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Infection control practices for SARS in Lao People's Democratic Republic, Taiwan, and Thailand: Experience from mobile SARS containment teams, 2003

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Background: Despite available recommendations on infection control for severe acute respiratory syndrome (SARS), information is limited on actual practices in Asian hospitals during the epidemic. We describe practices observed by mobile SARS containment teams (mobile teams) during outbreak investigations.

Methods: We retrospectively summarized infection control practices observed in hospitals visited by mobile teams in the Lao People's Democratic Republic (PDR), Taiwan, and Thailand, during March and April 2003.

Results: Mobile teams investigated 22 reports of SARS in 20 hospitals (1, 5, and 14 hospitals in Lao PDR, Taiwan, and Thailand, respectively). Facilities ranged from urban hospitals with negative-pressure isolation rooms and high-efficiency particulate air filtration to rural hospitals with patient rooms open to outside air circulation and intermittent running water. At the time of mobile team visits, 5 (25%) hospitals implemented infection control practices consistent with World Health Organization recommendations on visitor policies, private negative-pressure rooms, and personal protective equipment.

Conclusions: Early in the SARS epidemic, mobile teams found wide variations in infection control practices and resources among Asian hospitals evaluating patients for SARS, indicating the importance of ongoing assessment during SARS preparedness. Mobile teams are one mechanism to assess practices and promote implementation of recommended infection control measures. (Am J Infect Control 2004;32:377-83.)

During 2003, severe acute respiratory syndrome (SARS) was efficiently transmitted among health care workers, patients, and visitors in hospitals. The causative agent of SARS is a novel coronavirus (SARS-CoV).[1] In some settings, airborne transmission might occur[2]; however, the main mode of SARS-CoV transmission in the hospital is thought to be through direct or indirect contact of mucus membranes with respiratory droplets or fomites.[3,4] Large outbreaks among patients and staff have been associated with aerosol-generating procedures (eg, bronchoscopy, endotracheal intubation, and aerosolized therapy).[5] SARS-CoV can survive for days on dry surfaces and in stool from patients with diarrhea,[6] a symptom reported by 80% of patients in one series.[7] The concept of ''super-spreaders,'' patients who transmit infection to a large number of other persons, has been used to explain some large clusters of disease,[8] but more needs to be learned about

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the host, viral, and epidemiologic contributors to super-spreading events.

Current policies in many countries rely foremost on the immediate recognition and isolation of a patient with SARS at the first point of contact in a hospital. Policies also focus on preventing transmission in the hospital through basic hand hygiene and droplet precautions, administrative measures, and proper management and follow-up of health care workers and other contacts of infected persons.[9] Closure of hospitals and work quarantine of hospital staff might be necessary once secondary transmission has occurred.[10] However, during early outbreaks, the standardization of policies and procedures was especially difficult because little was known about the etiologic agent.

Since the World Health Organization (WHO) issued a global alert during March 2003,[11] SARS has been reported in over 25 countries.[12] These countries have varied in the availability of resources for hospital infection control. The US Centers for Disease Control and Prevention (CDC) and WHO issued guidance for the infection control of SARS.[13,14] However, little information is available on the implementation of these recommendations at hospitals in Asia caring for patients with SARS-CoV infection. Published reports of SARS infection control predominantly describe only large academic hospitals in urban settings. Knowledge on the implementation of practices and approaches to infection control in both developed and developing countries might be important in narrowing the gap between the principles of infection control and actual practice in a SARS epidemic. Because SARS-CoV can be rapidly transmissible and lethal, hospitals must observe strict standards to protect patients, visitors, personnel, and the surrounding community.

During the course of the epidemic, WHO and health officials in Lao People's Democratic Republic (PDR), Taiwan, and Thailand sought collaboration with the International Emerging Infections Program (IEIP) to investigate reported cases of SARS and to implement necessary hospital infection control measures. These 3 countries reported 355 probable SARS cases with onsets of illness during November 2002 to July 2003.[12] IEIP is a major component of the Thailand Ministry of Public Health—US CDC Collaboration, with the goal of increasing capacity to identify, prevent, and control emerging infectious diseases. We report a retrospective summary of the infection control practices encountered by mobile SARS containment teams at a broad range of hospital settings in these countries during an early stage in the epidemic.

