SARS (and Me) (Part 1)

By Prof Chee Yam Cheng, Editorial Board Member

This article is a diary, my diary, of events.

Editorial Note:
The following article was submitted on 31 March 2003. Contents are accurate and current as at this date. Part 2 will be published in the next issue of SMA News.

UK BOUND – THE HK CONNECTION
On the night of Sunday 9 March 2003, I left Singapore for London on Singapore Airlines. I was headed for Glasgow, and arrived safely there on Monday morning. I was there for some medical meetings of the Royal College of Physicians. The meetings proceeded as planned and on Friday evening, I was on the night flight of Singapore Airlines. I arrived in Singapore on Saturday 15 March evening. While in Glasgow, the TV programmes were about Tony Blair and his war efforts. He was being taken to task by his own MPs and members of the public. He was accused of being reckless. Also on TV was European football. Arsenal, Liverpool, Celtic and Real Madrid. There was nothing about SARS, Hong Kong, Guangdong or Hanoi.

However, on CNN, there was mention of SARS. So I asked my Hong Kong doctor friend, also present at the same meetings, about the SARS situation in Hong Kong. It was not rosy. He promised to send me updates on our return home.

HOME AGAIN
It was Monday 17 March when I returned to Tan Tock Seng Hospital. As usual, I ran my clinic at KKWCH that morning. I was aware that there were already SARS cases in the ICU. That afternoon, I was present at the meeting chaired by an anesthetist, with nurses and doctors discussing how best to deal with the resources available in our ICUs. As you are all aware, Tan Tock Seng Hospital has 4 different ICUs – Neuro, Cardio, Surgical and Medical. The advice was to cohort cases as SARS was noted to be highly contagious. At that time, Tan Tock Seng Hospital continued to function as it always did – as a general hospital. Patients were still admitted through Emergency Department (Tan Tock Seng Hospital ED is the busiest ED in Singapore), and elective operations were ongoing. ICU beds were in demand.

That meeting gave me the first inkling of the pulse of our staff. Yes, there was fear. Yes, nobody would volunteer to manage the cases. All quite natural reactions. We were not fully aware of what SARS was about, at that time. Nonetheless, once the decision was taken to allocate certain resources (staff, equipment, wards, ICU, etc.) to manage SARS patients, everyone did their best and showed their commitment to their professional standing and ethical standards.

What did we tell them? These were our assumptions:

SARS is Severe Acute Respiratory Syndrome. As its name implies, the severely ill ones suffer respiratory failure from ARDS. It is acute. Usually, by the third day of illness (first day defined as when the fever starts), lower respiratory tract involvement begins. The chest X-ray starts to white out, the PaO2 falls, and supplementary oxygen is mandatory to maintain life. Further deterioration means assisted ventilation. Of course, some do not go that far and after oxygen therapy for a few days, start to improve, fever settles, and appetite returns.

The cause is viral. Which virus – initially thought to be paramyxovirus (as are measles, mumps and RSV and Nipah) – but now, it may be the corona virus (as is influenza).

The next critical assumption is that the spread, contagious as it is, is by close contact and droplet. It is not airborne. This has huge implications on the protection of our staff. Therefore, for those dealing with suspect or probable cases (the difference being the latter has CXR infiltrates), protection of self meant the wearing of the 3M N95 mask, properly fitted, and with gloves and gown.

Patients were in 3 categories: for observation, suspect SARS and probable SARS. It was essential that there be a history of contact with a SARS patient, or history of recent travel to the 3 countries mentioned earlier. Of course, patients could still be febrile from URTI, UTI, cellulitis, and so on, but in such cases, they were treated as non-SARS, in the usual manner. Most cases were admitted to the CDC low lying wards with lots of fresh air, open ventilation, sunshine and green grassland pleasing to the eyes. If they deteriorated and became breathless, CXR with infiltrates, then they were moved over to Tan Tock Seng Hospital’s main building, and isolated in single rooms in certain wards on certain levels. Segregation of SARS and non-SARS patients in main Tan Tock Seng Hospital had begun. Likewise, staff were divided into the SARS and non-SARS teams.

Remember at this stage that Tan Tock Seng Hospital was still operating as per usual. We are a large hospital with over 1,000 beds and the busiest ED in Singapore.

MBBS EXAM – THE HK CONNECTION
Then came Tuesday 18 March. I had my reply from my Professor HK doctor whom I met in Glasgow. His e-mail said the situation was bad. I then asked for the medical protocol they were using in HK. This came a day later. It consisted of several antibiotics plus the usual management for ARDS. This day, I was
Examined for the Final MBBS held at SGH (and I was to be involved for the whole week). There, I met the External Examiner for Medicine who happened to be from HK. So I asked him about his perspective, the situation, the treatment, and the success stories. He is a hepatologist but he told me they tried ribavirin and steroids, and these seemed to work. So henceforth, we considered the same, but found in Singapore that we had thousands of tablets but little intravenous ribavirin. 

On Wednesday, the Minister of Health visited Tan Tock Seng Hospital in the afternoon. (This he said himself in one of his subsequent press conferences.) It was good that he saw for himself the situation, met, and spoke with some staff and some patients. He visited the ICU where the seriously ill were. Precautions at that stage for visitors were that SARS patients were allowed one visitor for 10 minutes only, and under the supervision of our staff ensuring their masks were properly worn.

At Tan Tock Seng Hospital, there was no daily operation room meeting once in the morning, and sometimes also in the evening. MOH had begun regular meetings with senior staff of the acute care restructured hospitals. Everyone was prepared to take in SARS patients and care for them. Hospitals were cancelling elective surgical operations for the following week. More masks were being ordered. Press conferences were being held. 

Saturday 22 March started off for us at 8am, at the Lecture Theatre of Tan Tock Seng Hospital. I was chairing a seminar on “SARS – All you need to know”. All the senior staff were present. The theatre was full. Staff were interested. A reporter tried to sneak in but was turned away. What did I say? SARS is a viral illness. Today it is thought to be a paramyxovirus in the same family as measles, mumps, RSV and Nipah virus. It is spread by close contact. TODAY newspaper reported the deadly sneeze of the Beijing Professor who stayed at the Metropole Hotel in HK, resulting in Singapore’s first 3 index cases contracting the disease. At this stage, I was interrupted by a senior doctor saying rhinorrhoea and sneezing are not common symptoms (less than 25%).

Our doctors presented the epidemiology and clinical features. Management protocol was shown. Precautions were re-emphasised for all staff. Then, the CEO took the stage to give out policy statements regarding how the hospital was dealing with the SARS outbreak as it affected staff morale (many taken ill were healthcare workers). MOH was standing solidly behind Tan Tock Seng Hospital in this war against SARS.

WHO LIST

At 11am on the same day, Saturday 22 March, I attended for the first time, the MOH briefing. It was announced that schools would reopen on Monday 24 March. It was also announced that Tan Tock Seng Hospital had been designated the SARS hospital with immediate effect. So that meant, we were to stop ED admissions, stop admissions/transfers from other hospitals unless the patients were SARS-related. And of the non-SARS patients still in hospital, we were to gradually discharge them when they were better, and so empty our wards to only look after SARS-related patients. The outpatient clinics were also closed. 

At the meeting, some questions were asked. Is it true that Singapore is now in the WHO list of countries with SARS together with Hong Kong, Vietnam and Guangdong? If yes, what does this mean? What are the implications for our people, our doctors, and our airlines? Can MOH give some guidance to our doctors who are asked to certify fitness to travel abroad? I will leave it at that, as it is another story.

The next week from 24 March unfolded with the finding that some of our TTSH staff had fallen ill, seen a GP or polyclinic doctor, and were at home on medical leave. We at TTSH worried they might have SARS. So we had to do daily roll calls on all staff to ensure they were healthy. And if they were ill, to verify that they did not have SARS, and a staff clinic was set up purposely for this reason. Meanwhile, patients by themselves, or referred by GPs, were being screened at Ward 72 CDC. From these 2 sources, SARS-related patients were warded and the numbers rose. At ED itself, although it was supposedly closed, patients still came and had to be seen. If they were serious enough to warrant admission and were not SARS, they were transported to the other hospitals.

On Wednesday 26 March, came the decision that all schools (from pre-schools up to Junior College, but excluding ITE, Polytechnics and Universities) would be closed from the following day Thursday 27 March.

That week, my usual clinics had been closed. Nonetheless, I was reviewing my patient's case sheets, writing prescriptions and making copies of investigation results to give to them when they came to collect their medication at the pharmacy. Those in need of urgent attention were given letters of referral to doctors of other hospitals. The idea was for well non-SARS patients to have no contact with SARS patients and doctors/staff managing SARS patients. This has worked as the number of new cases has seen a decrease in recent days.
Friday 28 March, I gave my scheduled talk on “Current Concepts on Hypertension” at the Ang Mo Kio Polyclinic. That over, I answered questions on SARS to reassure them that the situation appeared to be getting better (although 2 have died) and that the measures taken to protect staff were effective. However, the same night, things seemed to take a turn for the worse when it was announced that a new case was being investigated. She (somehow all the index cases are ladies) had returned to Singapore on China Southern Airlines CZ 355 at 5.40am, landing at Changi Airport Terminal 1. She was met by her mother, had taken a taxi to SGH whereupon she was redirected to Tan Tock Seng Hospital and promptly admitted. Intensive contact tracing is now in progress.

VIRAL ATTACK
The virus – now thought to be coronavirus – is an enveloped single stranded RNA virus. It is thought to be able to survive on environmental surfaces for up to 3 hours. It is highly infectious with attack rates of more than 50% among healthcare workers caring for patients with SARS.

