

What have we heard?

- There are doubts about the effectiveness of ribavirin and steroids for treating SARS
- Traditional Chinese medicine practitioners should be recruited to help frontline healthcare workers
- There were insufficient infection control personnel in hospitals
- Infection control in many hospitals was not effective
- Guidelines to hospital staff were unclear or inaccessible because no Chinese version was available or because some staff did not have access to the intranet
- Hospital staff need more training in dealing with infectious diseases
- Work safety in hospitals was not sufficiently emphasised
- HA did not do enough to allay the anxiety of hospital staff
- There were uncertainties and confusions among hospital staff regarding the standard and supply of personal protection equipment

INTRODUCTION

12.1 Because SARS was a new disease, it was managed empirically. Conventional treatment was disappointing and will need to be carefully evaluated in future. In the absence of effective treatment, hospital infection control became a major issue in the clinical management of SARS, both for the protection of staff and for the prevention of spread to other patients and hospital visitors. A good hospital infection control programme can appreciably

reduce the incidence of hospital-acquired infection. Hospital infection control teams also have an important role to play in conducting surveillance, supporting the control of infection in the community, and responding to major outbreaks. Given the occupational hazard posed by infections to healthcare workers, it is important that all staff are served by good occupational health services. During and after a major crisis such as the SARS epidemic, support for the physical and psychological health of staff is especially important.

CLINICAL MANAGEMENT

12.2 At the beginning of the SARS epidemic, very little was known about the disease. Initial clinical management of SARS cases consisted of supportive treatment and broad spectrum antibiotics covering known bacterial causes of atypical pneumonia. The results of conventional treatment were disappointing and no clinical improvement had been attributable to the use of antibiotics.^{1,2}

12.3 The Committee notes that clinicians at Prince of Wales Hospital had put together the initial treatment regimen through daily observations and using a stepwise clinical management algorithm, with subsequent evolutions as more knowledge was gained about the clinical course of the disease. Patients were treated for community-acquired pneumonia for the first 2 days with broad spectrum antibiotics, consisting of intravenous cefotaxime with either oral levofloxacin or clarithromycin. Clinical symptoms, blood oxygen saturation and chest radiograph were assessed daily. If fever persisted after 48 hours, patients would be given a combination of low-dose corticosteroids and ribavirin commencing on day 3 or 4.

12.4 The rationale for using corticosteroids was based on the observation that computerised tomography of SARS patients had shown radiographic features of Bronchiolitis Obliterans Organising Pneumonia, which was a steroid responsive

condition and suggestive of an immunological phenomenon. Postmortem examination had further revealed evidence of diffuse alveolar damage, pulmonary oedema with hyaline membrane formation. Additionally, dramatic response to the use of hydrocortisone in some of the early SARS cases in the Guangdong Province had been reported.

12.5 The use of an anti-viral agent was prompted by the failure of antibiotics. Ribavirin was chosen for its broad spectrum anti-viral effects: it had been shown to be efficacious against both RNA and DNA viruses. Previous studies had demonstrated that in acute viral respiratory infections, large amounts of early-response cytokines were produced. Ribavirin had been shown to decrease the release of pro-inflammatory cytokines from mouse macrophages, suggesting a possible beneficial immune modulating effect.

12.6 Evaluation of these early cases treated by steroids and ribavirin in Prince of Wales Hospital had suggested marked clinical improvement in a large proportion of these cases. Further understanding of the disease subsequently pointed to its triphasic course: after the initial viral replication phase, a proportion of patients (25%) progressed to the second immune hyperactive phase and a small percentage (8-15%) to the third phase of pulmonary destruction. The treatment regimen of steroids and ribavirin was therefore modified, and steroids were reserved for the second phase of the clinical course.