METHODS

Mobile SARS containment teams (mobile teams) were organized to investigate reported cases of SARS and to assess hospital infection control practices. Activities of mobile teams included (1) categorization of SARS cases by use of epidemiologic, clinical, and laboratory data in comparison with the WHO case definition of SARS,[15] (2) direct observation and demonstration of recommended SARS infection control practices, usually simultaneously, and (3) provision of personal protective equipment (PPE) to hospitals actively evaluating patients for SARS infection.

When a possible SARS case was reported, a mobile team was dispatched. The number of mobile teams was limited by availability of staff from the national health department and accessibility of the hospital. Mobile teams were generally led by a medical epidemiologist or other official from the national health department and often included members experienced in infection control, communications, and hospital engineering. Most teams were equipped with PPE, blood specimen tubes, nasopharyngeal swabs, culture media, and specimen cooler. Patients were later categorized as probable SARS, suspected SARS, or excluded from SARS after review by members of the national health department. Because of time and resource constraints, mobile teams generally visited a hospital only once during the observational period.

We retrospectively summarized infection control practices observed by mobile teams at the time of their first visits to hospitals during investigations of reported cases in Lao PDR, Taiwan, and Thailand, during the early days of the outbreak from March 11 to April 21, 2003. We used a standardized written questionnaire to obtain data from at least one representative mobile team member to each hospital investigated. We selected WHO recommendations, revised April 24, 2003, as a reasonable benchmark for comparison in this analysis (Table 1).[14] The first version of WHO recommendations was initially released on March 16, 2003.[16] Each national health department and other organizations had recommendations that varied over time. Since WHO indicated that a private negative pressure room was the preferred method to isolate a patient with SARS, we considered a private negative-pressure room the standard of comparison for patient isolation in this analysis, although other methods might be acceptable (eg, cohorting of patients with SARS). Team investigators used a strip of tissue paper to measure qualitatively the negative air pressure at the entrance of a patient's isolation room. We considered a double-layered gown equivalent to a single gown with an apron.

RESULTS

Each country had case-reporting policies and procedures that changed over time. During the observational period, mobile teams investigated 22 reports

of SARS cases in 20 hospitals (1, 5, and 14 hospitals in Lao PDR, Taiwan, and Thailand, respectively). These 20 hospitals identified 27% of the total patients reported and represented 14% of the total hospitals reporting SARS cases to the 3 national health departments during the observational period. Ninety percent of the hospitals visited were located in urban areas. Mobile teams found that hospital staff and administrators generally appreciated the opportunity to review SARS safety practices with an expert team and welcomed suggestions on how to improve the protection of hospital staff.

Of the 22 reported patients, 10 (45%) subsequently met the WHO case definition of probable SARS,[15] and 12 (55%) were found to have a diagnosis other than SARS. Selected infection control practices observed by mobile team visits are summarized in Table 2.

Administrative measures

Hospitals did not consistently have written policies for SARS infection control practices, triage of patients with possible SARS, and visitation requirements to rooms of patients with possible SARS. Even when available, the policies were not consistently applied. For example, 2 of the 9 hospitals with written protocols on SARS triage admitted patients with possible SARS infection directly to the regular ward before being evaluated and isolated.

Although 11 hospitals had policies prohibiting visitors from the room of a patient with SARS, 2 of these hospitals allowed visitors to enter the patient's room wearing surgical masks but no other PPE. Of the 11 hospitals in which mobile teams observed visitors in patient rooms (regardless of hospital policy), only 3 (27%) hospitals required the visitors to wear the same PPE that hospital personnel used. In one of these hospitals, visitors occasionally removed PPE once inside the patient's room. Thus, 11 (55%) hospitals effectively implemented WHO recommendations to restrict visitors from patient rooms or to require that visitors wear appropriate PPE in patient rooms.[14]

Environmental engineering measures

In half of the hospitals, hand-washing facilities (hand-washing basin with soap, clean water, and clean drying towels) were available immediately outside the patient's room or anteroom. In most remaining hospitals, hand-washing facilities were at a location distant from the patient's room, such as the nursing station. One hospital lacked access to running water for several hours per day.

