Crit Care & Shock (2004) 7: 134 - 139

A journey through the severe acute respiratory syndrome (SARS) crisis in Singapore ˘ Observations of an intensivist

Dessmon Y H Tai

Abstract

Singapore was the fifth most severely SARS (severe acute respiratory syndrome) afflicted country with 238 cases after China (5327), Hong Kong (1755), Taiwan (346) and Canada (251) [1]. On 31 May 2003, Singapore was declared SARS free by World Health Organization (WHO). The last SARS patient was discharged on 13 Jul 2003. The case fatality rate in Singapore was 13.9% (33/238), which was comparable to Canada 17.1%, Hong Kong 17.0%, Vietnam 12.7%, Taiwan 10.7% and China 6.6%. The global case fatality rate was 9.6% (774/8098).

In September 2003, Singapore reported the world s first laboratory-acquired SARS case [2,3]. Fortunately, this patient did well and did not result in any secondary cases.

This review chronicles the journey through the SARS crisis in Singapore. It also interpolates the emotional challenges faced by the healthcare workers, an aspect that has not been well documented in the literature. In addition, our experience from battling this SARS epidemic may provide useful information to those who have to deal with such easily transmissible and potentially fatal infection in future.

Keywords: severe acute respiratory syndrome (SARS), mortality, World Health Organization, Singapore

Overview

Singapore faced an unprecedented severe acute respiratory syndrome (SARS) crisis when a 22-year old Singaporean was hospitalized on 1 March 2003 after she returned from a holiday in Hong Kong [4]. Six days later, she was admitted to medical intensive care unit (MICU). She did well and was transferred to general ward on 11 March 2003. The World Health Organization (WHO) issued a global health alert on 12 March 2003 on a severe form of atypical pneumonia. On 16 March 2003, the disease was called SARS and was made a notifiable infectious disease [5]. By then, she had already infected many others.

In Singapore, we had 5 super-spreaders that resulted in 121 secondary cases [6]. The outbreak lasted 11 weeks with the last SARS patient having the onset of illness on 11 May 2003. The last SARS patient was discharged from hospital on 13 Jul 2003. Thirty three (13.7%) out of a total of 238 SARS patients died. Eighty four healthcare workers were infected and 5 lost their lives [3,7].

In September 2003, a 27-year old medical researcher acquired SARS in the laboratory as a result of accidental contamination of West Nile virus samples with SARS coronavirus [2]. This patient did well and did not result in any transmission. This single isolated case highlighted the importance of continued surveillance and strict adherence to appropriate laboratory biosafety procedures and practices.

National SARS ICU

After the first index patient, the next four cases were admitted to the MICU on 17 March 2003. All these 4 patients were contacts of the first index case; 2 were her parents, 1 was a pastor who visited her and the fourth was

From the Department of General Medicine, Tan Tock Seng Hospital
11 Jalan Tan Tock Seng, Singapore 308433 (Dr. Dessmon Y H Tai).

Address requests for reprints to:
Dessmon Y H Tai, MD, Medical ICU, Dept. of General Medicine, Tan Tock Seng Hospital, 11 Jalan Tan Tock Seng, Singapore 308433
Tel. 65-63577878, Fax. 65-63577588
E-mail: dessmon_tai_yh@ttsh.com.sg

a nursing staff who attended to her. Three patients were in their 40s and one in his early 50s; they had been healthy previously. We were really frightened because in our minds, we knew that we could be that patient, in that bed.

On 22 March 2003, Tan Tock Seng Hospital (TTSH) was designated as the only hospital for the isolation and management of all SARS patients in Singapore [8]. TTSH, with 1163 beds, was the second largest public hospital in Singapore [9]. To prevent mixing of SARS and non-SARS patients, we had to reorganize the 4 ICUs (medical, coronary, surgical and neuro) into 2 ICU complexes. The medical and coronary ICUs, located at level 6, were converted to become the SARS ICU. The surgical and neuro-ICUs, located at level 3, were re-organized for the care of non-SARS patients [10]. I became the national SARS ICU director, a 1-week belated birthday present that I will never forget.

All the beds in the SARS ICU were housed in single rooms, each with its own isolated air-conditioning system. All these rooms were equipped with smoked-tested negative pressure facilities to ensure no mixing of air between patients rooms and the general working areas [11].

We had 46 patients who required ICU care, representing about 20% of SARS patients treated at TTSH [4]. The maximum number of SARS ICU patients we had at any one time was 22. The reorganized SARS ICU complex had a total capacity of 36. When the outbreak started, we were not sure how many beds would be needed. We were always worried about our capacity to cope.

