme should be supported by adequate staffing. According to the SENIC project, there should be at least one full-time infection control nurse for every 250 beds.¹⁹ This standard, however, is still not reached in many Asian countries. There is also a need to develop surge capacity for infection control within hospital, knowing that a nosocomial outbreak of SARS could be explosive. For this purpose, one could build upon existing infection control liaison nurse programme in some hospitals.²⁰

Many unanswered questions remain with respect to the mode of transmission, period of infectivity, effectiveness of and compliance with infection control practices. The rapid surge of SARS cases made it impossible to conduct prospective studies to address many of the above questions. In hospital settings, it is at least known that heightened infection control precautions, empirical isolation of suspected cases, aggressive contact tracing and quarantine of the contacts are effective in halting even large outbreaks of nosocomial SARS.³ As SARS might re-emerge, it is critical that hospital workers

now review and repair deficiencies in their infection control programmes.

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