Mobile teams encountered various hospital settings (Fig 1), from rural hospitals with patient rooms open to outside air circulation (Fig 1A and 1B) to hospitals with negative-pressure isolation rooms and high-efficiency particulate air (HEPA)-filtered exhaust (Fig 1D). When adequate facilities were not available, staff often implemented resourceful measures to improve on existing facilities. For example, some hospitals were able to create a makeshift anteroom by erecting glass walls in the hallway directly outside of the patient's room (Fig 1C). Hospital staff often created negative pressure relative to the hallway by using room fans to draw air out of the patient's window to an outside area without traffic.

All 20 hospitals had private rooms for SARS case patients. Thirteen (65%) hospitals already had or were able to create an anteroom for the safe donning and removal of PPE, although, in one hospital, more than 1 SARS isolation room adjoined the same anteroom. Most hospitals attempted to create negative air pressure in SARS isolation rooms by using existing facilities or makeshift approaches, but, at the time of the visit, only 10 (63%) of 16 hospitals had effectively done so.

Although hospitals used the above approaches to separate patients with SARS from other patients, more than half of the hospitals admitted patients with and without SARS to the same ward. At 4 (29%) of these 14 hospitals, mobile teams demonstrated neutral or positive pressure at the door of the patient's room.

Personal protective equipment

The use and availability of PPE varied among the visited hospitals. All hospitals, except 1, had N-95 or

Table 1. Summary of WHO hospital infection control guidance for SARS[14]

In the outpatient or triage setting, patients requiring assessment for SARS should be rapidly diverted to a separate area to minimize transmission to others.
In the inpatient setting, probable SARS cases should be isolated as follows (in order of preference):
Negative-pressure rooms with door closed
Single rooms with private bathroom
Cohort placement in area with independent air circulation and bathroom
Hospital staff should observe strict barrier nursing and precautions for airborne, droplet, and contact transmission.
A staff member should be designated to oversee the practice of infection control.
Visitors, if allowed, should be kept to a minimum.
Access to clean water for hand washing is essential.
PPE should be worn by all staff and visitors to the isolation unit and should include:
Face mask with 95% or greater filter efficiency
Single pair of gloves
Eye protection
Disposable gown
Apron
Footwear that can be decontaminated

WHO, World Health Organization; *SARS*, severe acute respiratory syndrome; *PPE*, personal protective equipment.

Table 2. Selected SARS infection control practices at the time of visit for hospitals investigated by mobile teams in Asia, March and April 2003

Infection control practices	Frequency	%
Administrative Measures		
Written ICP protocol for SARS	7/20	35
Triage and segregation of possible SARS case patient	9/20	45
Patient with SARS admitted to a separate ward from patients without SARS	6/20	30
Traffic restricted outside of patient's room	10/20	50
Hospital policy prohibited visitors from patient room	11/20	55
Visitors observed wearing full PPE entering patient room	3/11*	27
Visitors observed wearing only a surgical mask entering patient room	5/11*	45
Visitors observed wearing PPE when entering patient room	8/11*	73
Environmental Engineering Measures		
Private room for SARS case patients	20/20	100
Hand-washing facilities immediately outside patient room	9/20	45
Separate dressing area for PPE and anteroom	8/19†	42
Negative air pressure at patient door documented by mobile team	10/16†	63
HEPA filtration of air from isolation room	7/20	35
Laboratory equipped with biologic safety cabinet	17/20	85
Personal Protective Equipment		
Hospital staff observed using N-95 or better respirator	19/20	95
Hospital staff observed using eye protection	15/20	75
Hospital staff observed using single gown with apron or double gowns	10/20	50
Hospital staff observed using double gloves	13/20	65
Hospital staff observed using head and foot covers	8/20	40

SARS, Severe acute respiratory syndrome; *ICP*, infection control practices; *PPE*, personal protective equipment; *HEPA*, high-efficiency particulate air.
*Among hospitals with visitors observed in patient rooms.
†Among hospitals with data reported.

better respirators in stock, although some hospitals had limited supplies. Only 3 (15%) hospitals had access to respirators with better than 95% filter efficiency. All hospitals used at least 1 layer of protective gown, ranging from washable cloth gowns to disposable paper gowns; in half of the hospitals, staff routinely used a single-layer gown with an apron or double-layered gowns. Few hospitals had access to eye protection, head covers, or foot protection. When used, the type of eye protection varied and included protective glasses, safety goggles, face shields, and protective hoods.