SARS was first recognised at the end of February in Hanoi Vietnam, when a doctor at the Vietnam-French private hospital reported it to WHO. However, it is now known that since late November 2002, the disease as it is now recognised, was already ravaging Southern China with sporadic spread into Hong Kong. And it was in Hong Kong that our 3 index cases contracted the disease. The incubation period is thought to be 5 to 9 days. The most common early, systemic symptoms include fever, malaise, myalgia, headache and dizziness. So it would look like any other viral illness. Hence, clinicians need a high index of suspicion, and need a history of travel or contact to make the diagnosis.

After 3 to 7 days of fever, the lower respiratory tract involvement results in a non-productive cough, with dyspnoea and chest pain. Breathlessness worsens, oxygen therapy is required, and ventilatory support is needed in 15% of those who have lung infection. Lymphocytopenia is common, and occasionally liver function values are raised. (Reference: BMJ 29 March 2003 pg. 669-70.)

SQ INVOLVEMENT
The SQ problem revolves around our colleague Dr Leong, who working in the CDC Tan Tock Seng Hospital, saw and treated one of our index cases. At that time, he and the index case did not know what the latter had. Therefore, no precautions to protect staff in the wards were in place.

He travelled to New York, attended the conference as planned, and on Friday 14 March boarded SQ in New York. (That same evening I boarded my SQ flight in London.) He took ill and was promptly quarantined in Frankfurt by the authorities who knew what disease they were dealing with, and therefore took more than the necessary precautions (being in space suits).

The other passengers and crew were also quarantined in a gymnasium, and later allowed to fly on to their destinations. The passengers were flown back on another SQ plane (not the one from NY – Frankfurt which Dr Leong flew in), and those who disembarked in Singapore were met by MOH officials at the airport, and given advisories regarding what to do should SARS symptoms develop. Others in transit made their way to other places. Later, when the German authorities were satisfied the SQ aircraft could leave, it together with its crew (who flew with Dr Leong) returned home. As was reported in the press, SQ disinfected the plane, burnt the carpets and seat cushions, and so on. The crew were on daily surveillance as part of contact tracing. Unfortunately, at least one of the crew is now warded at Tan Tock Seng Hospital.

A CHRONICLE
I have tried to live up to Channel News Asia’s motto – giving you insights from the inside. Hopefully, this will lead to a better understanding of how things were handled and are being handled. Ignorance breeds fear, and fear leads to panic and paralysis. This should not happen in Singapore.

This article is a diary, my diary, of events. It is free of judgement in any and all forms, and there is no intention whatsoever to judge anybody, any decision, any policy, anything and anyone.
By now, most people throughout the world would have heard about SARS and the death toll associated with it. In this article, I would like to examine SARS from YOUR perspective rather than mine. And I would define you as the medical profession out there in Singapore, faithfully practising long hours in the heartland, in not so busy Orchard Road, and much less busy private hospitals. What were your thoughts and reactions as the crisis broke?

How did our frontline doctors even within TTSH feel?

SITUATIONAL ANALYSIS

It was on 1 March 2003 that one of the first imported cases was warded at Tan Tock Seng Hospital (TTSH). She was young and febrile with a cough that worsened and a CXR that worsened even more rapidly. As usual, she was under the care of our doctors (house officers, medical officers, registrars and consultants). The Infectious Disease physician was involved as her pneumonia failed to respond to the usual antibiotics. We would have given her the usual antibiotics for community-acquired pneumonia. The fact that she was in Hong Kong recently (we do routinely take a travel history, especially for those with fever) did not ring any bell. She was in a general ward, and the nurses and other staff treated her like any other patient. There was no indication to isolate her.

However, as the blood cultures repeatedly failed to grow bacteria, and as her chest X-ray worsened and her fever refused to settle, it became more and more clear that this pneumonia was unusual (or in medical terms – atypical). The addition of levofloxacin to her antibiotic regimen made little difference.

By 7 March 2003 (that is 7 days later), the first healthcare worker took ill and was warded at TTSH. And over the next week, more and more nurses and a few doctors looking after in-patients took ill with fever and a rapidly deteriorating CXR. Of course, the ID team of doctors (including Dr Leong) were involved in their care, and finally it clicked. The transmission of virus was amongst hospital staff who had been in contact with the index case. And to confirm the transmission, the index case’s father and other family members were warded, as was the pastor who visited her.

So began a frantic exercise to trace contacts. By the start of the second week, we learnt that patients in the same ward as the index case had also contracted the illness. It became clearer by the day that from one index case, her family was down, her pastor was down, and the staff in that ward were also coming down with the illness. More than that, patients around her, admitted for other non-infectious diseases, like the Malay lady with diabetes, had become infected.

When we were clear about the epidemiology of spread within TTSH and amongst our staff, all these patients were isolated, some cohorted together, and the staff looking after them were in full protective gear – proper N95 mask, gloves and gown. This policy was instituted on 15 March. That is 8 days after the first nurse took ill and was warded, and 15 days after the index case was warded. That meant that for 15 days, the index case was spreading the virus to those around her (the in-patients), to those in the other departments (e.g. X-ray department, other surgical doctors, cardiology doctors who were looking after other patients in the same ward), to her family and friends who visited her. However, it could have been lesser days of exposure as at some point before 15 March, she was in an isolation room or in the ICU.

As the contacts of the index case were traced (i.e. second wave), we were concerned about a third wave of patients who included healthcare workers. It was possible that their families could be affected. At TTSH from 15 March, we fearfully awaited the onset of third wave cases amongst healthcare workers (who could be doctors, nurses, allied health professionals, pharmacists, attendants, ward clerks, radiographers, etc.). By 21 March, no new healthcare workers of TTSH were affected. This meant the protective gear implemented some 6 days before had proved effective.

At TTSH, the safety of our staff is paramount. Staff who had taken the full universal precautions had minimised the risk of contracting the disease to near zero. Further, this fact went a long way to support the assumption that the spread is by close contact through droplets, and is not by airborne particles. So, only those involved in the direct care of patients with the condition needed to wear universal precautions. Close contact has been officially defined as having cared for, having lived with, or having had direct contact with respiratory secretions and body fluids of a person with SARS. Thus, whatever the final aetiology turns out to be, be it one or two viruses, or whatever, for nursing care of SARS patients, strict attention to details and the meticulous adornment of the N95 mask together with gloves and gown is protective. This “experiment” had proven successful.

Would healthcare workers continue to get infected? Theoretically, yes. It could occur in situations where the caregiver is unaware the patient has SARS. For example, if a patient with severe pneumonia thought not to have SARS, has a lung lavage done through a bronchoscope and secretions are splashed into the air as droplets, it is conceivable
that the doctor could be infected if the patient subsequently turns out to have SARS. It is therefore safest to wear goggles, space suits if necessary, when performing such risky procedures. Take no chances as the disease remains without cure. The other scenario is that the patient is unable to give you any history of contact with SARS or having travelled to those countries with SARS. In this case, the best advice is for all healthcare workers to wear masks when dealing with them, when their complaint is fever and the cause likely to be the respiratory tract.

On 16 March, we were informed that the WHO had revised the name of this illness to SARS. SARS is an atypical pneumonia for which the cause is not yet determined. At the triage station of clinics and ED, procedures to identify patients who could satisfy the criteria for suspected case of SARS, were in place. They were to be separated from the main crowd and seen in the express stream. The 2 criteria then were high fever (38°C) and history of travel to Hong Kong, Hanoi or Guangdong. Once such a suspect case was diagnosed, a chest X-ray was done. If there were infiltrates in the lung fields, the case was upgraded to probable. Either way, suspect or probable, the patient if adult, was sent to CDC Ward 72, and if a child, to KK ED. However, should the case be seriously ill, the patient was to be admitted in whichever hospital it was at first contact.

By this time, Singapore had 3 cases of atypical pneumonia (our first 3 index cases from Hong Kong, courtesy of the Metropole Hotel), and another 6 admitted for pneumonia in TTSH and SGH, of whom 2 were staff with TTSH involved in caring for the cases. The guideline to other hospitals regarding infection control included the wearing of surgical masks (14 March), but on 16 March, this was upgraded to N95 respirator masks and proper hand washing. These procedures were to be observed when the suspect cases were managed at ED, wards, and during transport to CDC. Visitors were restricted to immediate family members only and they were to observe the same infection control procedures.

MOH CIRCULAR
To the many doctors outside of TTSH and restructured hospitals, I note that MOH’s first circular was dated 13 March 2003 (Thursday). (At this time, I was still in the UK.) The circular alerted the doctors to the outbreak of atypical pneumonia in Hanoi, Hong Kong and Guangdong, as well as the 3 cases in Singapore. A further circular stated that as at 16 March 2003 (Sunday), Singapore had a total of 20 patients with SARS. 10 were the family members and friends, and 7 were hospital staff who had attended to the first patients in hospital. It was stated expressly that “the transmission of the infection among the cases in Singapore appear to be due to close contact with the patients with SARS through droplet transmission.”

From this day, 16 March 2003, SARS was made a notifiable infectious disease, and notification of the disease was required under the Infectious Diseases Act. Notification of the disease is mandatory to MOH, by fax or electronically, not later than 24 hours from the time of diagnosis. I would therefore assume that all doctors would have received this MOH medical alert signed by the DMS himself. And different doctors would have different reactions and thoughts on the next steps regarding their practice.

So, as a GP or polyclinic doctor, or even an ID or respiratory physician out there, you can make the diagnosis clinically. Your diagnosis would be a suspect case of SARS. Should you send this suspect case for a CXR? The answer is no. The reason is this. If the patient did actually have SARS at this early but symptomatic stage, he would be able to theoretically infect you, his doctor, your nurses, the people in the bus, or MRT, or taxi, as he made his way to the X-ray facility and back to you, etc.

The advice given is that such suspect cases must be referred immediately to Ward 72 of CDC TTSH, for further assessment and management. The 2 key operative words are “must” and “immediately”. It is a highly contagious disease. The public must be protected. Thus, your referral would be to TTSH ED, and not CDC.