All the patients who were admitted to the SARS ICU had acute respiratory failure; 95% had acute lung injury ($PaO_2/FiO_2 \leq 300$) and 86% had acute respiratory distress syndrome ($PaO_2/FiO_2 \leq 200$) [4,11,12]. We also noticed a significant incidence of thromboembolism, e.g. deep vein thrombosis (23.9%) and pulmonary embolism (15.2%) [4,11,13]. Such findings were also confirmed on autopsies [12,14].

A multidisciplinary SARS Clinical Workgroup was formed, comprising intensivists, infectious disease physicians, immunologist, hematologists, radiologist, respiratory physicians and cardiologist. We did surveillance screening using ultra-sound scan on the patients legs to check for deep vein thrombosis. Anti-coagulation prophylaxis was instituted unless contraindicated [11,15]. We also used corticosteroids alone or in combination with immunoglobulin in an attempt to immunomodulate the severe inflammatory damage in patients who were deteriorating clinically [11,16].

In Singapore, 75.6% (180/238) of SARS infection was acquired in the hospital and nursing home settings [17]. Hence, provision of personal protective equipment, training in their use and ensuring compliance was a critical pillar in staff protection and welfare. This is especially important in a designated national SARS hospital.

Public Health Measures

The Infectious Disease Act was invoked on 24 March 2003 to quarantine for 10 days all contacts exposed to SARS patients [8]. To safeguard public transport, a delegated ambulance service was available for patients who had suspicion of SARS to fetch them to TTSH. All SARS patients who recovered were also issued Home Quarantine Orders for 14 days upon hospital discharge. About 8000 had been put under quarantine [6].

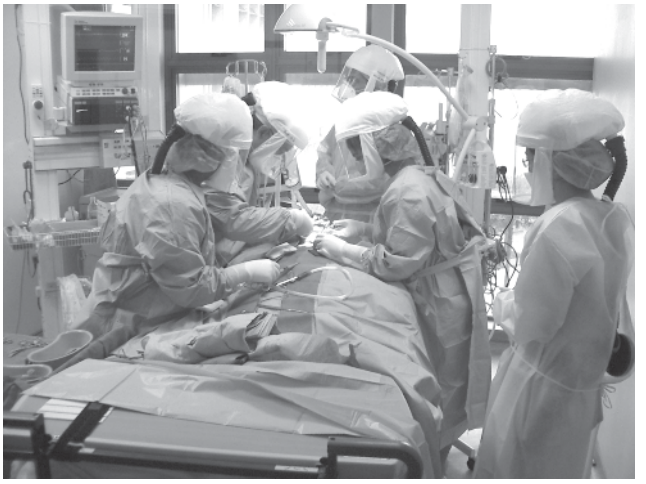
All healthcare staff had to check their temperature thrice daily, before coming to work, mid-way at work, and before going home. Temperature had to be monitored even on off duty days. The temperature recordings were submitted daily to the respective departmental head or manager. The rationale was to pick up early cases and prevent them from spreading SARS to fellow colleagues, family members, friends and community [18]. Subsequently, daily temperature monitoring was extended to all places in Singapore e.g. educational centers, private and government offices, armed forces, factories, shopping centers, food and transport establishments, hotels, tourist attractions, etc.

To prevent transmission in the healthcare settings to visitors, hospital visitation for in-patients was suspended on 24 March 2003 for our designated SARS hospital [18]. This rule was extended to all hospitals on 29 April 2003 [19]. When the SARS situation improved, the no-visitor rule for non-SARS patients was revised to 1-visitor on 1 June 2003. This was further relaxed on 15 August 2003 to allow 2 visitors from a list of 4 registered visitors per patient per hospital [20]. The restriction on inter-hospital movement of patients, except when the transferring hospital did not have the expertise or facility to treat the patient, was lifted on 18 August 2003 [21].

Travel was responsible for the rapid global spread of SARS. On 31 March 2003, Changi International Airport implemented screening of all in-bound flights from affected areas [18]. To prevent the import and export of SARS, thermal imaging scanners and health declaration were subsequently extended to all air, sea and land immigration points. Temperature screening of departing passengers at our immigration check points was suspended on 25 July 2003 [22]. However, inbound travelers still need to go through thermal imaging scanner.

Fear and sacrifice

In the beginning of the outbreak, as it was a new disease, no one knew whether the protective measures taken were adequate to prevent infection. We adopted the highest protection level within our means. This included the N95 mask for working in the wards and the powered air purifying respirator when performing risky procedures such as endotracheal intubation, cardiopulmonary resuscitation or tracheostomy (**Figure 1**).