In 6 (30%) hospitals, staff members were observed using the minimal personal protective equipment recommended by WHO (Table 1).[14] In the other hospitals, appropriate footwear and an apron were the 2 most frequently missing components of WHO-recommended PPE. At one hospital, staff members used plastic garbage bags secured over each foot with tape or string as an alternative to disposable foot covers.

Overall results

At the time of mobile team visits, 5 (25%) hospitals implemented WHO recommendations[14] of private negative-pressure isolation rooms, minimal PPE for all staff entering the patient's room, and effective visitor policies (visitors restricted from the patient room or required to wear personal protective equipment).

DISCUSSION

The dramatic spread of SARS in Asia posed formidable new challenges to infection control in hospitals evaluating patients for SARS. Despite limited resources, hospital staff members responded courageously with several resourceful approaches. However, as measured against current recommendations on the infection control and containment of SARS, 75% of hospitals visited did not implement recommended practices at an early stage of the outbreak.

During the time of mobile team investigations, scientific knowledge about the transmission of SARS was limited, complicating infection control efforts among affected hospitals. Both CDC and WHO advised droplet, contact, and airborne transmission precautions, but specific recommendations changed over time. Our findings indicate that the implementation of recommended infection control practices and the

Fig 1. Photographs depicting a range of isolation settings for patients with severe acute respiratory syndrome (SARS) in hospitals visited by mobile SARS containment teams in Asia. (A) An anteroom that opens out to an open-air corridor in a hospital in Vientiane, Laos. : (1) Demonstration of the donning of personal protective equipment in an anteroom that opens to an open-air outside corridor that connects patient rooms on the ward. (B) Typical open-air ward in a rural hospital in Thailand. (2) Open doors leading from the open-air lobby to the patient ward. The open construction allows for cool ventilation but presents challenges to assuring patient isolation and negative pressure rooms. (C) Makeshift negative-pressure isolation room and anteroom in a hospital in Bangkok, Thailand. (3) Medical staff, wearing minimal protective equipment, monitor care of a patient with SARS by looking through glass walls separating the nursing station from the anteroom and patient room. (4) Recently installed reinforcement bars and glass converting the hallway between the nursing station and the patient's room into an enclosed anteroom. (5) Window fan directing air flow from the patient's room to an untrafficked area outside. (6) In the patient isolation room, a nurse wearing personal protective equipment that includes a powered air-purifying respirator while caring for a patient with confirmed SARS. (D) Negative-pressure isolation room with high-efficiency particulate air filtration in Ilan, Taiwan. (7) Separate gauges measure air pressure in the anteroom and patient isolation room. (8) Door leading into the anteroom. On the other side, a closed door opens into the patient isolation room. (9) Closed double doors opening directly into the patient room.

available resources for infection control also varied among the hospitals visited.

As seen in the first reported outbreaks, health care workers are at higher risk for infection with SARS.[5,17] Worldwide, the proportion of probable SARS cases that were health care workers was 21%, with a range of 0% in the United States and other countries to 57% in Vietnam.[12] Although recent reports suggest that infection control practices can be effective in some settings,[18,19] outbreaks have been documented among protected health care workers.[20] Prior to our findings presented here, few reports have addressed differences in policies and practices among affected hospitals, which might explain differences in infection control effectiveness among institutions and countries. More research also is needed on the effectiveness of hospital policies for triage and visitor restrictions; staff training and education; patient placement in negative air

pressure rooms; 2-stage removal of PPE using anterooms or secondary staging areas; and the use of specific articles of PPE, such as eye protection, head covers, and foot covers. Such knowledge will help hospitals prioritize resources most effectively, especially when resources are limited.