¹ *Weekly Epidemiological Record* 78(12);81-88

² *New England Journal of Medicine* 348(20);1977-85

12.7 Laboratory evidence from overseas subsequently emerged, indicating that ribavirin did not exhibit significant in-vitro activity against the SARS coronavirus. This raised questions about its effectiveness in the treatment of SARS patients. A number of alternative treatment options were later proposed, including –

- ◆ The use of Kaletra, another anti-viral agent. Initial observational studies indicated promising results with this therapeutic agent. Its use appeared to result in less intubation and a lower oxygen desaturation rate in a certain category of SARS patients. Better mortality outcome was also suggested.
- ◆ The use of convalescent sera. A small proportion of SARS patients had been treated by convalescent sera as the last resort. The sera were obtained from patients who had recovered from SARS. A small uncontrolled study suggested that its use had resulted in better patient outcome.
- ◆ The use of traditional Chinese medicine (TCM). An observational study involving 506 cases from 11 hospitals in Mainland China revealed initial beneficial effects of integrating western medicine with TCM therapy. It was reported that the integrated therapy group had done better in maintaining normal oxygen saturation, and achieving earlier relief of symptoms such as malaise and shortness of breath, as well as earlier resolution of pulmonary infiltrates.

12.8 The Committee notes that two TCM experts from the Chinese Medicine Hospital of Guangdong Province were invited by HA to provide advice on the use of TCM in treating SARS patients in early May. HA had also formed a multi-disciplinary SARS Collaborative Committee to evaluate the various treatment options for SARS and propose further research studies to be undertaken. The work of the SARS Collaborative Committee was presented at a WHO Workshop on the Clinical Management of SARS held in Hong Kong on 13-14 June 2003.

12.9 Although much experience has been gained with a variety of treatments for SARS, evaluation has only been done so far by retrospective analysis of data on clinical outcome or by non-randomised studies. To date, no randomised control trials have been conducted to evaluate the effectiveness, or otherwise, of conventional treatments for SARS. There is also a need for further research on the efficacy of TCM in preventing and treating SARS.

- ◆ HA should update, on a regular basis, treatment guidelines for SARS based on the best laboratory and clinical evidence available locally and internationally.

- ◆ The academic community and clinicians should agree protocols for information sharing and conducting randomised control trials before the next SARS outbreak. These should cover all aspects of the management of an epidemic, including clinical treatment, staff and patient protection (including personal protection equipment), and public health interventions. The protocols should be shared with the Pearl River Delta region.

HOSPITAL INFECTION CONTROL

12.10 Worldwide, healthcare workers constituted a significant proportion of the SARS cases, as shown in Figure 12.1.

12.11 The SARS epidemic showed that hospital infection control standards are inadequate and there has been little

appreciation of its importance until now. Examples include the fact that microbiology is almost entirely laboratory-based, there is no clear leadership from infection control doctors, there are insufficient trained infection control nurses, laboratory-based surveillance of infectious diseases is weak (with many hospital laboratories not reporting routinely to DH), and links between hospital and community infection control teams are poorly developed. Several sets of infection control guidelines were issued by HA during the SARS epidemic, eg, on isolation procedures, personal protection equipment (PPE) standards, and criteria for identifying high-risk patients and high-risk areas. They were made available on the HA intranet and were promulgated to all hospitals. However, it appears that they were not always fully implemented. Participation of frontline staff in making infection control policy should be encouraged, to ensure viability of implementation at ward level.

Figure 12.1 Number and Percentage of Infected Healthcare Workers

Areas	Number of probable cases	Number of healthcare workers infected (%)
Mainland China	5,327	1,002 (19%)
Hong Kong, China	1,755	386 (22%)
Taiwan, China	665	86 (13%)
Canada	251	108 (43%)
Singapore	238	97 (41%)
Vietnam	63	36 (57%)

Source: WHO website, data as released on 15 August 2003

12.12 Good infection control arrangements require that there is an established infection control structure within each hospital with sufficient resources and clear lines of management responsibility. There should be an infection control committee (ICC) supported by an infection control team that is led by an infection control doctor, usually a medical microbiologist with a clinical role. The ICC should –

- ◆ Initiate the development, evaluation and revision of infection control policies and procedures
- ◆ Ensure that policies are made known to staff and are implemented
- ◆ Assess adherence to these policies, procedures and guidelines
- ◆ Agree objectives and priorities for the surveillance of infection
- ◆ Ensure that staff receive appropriate instruction and orientation, and that there is ongoing education for staff working in high-risk areas
- ◆ Develop a programme for auditing infection control.