CXR: FOR DIAGNOSIS
The CXR is essential to make a diagnosis of probable SARS, not a suspect SARS.

SARS: DIAGNOSIS
By WHO’s case definition, the diagnosis is made on clinical history, clinical examination and a chest X-ray when indicated. The case definition falls into 2 categories:

(i) Suspect case – With high fever (above 38°C) and respiratory symptoms, including cough and shortness of breath or breathing difficulty. And close contact with a person diagnosed with SARS, or history of travel to areas reporting cases of SARS. So there are 2 criteria to be met.

(ii) Probable case – Suspect case with chest X-ray findings of pneumonia or respiratory distress syndrome. Or a person with unexplained respiratory illness resulting in death, with an autopsy examination demonstrating the pathology of respiratory distress syndrome without an identifiable cause. (Reference: DMS Circular, 17 March 2003)
As a frontline doctor, you must not send a suspect case for a CXR out in the community. Certain precautions are necessary to protect the public at large, the radiology staff and others involved in acquiring the CXR. You also will not be expected to sign up a death due to SARS as an autopsy is mandatory to confirm the diagnosis, and SARS has been made a notifiable disease under the Infectious Diseases Act.

**PROTECTION: SELF AND OTHERS**

Triage at the waiting area of clinics and ED is essential for protection of staff and public from a suspect SARS case. Therefore, the moment a patient walks into your clinic, he should be screened for possible SARS with the criterion above; that is, if he is febrile with respiratory symptoms, he should be segregated from all other patients, and seen fastest possible instead of waiting in queue.

The nurse, or clinic assistant doing the initial screen should be properly protected. Such a possible SARS patient should be asked not to cough or sneeze, and be given a mask to wear.

So, at this point of contact, staff should be protected from possible suspect cases, and other members of the public should not be in the same waiting area as this suspect case.

When examining the patient who is a possible SARS patient, the doctor and nurse should be fully protected. And if the patient thereafter is deemed a suspect case of SARS, besides referring the patient to TTSH, the clinic staff must also do 2 other things.

The first is to generate a list of contacts in the clinic, i.e. all those in the waiting area, staff on duty, etc. Name, address, telephone number and gender will be requested by MOH officials doing contact tracing, should the patient you have referred to TTSH becomes a SARS case.

The second is to call TTSH ED to ensure the patient was seen and find out what happened to the patient – admitted, or discharged, or given MC, and what the diagnosis is.

**REFERRAL TO HOSPITAL AND TRANSPORT**

Once you have made the diagnosis of a suspect case of SARS, you are obliged to notify MOH and to refer the patient immediately to CDC Ward 72 TTSH, or KKH ED. On 22 March, this changed. All referrals are not to CDC or KKH, but to Emergency Department TTSH. How does the patient get to TTSH? He should not go by public transport. You will remember the lady and her mother arriving on CZ 355 (China Southern Airline), who took a taxi to SGH from Changi Airport, which resulted in a 3-day hunt for the taxi driver.

It was not until the first week of April that MOH made available to GPs who notified MOH that they had a case in the clinic, a telephone number to call for a dedicated ambulance service. Before that, any ambulance service could be called upon to provide the necessary transport. (Reference: MOH Circular, 3 April 2003).

**CLINIC STAFF**

As frontline staff in this warfare, we need protection. First is segregation of patients with possible suspect SARS. The faster they are seen and sent to TTSH, the better. The clinic nurse or assistant should wear a surgical mask as she screens the patient. However, once a possible suspect SARS is picked up, all further contact with that person should only be staff (nurse or doctor) with full protection i.e. N95 mask, gown and gloves. As TTSH ED is now the central screening centre for Singapore, this is how our staff are dressed up for their protection. And of course, proper hand washing after every patient, after the gloves are removed and disposed away, is mandatory.

The assumptions operative here are as follows. SARS is a viral illness and the spread is thought to be by droplet (although on 3 April 2003, it was announced that the virus was also found in the urine and faeces of patients i.e. not just respiratory tract but also the gastrointestinal tract). So, if the patient coughed and sneezed, or spoke too much, saliva, sputum and nasal secretions would deposit on you as droplets. Hence, the gloves and gowns. As the virus is known to attack the respiratory tract, the N95 mask is therefore to prevent entry of the virus into the upper airways.

Why is the ordinary surgical mask not adequate? As you already know, in the operating theatre or when doing procedures in endoscopy, the surgical mask is to prevent the doctor or nurse transmitting his or her germs into the open wound of the patient. That is, the mask is to protect the patient from us who are doing or assisting in the procedures. That is why sick doctors or nurses are given medical leave (to protect the patients from them). Use of the N95 mask has the reverse reason – to protect us from a potentially highly infectious patient, which for maximum safety means we use the best mask for our protection (and the surgical mask is not the best available).

Of course, this assumes soiled masks, gowns and gloves are changed, and in between patients we also change to prevent transferring infection from one patient to another. It also means these items are worn properly. For the N95 mask, it must fit tightly without air leaks between the facial skin and the mask. Therefore, if the N95 mask is properly worn, breathing is less easy and there has to be intervals of respite from the mask. That is, you take off and go for rest somewhere else before wearing the mask properly again. It is not possible to wear the N95 mask for 8 hours, not even 4 hours at a stretch.

**WHO IS A CONTACT?**

From the official definition of a close contact, all nurses and doctors, and other persons caring for the patient with probable SARS, and even suspect SARS, can be deemed as close contacts. Not a few of those in the suspect SARS category get upgraded to probable SARS when their CXR becomes abnormal. Actually today, we are even sub-categorising suspect SARS into low and high suspect SARS sub-groups.
But the critical point is that if we, as healthcare workers, are properly protected when we deal with these SARS patients (suspect and probable) then we are not categorised as contacts and are therefore not served Quarantine Orders and not placed on the list for contact tracing by the authorities.

So we in TTSH are not defined as contacts just because we work here. But if before 15 March 2003 (when the full barrier protection instructions were issued for total compliance), we had managed patients who were suspect or probable SARS and been ordinary patients (who later turned out to have SARS), then we were definitely contacts and were put on daily surveillance, etc. Once symptomatic, our status would change from contact to patient – suspect at first but should the CXR become abnormal, then we would be upgraded to probable.

So this means that if you practise outside TTSH, you might come in contact with patients who you will diagnose as suspect SARS, but once you are adequately protected when seeing them in your clinic, taking history and during the physical examination, you are not deemed a contact case in need for MOH surveillance and even quarantine. However, should you become ill with fever, etc. after having diagnosed even one case of suspect SARS, then you should come to TTSH ED for proper screening to rule out SARS in yourself. This is your medical responsibility toward yourself, your family and the community.

**GP SYMPOSIUM**

On a Sunday afternoon, 29 March 2003, the MOH and the College of Family Physicians held a symposium in the auditorium of the College of Medicine Building. The Minister of State for Health, Dr Balaji Sadasivan graced the occasion. As the auditorium would house 300 people at most, many GPs would not have been present. I was not there but I am sure many questions were asked and clarifications sought. In particular, the mask issue would have been addressed, including the adequate supply and adequacy of masks in Singapore. I hope some doctor would summarise that afternoon’s proceedings for the benefit of all who were not there.

As of 3 April 2003, the SARS countries include the first 3 (Hong Kong, Guangdong and Hanoi) plus Singapore, Shanxi, Taiwan and Toronto. Further, the period between travel to these countries and the start of relevant symptoms for SARS is now taken as 2 weeks, for the travel history to be considered relevant to the diagnostic criteria. Previously, no duration was stated.

**CONCLUSION**

I am sure you as a practising doctor outside of TTSH would have further questions and concerns which I have failed to address. Or you may have felt isolated and abandoned in your solo practice. Letters to the Editor would be welcome. I hope all these published information would aid us in defining a national master plan to control diseases of a similar nature in the future.
SARS (and Us) (Part 3)

By Prof Chee Yam Cheng, Editorial Board Member

Editorial note:
The following article was submitted on 21 April 2003. Contents are current as at the time of submission. Parts 1 and 2 were published in the March and April issues of the SMA News.

I have tried to deal with the SARS situation as it affected me and you in the first 2 parts already published. Here I would like to discuss SARS as it has affected us not as doctors, but as members of family, community and the public. We are parents, we have children. We are family with parents, uncles, aunties. We are visitors to those of our relatives and friends sick in hospital. Some of us live in condominiums, take public transport, wear uniforms. Some of us have been designated as contacts and quarantined.

FAMILY AND FRIENDS

We belong to family. It panics us if one of family is warded in a public hospital. If it were a medical emergency, we should be grateful that there still are public hospitals attending to such patients. As of today (19 April 2003), only Tan Tock Seng has been dedicated to the management of SARS cases. All the other hospitals continue to function full steam at the Emergency Departments. However, from the third week of March 2003, SGH and NUH had started to reschedule patients for elective surgery, so as to create capacity in their wards to deal with the normal stream of patients shunted from TTSH, which from the third week of March 2003 started to reschedule patients for elective surgery, so as to create capacity in their wards to deal with the normal stream of patients shunted from TTSH, which from Saturday 22 March 2003 became a dedicated SARS hospital.

Therefore, with the “isolate and ring fence” national policy, the assumption is that patients who are suspected of SARS would all be managed at TTSH, leaving the other public institutions free to manage their own load of cases plus part of TTSH load redistributed to them. At this point of time, there is still no diagnostic confirmatory test for SARS and the WHO definition of SARS suspect and probable cases continues to apply.