Mobile teams encountered a diverse range of hospitals settings, highlighting the importance of adapting existing infection control guidance in a way that could be practically implemented by each institution. Some facilities existed or could be quickly built to care adequately for SARS-infected patients in Asia. In one Bangkok hospital, a makeshift negative-pressure isolation room with anteroom was constructed from existing facilities in less than 1 day. Observing strict infection control practices, approximately 70 health care workers were potentially exposed to a patient in whom SARS-CoV infection was confirmed by culture, polymerase chain reaction assay, and seroconversion.[1] None of these health care workers have reported subsequent infection with SARS (personal communication, Dr. Achara Chavavanich, 2003). Reports of creative approaches to infection control are encouraging and suggest that strict adherence to a high standard of droplet, contact, and airborne transmission precautions can effectively protect health care workers at high risk.

The findings in this analysis are subject to several limitations. First, the hospitals included in this analysis are a small sample and might not be representative of all hospitals caring for patients with possible SARS infection. Furthermore, mobile teams did not visit each hospital reporting SARS cases, either because staff was not available or because the hospital was not accessible. In addition, our findings describe infection control practices during a single mobile team visit and during an early period in the SARS outbreak. Our findings do not reflect changes in practice that might have occurred over the course of the outbreak or as infection control knowledge and recommendations evolved. For example, not all national health departments initially recommended airborne precautions for SARS infection control.

Although infection control in hospitals is made up of both administrative measures and physical controls, our observations of infection control practices indicated that basic universal precautions and assessment of their actual practice require increased attention at some facilities. Development of administrative measures such as triage of patients with possible SARS, visitor policies, and use of PPE do not require a large investment of material resources and can be applied to both developed and less developed settings. However, successful implementation of these measures requires prioritization of human resources toward training, health education, and health policy and administration.

Given the disparate allocation of infection control resources within and among SARS-affected countries, mobile teams might be effective mechanisms to assess infection control practices at hospitals. Mobile teams can focus infection control resources to hospitals actively evaluating patients suspected of SARS infection and provide specific training and recommendations that are appropriate to a hospital's setting and resources. On-site assessment and interventions can actively supplement recommendations and information that have been disseminated passively. Further follow-up and evaluation are needed to assess whether mobile teams improve implementation of infection control recommendations at targeted hospitals. In many facilities, a single evaluation visit or training might not be sufficient to ensure safe infection control practices, and a long-term mechanism for supervision and assessment of quality control could be useful. Unfortunately, resources are limited, and reevaluation of hospitals since the 2003 epidemic has not been done.

We found evidence of a gap between the recommendations and practice of infection control in some Asian hospitals, indicating the need for ongoing training and monitoring as a component of infection control in each hospital evaluating patients for SARS. As more is known about the transmission of SARS-CoV infections, infection control practices at hospitals evaluating patients for SARS will need to evolve. Even as the SARS epidemic has waned, preparedness for SARS infection control remains important among hospitals.[21] Furthermore, a recent survey of 2000 hospitals in the United States indicates that the need for SARS preparedness is not limited to Asian hospitals.[22] Future studies should evaluate the effectiveness of specific infection control practices, as well as assess the implementation of effective measures in countries affected by SARS.

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References

1. Ksiazek TG, Erdman D, Goldsmith CS, Zaki SR, Peret T, Emery S, et al. A novel coronavirus associated with severe acute respiratory syndrome. N Engl J Med 2003;348:1986-94.
2. Olsen SJ, Chang HL, Cheung TY, Tang AF, Fisk TL, Ooi SP, et al. Transmission of the severe acute respiratory syndrome on aircraft. N Engl J Med 2003;349:2416-22.
3. Peiris JS, Yuen KY, Osterhaus AD, Stohr K. The severe acute respiratory syndrome. N Engl J Med 2003;349:2431-41.
4. Chen Y-C, Huang L-M, Chan C-C, Su C-P, Chang S-C, Chang Y-Y, et al. SARS in hospital emergency room. Emerg Infect Dis [serial online] 2004 May. Available from: *http://www.cdc.gov/ncidod/EID/vol10no5/03-0579.htm*. Accessed March 11, 2004.