12.13 Surveillance is an essential component of the prevention and control of infection in hospitals. It assists the infection control team to allocate priorities for infection control activities, to identify risks of infection and reinforce good practices, and to detect outbreaks promptly. Since many cases of community-acquired infection will be identified and diagnosed by the hospital laboratory,

laboratory-based surveillance should also be a vital component of the surveillance system operated by DH. All hospital laboratories should participate in this in order to ensure comprehensive coverage.

12.14 Each hospital should have a hospital outbreak plan that is regularly updated. Outbreaks of hospital infection vary greatly in extent and severity, ranging from a few cases of urinary tract infection to a large outbreak of food poisoning involving hundreds of people. The plan should include criteria for calling an outbreak, and the circumstances in which the hospital outbreak control team should be expanded and the lead role passed to DH. The functions of the hospital outbreak control team will include –

- ◆ Taking all necessary steps for the continuing clinical care of patients during the outbreak
- ◆ Clarifying the resource implications of the outbreak for facilities, resources and staff
- ◆ Agreeing and coordinating policy decisions on the investigation and control of the outbreak, and making sure they are implemented
- ◆ Considering the need for outside help and expertise
- ◆ Ensuring adequate communication channels are established, including nominating one person to be responsible for making statements to the news media throughout the duration of the outbreak

- ◆ Providing clear information and instructions to all healthcare and ancillary staff
- ◆ Agreeing arrangements for providing information to patients, relatives, and visitors
- ◆ Meeting frequently, usually daily, and reviewing progress
- ◆ Ensuring communication with other hospitals in the cluster, HA, DH, and HWFB
- ◆ Defining the end of the outbreak
- ◆ Preparing interim and final reports of the outbreak, and evaluating and disseminating lessons learnt.

12.15 To function effectively, hospital infection control teams need to incorporate a range of knowledge and skills that include microbiology, principles of infection control, principles of surveillance, epidemiology, and outbreak management. The team may therefore include a hospital epidemiologist, a public health practitioner with skills in both epidemiology and infection control. The team also needs to have a population-based perspective in order to appreciate the implications of hospital infection for the wider community. In order to foster, enhance and support these skills, to ensure a seamless infection control service that covers both the community and hospital sectors and to improve collaboration between HA and DH, the Committee suggests that hospital microbiology and infection control staff should be employed

by the CHP. In this way, the CHP will have teams of staff with knowledge and experience of communicable disease control effectively embedded within HA.

- ◆ Each hospital should have an infection control team that reports regularly to a hospital infection control committee. The team should have responsibility for –
 - Developing, implementing and auditing policies, procedures and guidelines on infection control
 - Educating, training and advising students and staff in all aspects of infection control
 - Carrying out surveillance of hospital-acquired infection and contributing to the surveillance of community-acquired infection
 - Monitoring standards of hospital hygiene
 - Assessing and managing risks in relation to hospital infection
 - Liaising with occupational health services for staff
 - Advising on infection control aspects of the purchase of new equipment and hospital construction projects
 - Preparing and updating hospital outbreak plans and leading the response to hospital outbreaks
 - Producing an annual report
 - Working closely with DH/CHP and other hospitals.

STANDARD AND SUPPLY OF PERSONAL PROTECTION EQUIPMENT

12.16 There are many facets to hospital infection control, such as personal hygiene measures, patient management, environmental factors (eg ventilation, spatial arrangements, cleaning facilities, etc), and protective measures including PPE. Of these, the issue of the standard and supply of PPE received the most attention during the SARS epidemic, and was the central theme of the grievances of some frontline workers against HA management. The Committee learnt during the inquiry that some frontline workers, and the general public alike, were overwhelmed by conflicting messages regarding PPE standards advocated in the media and by different healthcare professionals. The issue resulted in a daily feature of criticism of the authorities during the early phases of the outbreak. There were also complaints from private doctors that they were unable to procure adequate PPE during the epidemic and the Government did not assist them.