For those of family warded in CDC or TTSH, the patient was either a SARS probable or suspect case, or warded for observation because of a distinct likelihood of SARS developing. So family members and friends visiting TTSH knew the risks involved in visiting the hospital but at the entry points to TTSH, definite precautions were taken to ensure adequate protection of visitors. A week later, all this was to change. No visitors were allowed for SARS patients at TTSH. However there was a remnant of TTSH inpatients who could not be discharged after 22 March 2003 as they were still ill or had nowhere to go. For them, as they were not SARS-related patients, the only visitors allowed them were family members duly registered at the entry point for a 10-minute visit. The idea was that TTSH did not want many visitors passing through its corridors and using the lifts.

To date, there still are over 100 inpatients of this category at TTSH and visitors duly protected are allowed to visit them.

The question asked has been how then did the disease spread within TTSH before 22 March 2003? Well, in the week before, on 13 March, WHO had issued a global alert to the SARS threat. The affected countries on the WHO list then were just 3 areas – Guangdong, Hanoi and Hong Kong. Singapore only made it onto the list on 20 March. So in early March, patients with fever and pneumonia were not specially nursed nor isolated. SARS was not born yet. Its label was atypical pneumonia and its highly contagious nature not yet documented. Therefore, the isolation policy for inpatient followed the usual rules and unless the patient was in an isolation room, the staff were not fully protected when attending to them. This was how the nurses, attendants, doctors and other healthcare workers came into contact with these patients and subsequently took ill. From one index case, staff became infected, patients in beds in the same ward around the first case also became infected, and when transferred to other wards, infected others. Others infected those who visited them and attended to them in other wards. Others also included family members, church pastors and church friends.

PARENTS

Next, I would like to look at us as parents. Many healthcare workers have young families and in the normal routine of life, have kids in school. That is one concern. One other is safety in the home to where they return after work. Admittedly in early March 2003, no special precautions existed for caring for patients with atypical pneumonia. So staff managing those in isolation rooms followed standard procedure and were safe. The unknown danger was when dealing with inpatients with fever and pneumonia in the general open ward. If a healthcare worker of TTSH took ill, he or she would see their family doctor or polyclinic doctor and be treated, given medical leave, etc. They would stay home and hopefully recover. If they worsened, they would have to come back to hospital and be admitted as patients if their condition warranted it. So while at home, close contact made it possible for the disease to spread. Likewise for patients discharged from TTSH who at that time were not diagnosed as SARS but as whatever medical condition it was. The family was at risk. So father, mother, sister, uncle, grandmother, etc, did become sick with SARS and in one particular family, both father and mother have died from SARS.

Today, with full protection to staff at TTSH, this cycle of transmission has ceased. At work, all staff are fully protected. They change clothes after a bath and go home well. Thrice daily, temperatures are taken by all staff themselves and the moment they are febrile, they go to the staff clinic and are taken off duty. At home, they know how not to be in close contact with family members. After 3 days of medical leave (with daily telephone calls from their TTSH supervisor), they return to the

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staff clinic for medical assessment (if not earlier). That is why staff protection and monitoring are essential – to preserve intact their family and other TTSH staff.

**SCHOOLS – OPEN/CLOSE**

Parents with school-going children had other concerns about their safety in the school environment. On Saturday 22 March 2003, at a MOH meeting, we were told 2 things – one, TTSH is now a SARS dedicated hospital and two, schools would reopen on Monday, 24 March after one week of school holidays. Come Monday 24 March, and schools duly opened. This was what was reported on Tuesday, 25 March. Some wanted schools to stay closed till the SARS threat cleared (Pg. 2, Streets). Several parents felt anxiety and unease about their children contracting SARS at school. Some school principals did send their students home mostly as a precautionary measure, if the students had been in contact with a SARS victim or had holidayed in Hong Kong. Some 600 to 700 students who were feeling feverish were also sent home.

Some others felt the population had taken unnecessary risks by not cancelling their holidays to Hong Kong and Guangdong during the school holidays, and it seemed ripe that sick students if they contracted the disease would incubate, then fall sick while at school. On this logic, some parents wanted schools closed for another 2 weeks. On this, MOH's advice was that parents whose children had been to Hong Kong, Guangdong or Hanoi, should not send them to school if they had fever but to seek immediate medical attention. MOH also said WHO had not recommended school closure, as cases of infection were still those who had been in close contact with SARS victims. So was it better to be safe than sorry?

The New Paper on 25 March, page 13, reported another school shut. Little Skool House at the SGH childcare centre was closed for 7 days. Also closed was the Serangoon Centre of Pat Schoolhouse, for 10 days, so that its 140 pupils could stay home. Another 200 students from Pei Cai Secondary School were also told to stay home for a week. It was much later that a clear policy was laid out – that those schools with student victims be closed for 3 days and the situation reviewed thereafter.

Ms Chitra Rajaram, editor of Tamil Murasu wrote a piece for Streets titled "I am keeping my kids at home." It started with, “Call me kiasu, call me crazy. I don’t care”. She listed her reasons for not sending her 2 children to school the day before when school re-opened. One, the situation was getting worse – more people were in contact with the virus and the increasing number of SARS victims everyday. The number of patients had risen from 3 to 69; 11 were in ICU and maybe 1 or 2 may die. Two, some parents will send their sick children to school; were they ignorant, stubborn or irresponsible? Third, Singaporeans although told not to travel to unsafe Hong Kong, Guangdong and Hanoi, still insisted on going anyway because they had paid for their packages. So she felt another week or 2 of holidays would allow those who had travelled the previous week (school break of one week from 15-22 March 2003) enough time to know if they had avoided the virus. Also during this period, more public education on SARS could be done. "We haven't done enough, parents like me worry that the steps already taken may not go far enough." So she kept her kids home, away from school on Monday 24 March. "...missing a few days of school is a small price to pay compared with having to deal with them falling seriously ill.”

How many of us shared her feelings? Why the hurry to go back to school and mix with those who had taken risks and been exposed in SARS countries abroad? Enough was said, voiced and complained about. On Wednesday 26 March 2003, the decision was taken by the government to close schools with effect from the next day, Thursday 27 March, for one more week. Hurray, said many parents. Yet others felt that this precipitate decision left them in the lurch looking for childcare facilities for their young children. Junior colleges, centralised institutes, secondary and primary schools and kindergartens and childcare centres were closed. Why not the polytechnics, questioned their students. What about the universities?

**SCHOOLS RE-OPEN**

The following week, the Ministry of Education was busy preparing educational material on SARS and briefing school principals and teachers. Then on Saturday 5 April 2003, at 11am, the government announced the decision to re-open schools in 3 phases. The junior colleges and centralised institutes would open on Wednesday 10 April, followed by the secondary schools on Monday 14 April, and finally the primary schools, kindergartens and childcare centres on Wednesday 16 April. As they opened, definite precautionary measures were implemented at entry points into the school. Health declarations signed by parents, temperature taking, segregation of ill pupils – these and more gave the assurance that the risk of contracting SARS in the school environment was minimal. Parents felt better and schools had 95% or higher attendance on the first day of re-opening.

What had Ms Chitra Rajaram to say this time round? She started her article with “My kids will return to school...” (Pg. 11, Streets, 14 April 2003) Further, they were equipped with a surgical mask, each having practised using it at home. This she felt was a sensible thing to do. She felt it was probably very safe to return to school as the chance of contracting SARS in school seemed very remote. She noted several changes already happening – contact tracing and tracking, isolation of patients and suspect cases, reduction of flights to SARS countries – and these were effective and efficient. Yet she felt there were limitations to how far these could go to control the situation.

Those still travelling to China and Hong Kong and keeping quiet about it, were in her opinion irresponsible and reckless. They could spread it to their kids who in turn could pass it on to another kid in school. Others had broken quarantine rules. And yet others sneeze, cough and spit anywhere and everywhere. So to protect her kids, they were to wear their masks if they sat next to anyone with flu or fever, and offer a mask to those who sneeze and cough without covering their face. In the end, there was the need for individual social responsibility – no more a lifestyle choice but a lifestyle must.
PAEDIATRIC CASES

It is natural to be concerned about little children and their propensity, if any, to contract SARS. That is why schools for the youngest kids opened last in the phased re-opening schedule. It was to test that the precautionary measures were working for the older children before the child care centres re-opened. So is this concern justified? In TODAY, 12-13 April 2003, page 2 under the “Best News” column was a write-up that children seemed to be highly resistant to the virus. There were not many world-wide cases. The few who got infected did not become critically ill and no child has died. In Singapore on 12 April, there were 140 SARS cases. Only one was a child below 12 years old who recovered fully.

In the NEJM 7 April 2003 article on “A major outbreak of SARS in Hong Kong,” the author reported their experience of 138 cases of suspected SARS, the outbreak starting on 10 March at the Prince of Wales Hospital. The mean age of their patients was 39.3 ± 16.8 years, i.e. all adults. The independent predictors of an adverse outcome were advanced age, a high peak lactate dehydrogenase level and an independent predictors of an adverse outcome were advanced age, a high peak lactate dehydrogenase level and a high absolute neutrophil count on presentation.

In childhood, there are many immunisations given from birth onwards. Perhaps these somehow are protecting the children from the SARS virus as their immune system is at a heightened state of reacting. We know that childhood illnesses like mumps, measles and chicken pox affect adults and the elderly far more severely than children in whom morbidity in the majority is not serious.

EXAM FEVER

Although it is early in the year, in our universities, it is examination time. Some have asked for exams to be postponed thinking that the gathering of many young adults in exam halls is a risk not worth taking. So the National University of Singapore announced its zonal plan to fight SARS should it occur on campus. (Page H2, Straits Times, 12 April 2003) There would be no shutdown. The affected area of common facilities would close and be disinfected over 3 days as part of the government’s guidelines for schools (as did apply to Ngee Ann Polytechnic when one of its students came down with SARS through his mother). Examinations would be held in more venues so that they are in smaller groups of 20, 30 or 50 rather than in one huge cavernous hall. This should minimise risk and close contact (there was this case of a patient at ED in one of our huge cavernous halls. This should minimise risk and close contact). Examinations would be held in more venues so that they are in smaller groups of 20, 30 or 50 rather than in one huge cavernous hall. This should minimise risk and close contact (there was this case of a patient at ED in one of our huge cavernous halls. This should minimise risk and close contact).