There was also no effective anti-viral therapy. Everyday when I came to work, it was like facing a potential death sentence. When I said goodbye to my wife every morning, I was not sure whether that would be the last time I would be seeing her.

The intense fear of the unknown and utter hopelessness was eloquently expressed by the healthcare workers in Hanoi, We were locked up with the beast. We were not playing with fire ˇ the fire was playing with us. We faced death. We play bridge with it, but it was not a virtual partner.*f*

I was afraid that staff might refuse to come to work or even resign. As director of SARS ICU, I had to lead by example. However fearful I was inside, I had to hide my fear behind the N95 mask. I had to inspire my team, so that together, we could charge forward and win this microbiological battle. When the patient load in the MICU increased and consultants were needed to go on night duty, I rostered myself first. The ICU had to draw upon a common pool of doctors from the departments of anesthesiology, respiratory medicine, general medicine, other medical specialties and surgical disciplines.

Naturally, many were apprehensive, but when they were rostered to come in, they turned up. I was also very grateful to the volunteers who chose to work in the SARS ICU, e.g. Head of Neurology Department, an ENT consultant and a number of medical officers from TTSH. There were also volunteers from other hospitals, e.g. an anaesthetist and two nurses from Alexandra Hospital, and eight nurses from the Singapore General Hospital.

One doctor told me, At the end of the day, this is my job; it is like a war, you don t leave your colleagues to fight it alone.*f*

Another nurse remarked, I don t kiss my child so that others may continue to kiss their children.*f*

It was a very traumatic experience for healthcare professionals during the crisis. They put their lives at risk fighting a previously unknown enemy, yet they faced discrimination from the public. One citizen wrote to the Straits Times, the largest circulating English local newspaper, I read with tears in my eyes to see that you have to make arrangements to stay elsewhere, get ostracized by family, friends and society, are unable to show love and care to your family members[a] Some of you even have to sign on insurance policies, write a will, in case anything happens. Only you will know how it feels to be outcast by the very society that you re serving.*f*

Counseling sessions were organized by the psychiatrists and medical social workers for staff to share their experience and support each other. Some of these sessions were extremely heart rending as well as heart warming. A few of the staff even broke down during the sharing.

Lonely death

We knew that dying from SARS was a very lonely affair because of the need for strict isolation to prevent transmission. Dr Scott Dowell, a WHO doctor who attended to Dr Carlo Urbani in Bangkok, aptly said, To be by yourself in a strange country, in a room full of people in spacesuits who cannot touch you[a]. That is not a good way to die [23].*f*

Dr Urbani, 46, alerted the world to the new global threat of SARS, after he was called to investigate an outbreak of pneumonia in Hanoi. He died of the same disease on 29 Mar 2003, 3 weeks after he arrived in Bangkok for medical care.

Understandably, my wife was afraid for my life. She was extremely worried that my immune system would be overwhelmed due to sheer exhaustion from overwork and continuous exposure to the SARS virus. She said, I do not want to live with the memory of a dead hero. I would rather grow old together with an ordinary man.*f*

It was a very touching moment; we held each other s hands and tears welled up in our eyes. I explained gently

to her that I have chosen medicine as my vocation. In good times or bad, I cannot turn my back on my responsibilities, however dangerous, especially in the thick of an unprecedented national crisis.

Many of us, including myself, are afraid to die. But the sad fact was that we had to be prepared to die in the course of our duty during this crisis. I could fully empathize with Dr Vu Hoang Thu from Hanoi, We were scared. But we did not have a choice; we had to work, to care for our colleagues. Those in good health saw others fall sick and their health deteriorate. We cried a lot. But we had to encourage them; and for some, lie to them, about the progress of the illness. What we lived through, it was like a war. Without force, without solidarity, we would not have been able to get through it [24].*f*

If I was unfortunate to be infected by SARS, I did not want to pass it on to family members. We stopped attending family functions and meeting friends during the outbreak. I also asked my wife to stay at her mother s house for the duration of the SARS outbreak in case I came down with it. She flatly refused and said that I should not have to return to an empty home. She was prepared for the risk of contracting SARS if I had been infected.

High and low

Thankfully, things became better two weeks after recognition of the syndrome and implementation of full protective measures. Not a single SARS ICU staff was infected with SARS from 17 March 2003 [25]. It showed that the protective measures worked. It was a very important and potent psychological antidote because it gave us the first assurance that we were safe in our work environment with our personal protective equipment.