12.17 As SARS was an emerging infectious disease, little was known initially about its infectivity and modes of transmission. Droplet and contact transmission through contaminated surface appeared to be the predominant modes. It was observed that HA had made a number of revisions to its guidelines on the recommended PPE for healthcare workers during the epidemic, in keeping with the best available evidence and

the recommendations by international health authorities, such as WHO and the Centers for Disease Control and Prevention (CDC), Atlanta, USA. In addition, HA further upgraded the PPE standard in response to increasing staff demands for a higher level of protection as a result of heightened anxiety and media advocacy.

Evolution of the PPE Standard

12.18 The evolution of the standard of PPE in HA hospitals could be summarised as follows –

- ◆ In February 2003, on detection of the Avian Flu (H5N1) cases, HA issued a recommendation to staff advising droplet precautions, hand washing, proper disinfection of the environment/equipment and the use of barrier apparels including masks, gloves and gowns when caring for cases with an influenza-like illness.
- ◆ In mid-March, with the emergence of SARS and the issuance of the global alert, WHO first recommended respiratory isolation and strict respiratory and mucosal barrier nursing for SARS cases.
- ◆ This was followed a few days later by CDC's recommendation that until the mode of transmission had been defined, infection control measures should include precautions to prevent airborne (eg N95 respirators), droplet and contact (eg gowns and gloves) transmission. Eye protection was also recommended for all patient contacts.

12.19 These recommendations were incorporated by HA as its PPE standards. Staff working in the high-risk areas were recommended to put on barrier apparels including N95 respirators, goggles, gloves, caps and gowns. Emphasis was also placed on the proper use of PPE, in particular the importance of hand washing after touching the external surface of masks. For all in-patient settings, surgical masks were recommended for all patient contacts, and additional protection with goggles, face shields, gowns and gloves were advised where appropriate, such as in close patient contacts.

PPE Supply

12.20 Prior to the SARS crisis most of the PPE, except surgical masks, was not commonly purchased for use by HA hospitals. The sourcing and procurement of all PPE were very much affected by the beginning of the global surge in demand after the global alert by WHO. During the months of March and April, there were problems in building up an estimated stock of 1-2 months' supply of PPE despite much efforts in sourcing, both locally and from overseas. With HA's decision to centralise sourcing and procurement of PPE items, however, the consumption and stock statistics did not show significant supply problems, except that some near stock-out situations occurred during certain critical periods. However, the supply of N95 small-size respirators that would fit the majority of female staff had remained an area of ongoing concern. To ensure adequate supply,

alternative models of N95 respirators were tested and introduced to meet the demand.

12.21 A list of the types of PPE purchased and supplied to hospitals after these arrangements were taken up by HA centrally is given below in chronological order.

- ◆ 4th week of March: surgical mask, N95 respirator, and disposable isolation gown
- ◆ 1st week of April: 3M Air-Mate PAPR, eye shield, face shield, and goggles
- ◆ 2nd week of April: Tyvek Barrier Man Coverall, Stryker T4 Helmet
- ◆ 4th week of April: N100 respirator

Consumption of PPE

The peak daily consumption of the various types of PPE and the average stock available in the affected HA hospitals are shown below.

PPE Item	Peak Daily Consumption	Average Daily Stock
Goggles	2,599	24,598
N95 Respirators		
– Small	13,556	243,593
– Regular	15,568	293,967
N100 Respirators	727	45,471
Surgical Masks	278,636	5,213,471
Disposable Gowns, Water Repellent	41,297	1,306,967
Disposable Gowns, Fluid Resistant	40,449	1,121,695
Eye Shields	15,975	350,027
Face Shields	15,666	346,997

12.22 The Committee notes that the community had responded to media publicity of various fund-raising activities to donate PPE to healthcare workers. PPE donations from the Central Government were also received. The PPE received were distributed promptly to frontline healthcare staff.