One relative of a SARS patient was to be electronically tagged and now all finally re-opened on 16 April.

Another area that affects us is when we are told we cannot leave home. So what is quarantine and why? Historically, the old Middleton Hospital, now renamed Communicable Disease Centre, was the quarantine centre for contagious infectious diseases like polio (no treatment). Today it does not function like a prison. Yes, there are gates that can be locked, but access in and out of the CDC is not very restricted. Another quarantine facility that comes to mind is St John’s Island; that is really quarantine. Totally cut off by land and only accessible by sea, I remember it being used to house opium addicts (who are not infectious).

Anyway, in the SARS era, and to prevent endemic spread within Singapore, it was felt that quarantine was a necessary instrument to be used on us, the people of Singapore. So for the first time in recent memory, on Monday 24 March 2003, the Ministry of Health invoked the Infectious Diseases Act and quarantined 740 people, including 340 children. Why? They may have been in close contact with victims of SARS, and so they were quarantined at home. CDC would not have been able to house them all for sure. (It has only 200 beds presently.) Anyone who flouts a home quarantine order (HQO) can be fined up to $5,000 for a first offence and $10,000 for a second. Those under quarantine must stay indoors for 10 days to minimise their contact with other people. An incubation period of the illness is usually between 3 to 7 days but could stretch to 10. The National Environment Agency (NEA) will monitor those under quarantine and carry out daily checks for symptoms of the illness. MOH agreed to give help to those who may suffer financial difficulties because of the HQO. For example, a daily rated worker.

At the press conference announcing this HQO, the Minister of Health also said, “The message for Singaporeans is: This is going to be quite a long haul.” He also said on 24 March 2003, “It is not something for which you can declare victory in a matter of days, or one or 2 weeks”. “If you close the schools, it is not one week but 2 weeks. If the situation warrants it, Singaporeans can be assured that we will make the decision.” (Page 2, Straits Times, 25 March 2003) Well, Baghdad fell on 10 April 2003 but the war against SARS is far from over. Well again, schools were closed on Thursday 27 March and now all finally re-opened on 16 April.

Is it easy to be quarantined at home? Evidently not. On 12 April 2003, MOH announced that 12 people had broken the rules and left the confines of their home. At that point in time, 558 people were under HQO. This number fluctuates on a daily basis depending on how many new contacts are served HQO and how many already on the list have completed their 10-day “sentence”.

ELECTRONIC TAG & EPIC

One relative of a SARS patient was to be electronically tagged after repeatedly flouting a HQO. (Page 24, Straits Times, 13 April 2003) The previous week on 10 April, MOH announced that the security firm Cisco was appointed to serve HQO and to install Web cameras in the houses of those served HQOs. Yes, cameras in all 558 houses. So someone is watching. The new rules require those quarantined to stand in front of the...
camera when the Cisco officers call them by phone. The camera comes with a built-in modem. They have to plug it into a power source and phone line. Images taken will be sent through phone lines to a secure computer server at Cisco headquarters. Officers will verify the person’s identity by comparing the images with photos taken when the cameras were installed. Those on HQO will be called twice a day at least and the photos will be deleted after the quarantine period. And those who still break the rules will be electronically tagged and given a written warning. These tags are similar to the ankle tags used on prisoners serving home detention. The tag alerts officers if a quarantined person goes out or tries to take it off.

FURTHER QUARANTINE

The above HQO applies to contacts of SARS patients to ensure that they stay home and become alert to the possibility of themselves contracting the illness without spreading it to the community at large. This order is to protect the public from sick SARS patients avoiding hospitalisation at Tan Tock Seng Hospital. If they do fall ill while on home quarantine, a special ambulance will be arranged to take them from home to TTSH. Again, this is to protect the public and prevent community spread.

On 14 April 2003, MOH introduced yet another category of patients for HQO. These are all the SARS patients discharged from TTSH and the quarantine period is not 10 days but 14 days. Before this date, following the WHO criteria for discharge of SARS patients, they were given 2 weeks of medical leave after which they returned to CDC TTSH for medical review. While on this medical leave, they were advised to stay at home. The new measure makes it mandatory that they remain indoors. (Page H1, Straits Times 15 April 2003) For those discharged from the other public hospitals (presumably not with a diagnosis of SARS but who nonetheless could be possible SARS patients), and a list of hospitals is given (SGH, NUH, CGH and KKH), they will be advised to monitor their temperatures at home and hospital staff will call them daily for 14 days to check on their health. Previously, only TTSH monitored non-SARS patients after their discharge.

These 2 additional steps were explained by MOH as part of a “very cautious approach” to monitor all hospital patients closely so as to pick up those who develop fever early. At this time, 15 April 2003, Singapore’s situation was 10 dead out of 158 total cases. 62 were still in hospital with 18 critically ill in ICU. A further 599 were under HQO. Imported cases were 7.

CONCLUSION

As with previous articles, my aims were to inform and educate, and where possible, give reasons for certain actions. You may perceive the same issues differently. I would value your insights from the outside. Please write to the Editor of SMA News with your views, which I hope will help improve and fine-tune the master blueprint for the nation in dealing with such a crisis. As the BMJ article on 29 March 2003 page 669 asked, are we prepared for the onslaught of a new epidemic? Or as was the case in 1918 and 1919, are we in the same situation? Until mankind developed a defence against influenza, it was as terrifying a killer as SARS. In fact, in those 2 years, influenza accounted for between 20 and 40 million lives, which was more than the human cost of the First World War. (Page 1, TODAY 12-13, April 2003) As a weak comparison, SARS deaths have claimed less lives than the Iraq war, but it would appear that the Iraq war would draw to a close faster than the war against SARS.

The other point is, is “Faster... Fast enough?” This was asked in an editorial of the NEJM 2 April 2003. The speed of events went something like this. 12 March: WHO issued global alert. 14 March: CDC Atlanta activated its emergency operations centre to support the response of WHO to this global threat (Singapore is fortunate and grateful to have the help of WHO and CDC doctors personally involved at MOH). 24 March: Scientists announce new corona virus isolated from patients with SARS. And mid-April: Some diagnostic kits have started to appear. In Singapore, the Genome Institute of Singapore (GIS) announced a Singapore-made SARS test ready by the weekend of 19 April. (Page 1, Straits Times 16 April 2003) The Singapore SARS statistics at this time, 16 April – total 162 cases, 12 dead, with another 2 deaths not confirmed as due to SARS. And in ICU, 18 patients.

So can we prevent a pandemic of SARS? Southern China in Asia is its epicentre.
SARS at TTSH (Part 4)

By Prof Chee Yam Cheng, Editorial Board Member

Editorial note:
The following article was submitted on 17 May 2003. Contents are current as at the time of submission. Parts 1 to 3 were published in the earlier issues of the SMA News.

THE STORY BEGINS

Around the third week of February 2003, three young ladies from Singapore were in Hong Kong for a short holiday. They stayed at the Metropole Hotel and were unlucky to have rooms on the same floor as a retired Chinese doctor from Guangdong who was ill with fever and cough. Maybe they travelled in the same lift or were together in the lobby. Whatever it was, the sneeze and cough of the elderly doctor spread infection to all three of them. They returned to Singapore and on 25 February, one of them took ill. She was hospitalised at Tan Tock Seng Hospital (TTSH) on 1 March and became the first index imported case of SARS as the disease was later so named in mid March by the World Health Organisation (WHO). Later, her two friends were also warded, one at TTSH and the other at Singapore General Hospital. All three recovered and survived the illness. The first case has been reported in the Singapore Medical Journal, April 2003 pages 201-4. From this one case, many more were to suffer the disease.

While at TTSH, many who came into contact with the first index case took ill – patients around her bed, nurses, attendants and doctors. And when the patients became febrile and went into heart failure (in the elderly) they were moved to other wards under the care of other specialists. The patient herself did not improve on the usual antibacterial treatment regimens. Her chest X-rays worsened and were the worst on day 13 of her stay. She was not intubated and became afebrile on day 16 (16 March 2003). So the damage was done. The unknown disease had spread unknowingly to those about her.

Our staff were in contact with her without knowing her illness and just how contagious it was. Our doctor who attended to her from 3 to 9 March, was well when he left for New York to attend a medical conference. His illness began when he was there, and on 13 March, he flew home but during the stopover in Frankfurt (of course he was flying on Singapore Airlines), he, his wife and his mother-in-law were transferred to an isolation facility with the diagnosis of paramyxovirus. (This was subsequently proven wrong. It is now due to a coronavirus.) Transmission is by droplet and close contact, and all staff must take full universal precautions to prevent contracting the disease. Patients with atypical pneumonia were housed in special wards. All other wards and areas within TTSH were safe and continued operation as normal.

The case definition of SARS was presented. A suspect case was a person with a high fever of more than 38°C, respiratory symptoms, and had close contact with a person diagnosed with SARS or travel history to Hong Kong, Hanoi or Guangdong. Close contact meant having cared for, having lived with, or having had direct contact with the respiratory secretions and body fluids of a person with SARS. A probable case was a suspect case with chest X-ray finding of pneumonia or respiratory distress syndrome. A probable case was also a person with an unexplained respiratory illness resulting in death, with an autopsy examination demonstrating the pathology of respiratory distress syndrome without an identifiable cause.

There was no diagnostic test. Diagnosis was purely on clinical grounds. And there were two main pointers – history of contact and relevant travel, as well as symptomatology. Precautions at this stage were N95 respirator masks, gloves and proper handwashing after contact with every patient.