Every morning when I opened my eyes, I would immediately feel myself for fever before I checked my temperature. It became a daily high for me to know that I was afebrile and had no other symptoms of SARS. As an added precaution, I slept in a separate room from my wife and sat at a distance from her when we ate meals at home. We waited anxiously for the SARS outbreak to be over.

Twenty five (54.3%) of our 46 SARS ICU patients died. Our most challenging patients were those who had multiorgan dysfunction and required more than two months of intensive care. All of us were very happy when some of these patients made a turn for the better and survived, especially when at one point we thought we might lose them. They made our high-risk job all the more rewarding. Indeed, some of us even shed tears of joy when we saw our patients transferred to the general ward.

My lowest moment was when a 27-year old cardiology medical officer had cardio-respiratory arrest. He had plans to get married soon. When I was informed about it at around 11 p.m. on 28 March 2003, my heart sank and I cried for help. I felt I had to go to the hospital to see if there was anything at all I could do. My wife would not allow me to drive alone to the hospital, as I was very tired after completing night duty that day. She drove me there and waited for me till 1 a.m. at the nearby deserted Novena Square Shopping Centre, all the time continuing to pray.

A lot of his brain stem reflexes were absent. We knew in our hearts that his prognosis was extremely poor. Our morale was very low that night. All of us looked down, speechless, on the floor of the SARS ICU. He passed away subsequently on 7 April 2003. He was our first healthcare staff who succumbed to SARS. The hospital s flag was flown at half mast the next day in his memory.

Out of the 238 SARS patients, we lost five healthcare workers: two doctors, 1 nursing officer, 1 nursing aide and 1 healthcare attendant. It was an especially painful experience as well to see our colleagues fighting for their lives. This reinforced my oft-held notion about life s fragility and the need for divine intervention in all our lives.

There was never a question of giving up the battle. There was a very high level of cohesion, encouragement and determination among the healthcare professionals to give our utmost despite the high risks involved. If we lost, it could spell great disaster for Singapore as well as mankind. If we had given up earlier, we would not have survived. We knew that we could not lose in the fight against this scourge.

Singapore was declared SARS free by WHO on 31 May 2003. We were quietly jubilant as we were aware of the recurrence of SARS in Toronto. Toronto was declared SARS free on 14 May 2003. Twelve days later on 26 May, WHO returned Toronto to the list of areas with recent local transmission of SARS [26].*f* On 2 July 2003, Toronto was declared SARS free, followed by Taiwan (the last remaining country on the SARS list) on 5 July 2003.

Tributes to healthcare professionals

To close the chapter of Singapore s battle with SARS, a Commemoration Ceremony was held at the Botanic Gardens on 22 July 2003. The candle-lit ceremony moved many among the 4000 including healthcare workers, SARS survivors and next-of-kin of SARS casualties who came to say their final goodbye to tears. Our Prime Minister, Mr. Goh Chok Tong, lauded the professional-

ism, fighting spirit and dedication of Singapore healthcare workers, and singled out the five who died, ª..(they) knew the dangers of SARS. But they did not flinch from their duties. They sacrificed their lives in the service of others. They stood where few dare to stand. There is nothing more noble. There is nothing more humbling [7].*f*

We also received many other tributes and well wishes from the public.

Personal reflections

We could not have won this war without teamwork. For the nurses, doctors, respiratory therapists, physiotherapists, radiographers, medical social workers, healthcare attendants, clerks, administrators and many others who willingly risked their lives, we sincerely thank them all.

Personally I ve learnt to appreciate even more, the little things in life. To be alive is a gift. To be able to live it fully is a blessing. Every day, as I start my car to go to work and at the end of the day, no matter how hard the work is, I m very thankful that I ve been given another day of life. I m also thankful that I m the physician working on the patient, rather than be the helpless patient fighting for his life.

I m glad my career is also my vocation.

Conclusion

This previously uncharted journey was an arduous and challenging one for many of us from many perspectives: professional, emotional, social, spiritual and economic. We did learn many useful lessons from it and emerged stronger from the rich experience. However, this is one journey which no one would hope to experience again.

We can take great comfort in knowing that our healthcare community has epitomized the Hippocratic Oath through their selfless actions.