12.23 The Committee also notes that HA had been conducting studies to collect evidence to guide its decisions on infection control measures. According to a case-control study³ on 254 staff from five HA hospitals, staff who wore masks ($p=0.0001$), gowns ($p=0.006$) and washed their hands ($p=0.047$) were less likely to develop SARS than those who did not use them or wash their hands. The study also provided evidence that surgical and N95 respirators were both effective in significantly reducing the risk of infection.

12.24 Evidence of the protective role of masks suggested that, in most circumstances, the infection was transmitted by droplets in hospitals. In the light of these findings, HA's recommendations were further refined with emphasis on the use of the risk-stratified provision of PPE. Surgical masks were recommended for most situations, while N95 masks, goggles, face shields and other PPE were advised for high-risk procedures.

OCCUPATIONAL HEALTH

12.25 The world was first alerted to SARS as a result of outbreaks of illness in healthcare workers. Globally, one-fifth of all SARS cases were healthcare workers. WHO has indicated that the occurrence of a cluster of atypical pneumonia in hospital staff is a sentinel event that should raise suspicion about the possibility of SARS. It is essential, therefore, that health workers remain alert to illness in colleagues, that there are effective systems in place for reporting illness to occupational health services, and that there is close liaison between occupational health and the hospital infection control team.

12.26 Of the 1,755 SARS cases in Hong Kong, 386 were healthcare workers, of whom 320 were HA staff infected while on duty. In the New Territories East Cluster, where the highest rate of staff infection occurred, 15 staff were infected per 1,000 SARS patient bed days. Overall, the highest attack rates occurred in doctors and nurses, but healthcare assistants and allied health staff were also affected. Not only were healthcare workers directly affected by SARS, many also experienced the trauma of seeing infected colleagues suffer the debilitating effects of the disease. Most worked indefatigably in stressful and difficult circumstances, and all were exposed to the fears and anxieties of dealing with a new and unexplained disease.

³ WH Seto et al., "Effectiveness of Precautions against Droplets and Contact in Prevention of Nosocomial Transmission of SARS", *Lancet*, 3 May 2003.

12.27 Although criticisms have been made of staff being put at unnecessary risk from SARS and of inadequate measures to address staff stress and anxiety, several initiatives were taken by HA and DH to address these issues. HA organised staff forums, made temporary living quarters available to staff worried about infecting their families at home, and introduced a telephone hotline service called 'Oasis' that provided psychological counselling for staff. DH had also been in consultation with a university about developing a package of psychological health programmes and counselling services for health workers.

12.28 Nevertheless, existing occupational health services for healthcare workers are not well developed. They are generally focused on occupational safety and do not offer a comprehensive package of services that addresses both prevention and care and provides support for the physical and psychological health of staff. Occupational health services should ideally be led by trained occupational health physicians, supported by occupational health nurses, occupational psychologists, occupational hygienists, and safety officers. Many health issues affecting staff are related to communicable disease hazards, eg the risk of blood-borne infections from needlestick injuries. Particular attention should therefore be paid to issues such as immunisation and infection control precautions for the protection of patients and staff, and reporting of communicable diseases affecting staff.

Principal functions of the occupational health services

The principal functions of the Occupational Health Services should be –

- ◆ To develop a data collection and monitoring system on occupational health diseases and occupational accidents and injuries among health workers in hospitals
- ◆ To develop strategies and programmes for the effective protection of healthcare workers and the promotion of health and safety at work in hospitals
- ◆ To establish partnership with the Occupational Health and Safety Council, the Occupational Health Division of the Labour Department and other non-government organisations and academics in the promotion of occupational health and safety
- ◆ To establish partnership with the frontline staff of the hospitals in promoting occupational health and safety
- ◆ To act as advisor on occupational health and safety and to liaise with the CHP and infection control teams in joint efforts to promote health and safety at work.

- ◆ HA should review its occupational health services and put in place a comprehensive package of occupational health services, led by professionally trained occupational health staff, which will support physical and psychological health and promote safety at work for healthcare staff.