Our CEO mentioned that the Ministry of Health (MOH) strongly supported TTSH as the Communicable Disease Centre (CDC) was the focal point for admission and screening of SARS cases. All patients had to be referred to Ward 72 CDC while paediatric cases were seen at Kandang Kerbau Women’s and Children’s Hospital (KKWCH). If a patient were seriously ill, he could be admitted to the nearest hospital. SARS was now a notifiable disease under the Infectious Diseases (ID) Act. The CEO said we were therefore one of several hospitals dealing with SARS patients.

All this changed at the 11 am MOH meeting. A circular from MOH stated that: “Following review by the SARS Task Force on Friday 21 March and Saturday 22 March, the following decisions have been made in relation to the management of SARS cases.”
The first was concentrating all SARS cases in the TTSH complex i.e. TTSH, National Neuroscience Institute and CDC. So now, even children were to be admitted to TTSH. All suspected and probable cases in any other hospital should be transferred over, and no patient could refuse transfer. Compulsion was provided for in the ID Act. Patients seen at Emergency Departments of hospitals were to be transferred to CDC by hospital ambulance with patient and staff properly protected.

The second decision was that TTSH would no longer attend to non-SARS patients. All SCDF (Singapore Civil Defence Force) ambulances were to be diverted away from TTSH to other hospitals. The media published that the Emergency Department (ED) of TTSH was closed to the general public. TTSH specialist outpatient clinic (SOC) was to be managed for existing patients with a dedicated SOC team of doctors and nurses who had no contact with SARS patients nor their contacts. New cases were not to be seen at TTSH. Instead these patients would be redirected to other hospital SOCs for the next three weeks. (In retrospect, this was unfulfilled optimism, as three weeks downstream, the SARS problem had not abated but had worsened.) And TTSH inpatients when fit for discharge could do so, but were placed on the contact list for the next two weeks with officers calling them daily to enquire about fever and their health status. If febrile, they were to return to CDC immediately (no mention of transport being provided at this time).

Of course, the other hospitals were impacted and so their elective operations and admissions for the next two to three weeks were cut. This would allow them to absorb our ED daily load (we are the busiest ED in Singapore) and SOC workload. KKWCH would set up paediatric services at TTSH by Monday 24 March and it happened. We got back our paediatrics, which we lost when KKWCH opened in 1997 at its new location. More than that; we had a dedicated team of paediatric doctors and nurses posted to us full-time for as long as we needed them. They would not go back to KKWCH to work during this period.

As at 22 March 2003, there were 44 probable SARS cases and 31 suspect cases. By 27 March 2003, all our SOCs were closed. Existing inpatients were managed as usual until they went home. Entry of staff and relatives was closely controlled and monitored. All staff in the team caring for SARS inpatients had no other inpatient or outpatient duties. They were to wear N95 masks, gloves and gowns (so gowns were now explicitly stated for protection), and gloves and gowns had to be changed and hands washed and disinfected between patients. So the m2g rule was in place. For hospital staff in other wards not treating SARS patients they were to wear N95 masks when in contact with patients, with hands disinfected between patients.

Further, staff who were unwell with fever were to report to the staff clinic for assessment and treatment. Only medical certificates from this clinic were recognised for leave of absence from TTSH. It was an important principle to help us track who amongst our workforce took ill after contact with SARS patients. It helped us to identify if any wards (non-SARS, so designated) were breeding cases of SARS when two or three staff in one ward took ill with fever. It could be the nurse, doctor, and attendant – anybody in the ward. Clusters of febrile cases being sought. Medical leave was for 3 days only, followed by medical review.

**A GIFT OF THERMOMETERS**

On 25 March 2003, the temperature-monitoring rule was implemented. All staff working in inpatient areas were given a personal thermometer each (made in China) and instructed to take their oral temperatures thrice during their duty cycle – start, mid point and end of duty. If the temperature reading was 38°C or above, the staff was to wear a surgical mask and proceed to the staff clinic. The purpose of this was to quickly detect any new SARS cases among staff and prevent spread to colleagues and family. Temperatures were to be charted and records kept for each staff, including the hospital cleaners.

For doctors, all department heads were instructed to comply strictly with these rules. Charts were submitted to Medical Affairs daily and any temperature readings above normal highlighted. However, on the day before, if temperature was between 37°C and 38°C, it was rechecked after one hour, the doctor staying in isolation and in no contact with any patient or staff. If above 38°C, he proceeded to the staff clinic. This cut off was lowered to 37.5°C subsequently.

A month downstream, thermometers have become routine personal equipment for Singaporeans. Schools, canteens, ministries, all hospitals, and so on, have instituted the temperature rule. Thermometers are suddenly in great demand. Aural and oral thermometers, digital and mercury thermometers, are now in widespread use. So if you have a fever, go see a doctor. This advice is healthcare news in The Straits Times almost daily.

**VISITOR RESTRICTIONS**

Also, from 25 March 2003, following WHO guidelines, SARS patients are not permitted any visitors. Paediatric SARS patients are allowed two registered visitors and their visitors should not be above 40 years old nor with medical problems. Further, no children or pregnant women are allowed into a SARS ward. Visitors must be registered (so that they can be quickly contact traced if required), must wear N95 mask, gown and gloves (m2g) at all times when visiting patients. They must discard gloves and gowns and wash their hands thoroughly before leaving the patient’s room. Each visit is supervised by staff and lasts no more than 10 minutes per patient. Further, for young paediatric patients, one adult visitor may be allowed to stay.
with the child throughout the stay but that visitor needs m2g protection.

As for visitors to non-SARS wards, they still needed to be registered. Three could be registered but only one visitor allowed in at any one time. Again, visitors should preferably be below 40 years old and with no medical problems. No children or pregnant women are allowed. All visitors are advised against moving around to other patients and sitting on a patient’s bed.

Why all these restrictions? It is in the hospital setting that infection has spread between healthcare workers, patients and visitors (three groups). It is prudent to minimise contact between these groups, and if contact were necessary, that visitors and healthcare workers be appropriately protected. The assumption at this time was that spread is by droplet and close contact. It was later learnt that the coronavirus (identified end March) could survive for up to three hours on fomites, which if touched by hands that then touch the face or eyes or nose, may be a possible route of transmission. For young children, isolation is difficult to enforce and so usually one parent or relative is allowed throughout to help manage and pacify the child. Again, more than one month downstream, the “no visitor” rule was passed to apply to all wards in all public hospitals regardless of their SARS status. The reason is slightly different. It is to decrease the stress on the healthcare hospital system because all visitors needed their temperatures checked at the registration counter and only if they were afebrile were they allowed to visit inpatients.

DEATHS
On Tuesday night 25 March, we lost our first patient and another one on 26 March 2003. Both were men; the father of the first index case and the pastor. They had been in the ICU when the Minister for Health visited TTSH on Wednesday 19 March 2003. Yes, the two men were very ill, on the ventilator and not easily roused. Their chest X-rays showed very opaque, white lung fields. They were stable in that their ventilator and not easily roused. Their chest X-ray showed very opaque, white lung fields. They were stable in that their vital signs and other monitoring parameters were normal. Why was it difficult to accept their deaths? It was a big blow to the morale of our staff especially those caring for them in the ICU. It brought home to all the reality that this illness kills. Two men previously healthy had succumbed. Their contact with the index case? The father at home and at the patient’s bedside in hospital; the pastor in a prayer session. Their chest X-rays showed very opaque, white lung fields. They were stable in that their vital signs and other monitoring parameters were normal while on high concentrations of inspired oxygen.

It was difficult to accept their deaths. It was a big blow to the morale of our staff especially those caring for them in the ICU. It brought home to all the reality that this illness kills. Two men previously healthy had succumbed. Their contact with the index case? The father at home and at the patient’s bedside in hospital; the pastor in a prayer session with the patient in hospital.

On 28 March, Dr Ong (who had worked at TTSH previously) wrote a heart-rending letter to the Forum page of The Straits Times, titled “Be thankful for heroes among us”. I quote excerpts: “As my family battles SARS – my brother and mother have been admitted to TTSH – we would like to convey our deeply felt thanks to all the dedicated staff who have been caring for them. My brother who is a healthcare professional at TTSH caught SARS from a patient. He has since moved from intensive care to the general ward. We feel proud of the doctors, nurses and healthcare workers there especially knowing that there were doctors who volunteered to go near the areas where the patients are most critically ill. The world is short of heroes and heroines and their contributions should not go unnoticed...” Most unfortunately, tragedy of tragedies, both her brother and mother succumbed. They battled SARS to the last.

Fast-forward to 11 May 2003 (Mother’s Day) and TTSH lost a long-serving Nursing Officer whose battle lasted 56 days since her hospitalisation on 12 March. She was a tower of strength, a loving nurturer, a dedicated protector, a caring comforter and a steadfast beacon to all around her, at work and at home. We lost a faithful and dedicated mother and nurse.

GHOST TOWN?
The retail outlets at our Atrium saw diminishing returns since 22 March. They cut down their operating hours and then they closed. On 28 March, Polar Café, Standard Photo and Starbucks closed. Soon the others followed suit – Astoria Florist, Fa Salon, Norgen Vaz, Pearl’s Optical, and finally on April Fool’s Day, Assisted Living and Food Junction shut their doors. As of 1 May 2003, all have remained closed. The new 1.99 shop had not even opened and press reports mentioned that the company had gone into liquidation (not due to TTSH nor to SARS). The only shops open throughout were 7-Eleven and Nes Cafe. All staff of TTSH are grateful for the convenience they provide – always close and never closed?

Fast-forward to 28 April and 2 May, when Norgen Vaz and Fa Salon have re-opened for business respectively. Great faith they have in TTSH getting back on her feet.

THE OPERATIONS ROOM
On 12 March 2003, WHO issued the global health threat alert on SARS. MOH alerted all registered medical practitioners on this in its circular of 13 March.