5. Lee N, Hui D, Wu A, Chan P, Cameron P, Joynt GM, et al. A major outbreak of severe acute respiratory syndrome in Hong Kong. N Engl J Med 2003;348:1986-94.
6. World Health Organization. First data on stability and resistance of SARS coronavirus compiled by members of WHO laboratory network. Available from: *http://www.who.int/csr/sars/survival_2003_05_04/en/ index.html*. Accessed March 11, 2004.
7. Hsueh P-R, Chen P-J, Hsiao C-H, Yeh S-H, Cheng W-C, Wang J-L, et al. Patient data, early SARS epidemic, Taiwan. Emerg Infect Dis 2004;10:489-93.
8. Centers for Disease Control and Prevention. Severe acute respiratory syndrome—Singapore, 2003. MMWR Morb Mortal Wkly Rep 2003; 18:405-11.
9. Centers for Disease Control and Prevention. Supplement I: infection control in healthcare, home, and community settings. Public health guidance for community-level preparedness and response to severe acute respiratory syndrome (SARS) Version 2. Available from: *http://www.cdc.gov/ncidod/sars/guidance/i/pdf/i.pdf*. Accessed March 11, 2004.
10. Gopalakrishna G, Choo P, Leo YS, Tay BK, Lim YT, Khan AS, et al. SARS transmission and hospital containment. Emerg Infect Dis 2004; 10:395-400.
11. World Health Organization. WHO issues a global alert about cases of atypical pneumonia: cases of severe respiratory illness may spread to hospital staff. Available from: *http://www.who.int/csr/sarscountry/2003_04_21/en/*. Accessed April 21, 2003..
12. World Health Organization. Summary of probable SARS cases with onset of illness from 1 November 2002 to 31 July 2003. Available from: *http://www.who.int/csr/sars/country/table2003_09_23/en/*. Accessed January 5, 2004.
13. Centers for Disease Control and Prevention. Updated interim domestic infection control guidance in the health-care and community setting for patients with suspected SARS. Available from: *http://www.cdc.gov/ncidod/sars/infectioncontrol.htm*. Accessed May 20, 2003.
14. World Health Organization. Hospital infection control guidance for severe acute respiratory syndrome (SARS). Available from: *http://www.who.int/csr/sars/infectioncontrol/en/*. Accessed April 25, 2003.
15. World Health Organization. Case definitions for surveillance of severe acute respiratory syndrome (SARS). Available from: *http://www.who.int/csr/sars/casedefinition/en/*. Accessed April 9, 2003.
16. World Health Organization. Hospital infection control guidance. Available from: *http://www.who.int/csr/surveillance/infectioncontrol/en/print.html*. Accessed March 17, 2003.
17. Booth CM, Matukas LM, Tomlinson GA, Rachlis AR, Rose DB, Dwosh HA, et al. Clinical features and short-term outcomes of 144 patients with SARS in the greater Toronto area. JAMA 2003;289:2801-9.
18. Seto WH, Tsang D, Yung RW, Ching TY, Ng TK, Ho M, et al. Effectiveness of precautions against droplets and contact in prevention of nosocomial transmission of severe acute respiratory syndrome (SARS). Lancet 2003;361:1519-20.
19. Twu SJ, Chen TJ, Chen CJ, Olsen SJ, Lee LT, Fisk T, et al. Control measures for severe acute respiratory syndrome (SARS) in Taiwan. Emerg Infect Dis 2003;9:718-20.
20. Ofner M, Lem M, Sarwal S. Cluster of severe acute respiratory syndrome cases among protected health-care workers—Toronto, Canada, April 2003. MMWR Morb Mortal Wkly Rep 2003;52:433-6.
21. World Health Organization. SARS: breaking the chains of transmission. Available from: *http://www.who.int/csr/sarscountry/2003_07_05/en/*. Accessed July 10, 2003.
22. US General Accounting Office. Severe acute respiratory syndrome: established infectious disease control measures helped contain spread, but a large-scale resurgence may pose challenges. GAO-03–1058T. Washington; July 30, 2003.

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