To quote our Prime Minister, May we never have to face another crisis like this. But if we do, let us inspire each other, fight as one and win the battle as we did against SARS [7].*f*

References

1. World Health Organization. Summary of probable SARS cases with onset of illness from 1 November 2002 to 31 July 2003 (revised 26 September 2003). (Assessed 19 Mar 2004, at http://www.who.int/csr/sars/country/table2003_09_23/en)
2. World Health Organization. Severe acute respiratory syndrome (SARS) in Singapore ˘ update 2. SARS case in Singapore linked to accidental laboratory contamination. (Assessed 19 Mar 2004, at http://www.who.int/csr/don/2003_09_24/en)
3. Leo YS. SARS ˘ management in Singapore. In: Ling ML, Tan AL, editors. Proceedings of the 2nd International Congress of the Asia Pacific Society of Infection Control; 14-17 Mar 2004; Singapore. Communication Consultants, 2004:31.
4. Tai DYH, Lew TWK, Loo S, et al. Clinical features and predictors for mortality in a designated national SARS ICU in Singapore. Ann Acad Med Singapore 2003; 32:S34-36.
5. Chee YC. Severe acute respiratory syndrome (SARS) ˘ 150 days on. Ann Acad Med Singapore 2003; 32:277-280.
6. Lim OP. SARS and the city ˘ Singapore s experience: a national response. In: Ling ML, Tan AL, editors. Proceedings of the 2nd International Congress of the Asia Pacific Society of Infection Control; 14-17 Mar 2004; Singapore. Communication Consultants, 2004:43-4.
7. Long S. Tributes, tears for SARS heroes. The Straits Times, 23 Jul 2003: pg 1 (col 1-7).
8. Leo YS, Chen M, Heng BH, et al. Centers for Disease Control and Prevention. Severe acute respiratory syndrome ˘ Singapore 2003. Morb Mort Wkly Rep 2003; 52:405-411.
9. Ministry of Health (Singapore). Annual Statistics Bulletin 2002. Singapore: Health Information Management Branch, Ministry of Health; March 2003:27.
10. Loo S. Re-organization of the intensive acre services for the SARS outbreak. Medical Digest, Tan Tock Seng Hospital, Singapore, April ˘ June 2003; 21-22.
11. Lew TWK, Kwek TK, Tai DYH, et al. Acute respiratory distress syndrome in critically ill SARS. JAMA 2003; 290:374-380.
12. Franks TJ, Chong PY, Chui P, et al. Lung pathology of severe acute respiratory syndrome (SARS): a study of 8 autopsy cases from Singapore. Human Pathol 2003; 34: 743-748.
13. Wansaicheong GKL, Tsou IYY, Tan SSS, et al. Deep vein thrombosis in patients with SARS. Ann Acad Med Singapore 2003; 32 (S): S83-84.
14. Chong PY, Chui P, Ling AE, et al. Analysis of deaths during the severe acute respiratory syndrome (SARS) epidemic in Singapore: challenges in determining a SARS diagnosis. Arch Pathol Lab Med 2004; 128: 195-204.
15. Tai DYH. Overview of SARS patients in ICU. Critical Care & Shock 2003; 6:230.
16. Chng HH, Tai DYH. Immunomodulation therapy in SARS. Critical Care & Shock 2003; 6:230.
17. Tan CC. SARS in Singapore: Looking back, looking forward. Ann Acad Med Singapore 2003; 32(s): S4-5.
18. Chee YC. SARS at TTSH. Singapore Medical Association News, November 2003; 35(11): 12-16.
19. Ministry of Health (Singapore). Press statement: SARS ˘ continued vigilance. Press release, 10 June 2003.
20. Ministry of Health (Singapore). MOH press release: Lifting of SARS measures. Press release, 15 Aug 2003.
21. Ministry of Health (Singapore). Update on preventive measures against SARS. Letter to all registered medical practitioners, 27 August 2003.

22. Ministry of Health (Singapore). Joint press release: Lifting of SARS measures. Press release, 25 July 2003.
23. Cox News Service. WHO doctor Carlo Urbani warned the public of SARS but succumbed to the virus in a Bangkok hospital. The Straits Times, 6 Apr 2003: pg 32 (col 2-6).
24. AFP, Reuters. Doctors swift action may have stopped spread. The Straits Times, 2 April 2003; pg 6 (col 7).
25. Loo S, Tai DYH, Tai HY, et al. Effective protective measures for healthcare workers in an intensive care unit dedicated for patients with severe acute respiratory syndrome. Ann Acad Med Singapore 2003; 32 (S): S79.
26. World Health Organization. Update 66 ˘ Situation in Toronto, interpretation of areas with recent local transmission.*ƒ* (Assessed 19 Mar 2004, at http://www.who.int/csr/don/2003_06 26/en)