Friday 14 March 2003 was a bright, clear, and cold day for me in London. That night, I was to board SQ 322 for Singapore. Friday 14 March 2003 at TTSH was different. The number of cases of SARS was creeping upwards. Patients had landed in the ICU and were being ventilated. By late afternoon, the decision was made to activate our Emergency Operations Centre. Staff worked till late into the night to get it operationally ready. All the charts were put up, essential personnel listed with contact numbers and rosters made to man the place continuously over day and night. This was day one of the OPs Room (rather it was night when finally set up).

Saturday 15 March 2003 was the first official meeting at 9 am in the OPs Room. Army style briefing was conducted. First, there was a “sit rep” or situational report i.e. the number of patients, which wards, status of patients, were

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they improbable, suspect or for observation, how many in ICU, how many on ventilators, beds occupied, and so on. Each new admission was reviewed – was there a contact, who was the contact, and on a big white board, each case was linked to another – a new kind of web was being recorded. Were the contacts being traced and surveyed? At that time, there was no quarantine order and it was the first day of the week-long school holiday period. Families were going off to Hong Kong and China. Then each representative of an area of responsibility presented the happening of yesterday and sought advice for any problems encountered – be it supplies of masks, policies of MOH or TTSH queries from public, manpower needs of nurses, doctors, contact tracers, and so on. Also how SOC was functioning, how ED was being overwhelmed (as usual), and later (from 24 March), reports from the paediatric doctor, and later still, from the SGH doctor (7 April).

After each meeting, lasting about an hour, subgroups would meet to work out further details. Clinical Heads would meet at 11 am, and when SOC started to see patients again in mid April, the meeting time was shifted to 12.30 pm.

And so things were made as transparent as possible to all. We were facing a common, unknown, contagious, dangerous and deadly enemy. Fears and concerns had to be addressed and managed. When sufficient experience and information became available from these meetings, the hospital senior management held open seminars with all staff. These were held on Saturday 22 March, and again on Monday 1 April.

MINISTER OF STATE VISITS TTSH
The Minister for Health visited on 19 March 2003. There was little, if any publicity about the visit. The Minister of State who is a medical doctor visited us on 3 April. All staff were invited to the Lecture Theatrette to meet with him. Being a staff member of TTSH himself some years back, he was warmly welcomed and he himself felt at home amongst us. What surfaced prominently during the dialogue were the discriminations and ostracisms faced by staff. They were being shunned, booted out of homes, avoided by lay public on trains, buses, food courts and lifts. They were told to stay indoors and not mix with others. Buses would not stop for them to alight or board at the bus stops around TTSH. Their families too were under pressure. School-going children were specially treated by their teachers and classmates. With this feedback, public education was put into top gear to manage the fear that was pervading and gripping the community at large. What followed in the days thereafter were well wishes, cards, gifts, letters to the press, and by no means least, the Courage Fund (11 April 2003).

I quote excerpts from 2 tributes. The first is from Yahoo.com (14 April 2003).

“Dear Sir,

Please convey this message to all the working staff of TTSH; we, the people of Singapore are very proud of each and every one of you. Your sacrifices and perseverance in this “fight” against “SARS” have put many of us to shame (especially me!). You have shown through your deeds the meaning of the words “service to mankind.” From the deepest of my inner being, we salute you! From the bottom of our hearts we pray that all of you stay in the pink of health and may God bless and keep you and your families in good health. May all patients currently undergoing treatments recover in quick time. May good thoughts and prayers of all Singaporeans be with all of you. Remember, “you never walk alone”, we are with you all the way till victory come! Take care and may the Great God bless you again.”

The second is from the Straits Times titled “Medical Heroism” by a doctor.

“Like any other people, Singaporeans need heroes and role models. We often turn to people featured in the media, that is, celebrities, sports personalities, politicians, successful entrepreneurs and so on. Media attention may be the last thing on the minds of the staff of TTSH but perhaps this is precisely what they need: positive media attention. I can think of no better role models for young Singaporeans than these people. They are waging war against an unseen enemy and may be struck down at any time. They continue to give their heart and soul to the battle, even when their colleagues fall victim to the deadly virus. They show tremendous resolve in even setting foot outside the security of their home every day... Let us rally together in support of our heroes instead of treating them like the enemy. Give all of them, from doctors to hospital attendants, the recognition they so rightly deserve.....”

EXCISION BIOPSIES
With TTSH declared the SARS dedicated hospital, any patient with fever and a contact history was transferred over to us. On 4 April, TTSH had 94 inpatients, 11 of whom were in the ICU. The sixth death from SARS occurred. She was the lady from Beijing returning home as the fourth imported case. She had gone from the Singapore airport by taxi to Singapore General Hospital (SGH) and then was transferred here. Yes, SGH did the correct thing – it transferred her to TTSH immediately.

Next day, 5 April, a cluster of febrile patients was found in SGH Wards 57 and 58 – a general surgical ward. Post-operative fever? Infection? Complication from surgery? Fever altogether on the same day? And 10 staff also febrile the same day? Answer – SARS had popped up at SGH.

Prior to this, there was a SARS-related death also at National University Hospital (NUH). We discovered that those with medical/surgical illness plus SARS (through having been in TTSH before 15 March as inpatients) were more difficult to diagnose as SARS, in part because the doctors thought their medical/surgical diagnoses were sufficient causes for their fever, or they were too ill to mount fevers
of 38°C to meet the case definitions of SARS. But clustering of febrile patients was the red flag.

So over the weekend, Saturday and Sunday 5 and 6 April, SGH “excised” Wards 57 and 58 and sent them, patients and staff including the doctors caring for patients in those wards, to TTSH. This draconian move was completed on Monday. At TTSH, the SGH team of doctors and nurses managed these patients. Over succeeding days, the “biopsy” results confirmed SARS in more and more patients, some of whom took seriously ill, landed in the ICU, and even died.

At TTSH under the SARS microscope, with heightened awareness and sensitivity to all that relates to SARS, the “biopsy” was more confidently diagnosed and proper management instituted. With no definitive diagnostic test, SARS remains a clinical diagnosis and as experience accumulates and resides within TTSH, this remains the best and also the safest hospital to deal with problems related to this disease.

Fast-forward one month to 7 May 2003, and a cluster was forming at the Institute of Mental Health (IMH). Some 30 patients (and staff) were warded in TTSH by 13 May. Patients of Wards 64 and 65 were affected. However this “excision biopsy” was somewhat different to that in SGH. When patients at IMH developed fever, they were sent to Alexandra Hospital (AH) for medical management since only psychiatrists are based at IMH. So AH doctors began collecting these patients and when there were four or six with pneumonia, alarm bells sounded. So further transfers to AH were stopped as the diagnosis in a few of these patients was not nosocomial pneumonia but atypical pneumonia, probably viral. As far as we know, there were no contacts with SARS patients but the clinical picture could well go with viral pneumonia. Therefore, IMH patients and staff with fever were instead directed to ED, TTSH for assessment, and warded at TTSH if needed. It could not have been possible to excise many IMH wards and transfer their patients to TTSH. We do not have such capacity as one ward of IMH could house up to 100 patients. Some three days later, a few tested positive for influenza virus B.

CONCLUSION
From 25 February 2003 when our first patient took ill, or from 1 March when she was hospitalised at TTSH, or from 14 March when TTSH was geared up to handle SARS with an operational Ops Room, or from 22 March when TTSH became the declared, dedicated and designated hospital for SARS in Singapore, whichever date you feel is appropriate, there are many lessons to learn about this new disease. Tuberculosis was the scourge some 50 years ago. It is still not conquered. Singapore was one of the countries that helped in research on short course chemotherapy for tuberculous pneumonia. Today, we are still battling TB with DOT (Directly Observed Therapy) and STEP (Singapore TB Elimination Program). Some 20 years ago, TTSH became the HIV/AIDS centre for Singapore. Again, many drug trials have involved our patients, and combination therapy is the norm today but still not curative.

And today, we are challenged by SARS. With worldwide co-operation among clinicians, scientists and researchers battling SARS, and with WHO and CDC Atlanta support and backing, TTSH staff are very much involved in these activities (together with SGH pathologists, microbiologists, and others from the Genome Institute of Singapore). There is hope yet for a better tomorrow in dealing with the Urbani SARS – associated coronavirus and the disease it causes.

Editorial note:
The following poem was recently written by an SGH medical officer, contemplating his impending night call. Interestingly, however, that particular call, turned out to be one of his better calls.

NIGHT CALLS
After midnight
When all the world, has gone home
and stillness sweeps the wards.
The metal beds creak
An asthmatic coughs.
And the whole hospital
is like an old man –
groaning.

Alone, the A&E has fifty patients waiting,
driven by air currents, unseen

On call, even non-believers pray
For when courage
and stamina give way,

Science bends its head to superstition...

Adrenaline is its drug
I have grown accustomed to treading water
some others around me, drown.

The HOs don’t eat PAO
For when courage
and stamina give way,

I rise again
The Fury
Chaos bellows its head in defiance

Science bends its head to superstition...

Adrenaline is its drug
I make the doctors superhuman.

When night comes, I realise
I am a man, alone.

When night comes, I realise
I am not a doctor
I am my mortal elements –

I am my mortal elements –

Adrenaline is its drug
I make the doctors superhuman.

When night comes, I realise
I am a man, alone.
The virus for SARS was identified within one month of the disease being known. It is the coronavirus. And some eight weeks later, the civet is thought to be the most probable animal from which the virus jumped to infect man. However, unlike zoonoses, this infection can spread from human to human and not just from animal to man. Further, SARS has proved fatal and to date in Singapore, there have been 33 deaths among 206 infected with the virus.

Although the epidemic seems to have died down – Hong Kong was taken off the list of countries with local transmission on 23 June 2003, while China, Taiwan and Canada were removed by 6 July 2003, and no country remains on the WHO list – there are predictions that the coming winter might see a resurgence of SARS or some other novel viral infection. So we need to be prepared. At the personal level, how?

PPE stands for personal protective equipment. This is what I want to discuss in this article. The fact that personal protection is effective at all stems from our understanding of the transmission and infectivity of virus infections. This understanding is just over 200 years old.

HISTORY
The 19th century saw the beginnings of modern medicine. Two important advances so altered the course of medical history that concepts of illness, methods of treatment and hygiene practices at the end of the century bore only a slight resemblance to what they were at the beginning. These two advances were anaesthesia and the discovery of microorganisms as causes of disease.

The organisation of physicians, hospitals and public health activities arose out of the 19th century after alterations brought on by the Industrial Revolution. Before the discovery of bacteria as the cause of disease, the principal focus of preventive medicine and public health had been sanitation. The invention of the water closet by John Harrington (1561-1612) facilitated flushing away human waste and kept dwellings clean.

However, at Amoy Gardens in Hong Kong, this failed. The outbreak of SARS was traced to the faulty sanitation system in one block of apartments. There was no water trap to prevent the backflow of faecal material into the homes. And so instead of just spread of SARS by droplet infection, it was discovered that SARS could also spread by the oral-faecal route.

Going back to the first century, Varro had said that swampy land was dangerous because “certain minute animals, invisible to the eye, breed there and borne of the air reach the inside of the body by way of the mouth and cause disease”.

In the middle ages, shunning lepers, fleeing from areas of pestilence and segregating the severely ill all represented awareness that diseases could be transmitted.

In the 16th century, Fracastoro demonstrated his perception that there were “seeds” in the environment, which could multiply in the body and produce disease. His contemporary Giralamo Cardano reasoned that these “seeds of disease” were live creatures.

Leeuwenhoek in the 17th century discovered microscopic creatures. In the late 18th century, Agostino Bassi of Lodi suggested that many contagious diseases such as smallpox, typhus, plague and cholera were also due to live organisms.

A battle emerged between those who believed that diseases were definitely contagious and those who ascribed epidemic illness to causes such as environmental change and internal bodily derangement. By the 18th century, anti-contagionists noted that quarantine was not convincingly successful and that an epidemic such as yellow fever was often terminated by weather changes. Further, they observed that even people in contact with yellow fever victims did not necessarily contract the disease. (They did not know that mosquitoes were responsible for transmitting the infective agent or that their absence in winter ended the threat of being bitten and infected.)

That epidemics were most frequent in crowded slums was interpreted by the anti-contagionists as additional evidence that the environment was the prime cause – unhealthy air, poor food, and polluted water – rather than living creatures.

However, by then, Edward Jenner had introduced a new concept of creating immunity to a dangerous disease by producing an entirely different mild illness through vaccination.

Semmelweis (1818-65) used statistics to assemble facts and analyse the obstetric happenings in Vienna with regard to puerperal sepsis to prove the contagious nature of postpartum infection. He noted two different mortality rates – one was high where medical students were trained (10-20%), chiefly due to puerperal fever, versus another where mid-wives were trained for the job (3%). He discovered that doctors and students normally came to the ward to examine patients, directly from the autopsy room. In contrast, the midwives did not attend autopsies.

To Semmelweis, the next step was clear: physicians and students under his charge were to wash hands with soap and water and soak them in chlorinated lime solution before entering the clinic or ward, and to repeat this after each examination. Despite complaints, he persisted in his demands. Over the next few months, the 18% obstetrical death rate declined to 1.2%. Awed by this result, the chief of service,
apparently for personal reasons, condemned Semmelweis, arranged for him to be lowered in rank, and limited his practising privileges when he reported his results to the Medical Society of Vienna. His paper was greeted with virulent attacks. He was so hurt that he returned to Budapest where his methods effected a marked diminution in mortality rates. Semmelweis could be credited with having for the first time constructed a statistically tested system of asepsis (keeping germs away from the patient) before the germ theory had arrived.

Joseph Lister (1827-1912) was in Glasgow, in an intellectual climate modified by works on infections and germs. Among a variety of substances used on wounds from earliest times, some like urine and turpentine were probably antiseptic in effect while others no doubt contributed to infection.

Lister saw the frequent severe infections attending operations as additional evidence that something circulating in the air was responsible – possibly invisible particles which he called “disease-dust”. When Pasteur’s work of 1860 was brought to his attention, he appreciated the connection between his own observations on wounds and the microscopic bacteria involved in fermentation. Pasteur used heat to sterilise. Lister sprayed carbolic acid over the patient during an operation to kill any bacteria before they could grow in the wound. In 1867, he published a paper in the Lancet on his experience with 11 cases and he gave full credit to Pasteur’s work.

However, surgeons remained generally unconvinced. The leader of American Surgery, Samuel Gross, in late 1878 wrote, “Little if any faith is placed by any enlightened or experienced surgeon on this side of the Atlantic in the so-called carbolic acid treatment of Professor Lister.” Lister’s great contribution was to emphasise in the minds of surgeons the necessity for getting and keeping wounds free of contamination.

The employment of rubber gloves in operations was an innovation of the early 20th century. When William Halsted introduced them to protect the hands of his OT nurse (whom he later married), one of his students suggested their use by operators too, since they could be sterilised. At first, the gloves were relatively thick, and many refused to wear them. Even when the rubber was made thinner, some operators, especially in Europe, wore sterile cloth gloves over the rubber. (Masks were brought in even later, and as recently as the 1940s and 1950s, many highly placed surgeons left the nose uncovered, wearing the mask over the mouth only.)

**BUGS TODAY**

In microbiology today, microorganisms are classified into the Cellular and Unicellular kingdoms. Under the Cellular kingdom are three groups of organisms – Prions (protein particles less than 5nm), Viroids (comprise single strand of RNA e.g. hepatitis D virus, also less than 5nm) and viruses (20-200nm). The Unicellular kingdom is subdivided into two – Prokaryotic cells (20-200nm) consisting of chlamydia, mycoplasma, rickettsiae, bacteria and mycobacteria; and Eukaryotic cells consisting of fungi and protozoa. At 200nm, the mycobacteria are the smallest free-living microorganisms. There are 16 families of viruses that infect humans, of which coronavirus is one of them. The size of the coronavirus is about 60-100nm.

The SARS virus represents a novel group of coronavirus that is distinguishable from the known human and animal corona viruses. Evolutionally, it is situated at an equal distance from groups II & III coronavirus and is now classified as the sole Group IV coronavirus. As a family, coronaviruses usually cause respiratory and enteric infections. The virus contains a 27-32kb RNA genome encoding multiple gene products, which are usually translated from individual mRNAs. Some gene products are processed from a large polyprotein: continuous protein synthesis and processing are necessary for viral RNA synthesis. Therefore, viral proteases are important potential antiviral targets.

The virus encodes four to five structural proteins, including spike (S), membrane (M), envelope (E), nucleocapsid (N) and an optional protein, haemagglutinin-esterase (HE) protein.

The experience from animal coronaviruses suggests that coronaviruses tend to develop persistent infections, with a long-term carrier state. Viruses may continue to evolve as a result of recombination and mutation. The viruses may cause diseases as a result of both direct cytocidal effects and immune mediated mechanisms. The latter is particularly evident with feline and murine coronaviruses.

It is now necessary to re-look the WHO definitions for suspected and probable SARS. As reported last month (BMJ, 21 June 2003, pg 1354-8) from the Prince of Wales Hospital, Shatin, New Territories, Hong Kong, in the early stages of SARS, the main discriminating symptoms are not cough and breathing difficulty, but fever, chills, malaise, myalgia, rigors, and possibly abdominal pain and headache. Documented fever of more than 38°C is uncommon in the early stages and radiological evidence of pneumonia changes often precedes fever. Further in their study of 515 people presenting to their screening clinic (of whom 418 were without SARS and 97 with SARS), the authors concluded that the WHO case definitions for suspected SARS have a negative predictive value of 86%, a sensitivity of 26% and a specificity of 96% for detecting SARS in patients who have not been admitted to hospital. The accuracy of the WHO guidelines for identifying suspected SARS was 83%.

In another paper also from the Prince of Wales Hospital, Hong Kong, it was reported that lymphopenia was common among patients with SARS. (BMJ, 21 June 2003, pg 1358-62) Both CD 4 and CD 8 counts decreased during the early course of SARS. Low CD 4 and CD 8 lymphocyte counts at presentation were associated with adverse outcomes. The authors further stated that leucocytosis with neutrophilia, thrombocytopenia and isolated prolonged activated partial thromboplastin time were common in patients with SARS.

There is still no effective antiviral agent against the SARS coronavirus.
**PROTECTION**

While the search for a vaccine goes on, we as healthcare workers need to take care of ourselves. If we fail, the end result could be death. Hence, the need to understand the basis for the use of various equipment, and not only to understand, but also to use the equipment properly one hundred percent of the time. Otherwise, there is little benefit if any, and worse, a false sense of security.

Guidelines have been issued by the Ministry of Health (MOH), and guidelines from other countries and agencies are available on the Internet. These need constant updating as SARS the disease continues to be unravelled and new lessons learnt. Guidelines should be followed from the point of patient presentation until their discharge. To the many frontline doctors, that patient before you could be suffering from SARS. From 1 July 2003, Tan Tock Seng Hospital (TTSH) has opened its Emergency Department to the public at large and is not catering solely to the work of SARS screening. So in a way, the risk is dispersed back to doctors in the community. Healthcare workers caring for patients with SARS are at risk of contracting SARS. Personal protective equipment is mandatory to prevent transmission of SARS in healthcare settings. Further, in view of the atypical presentations of SARS in patients with multiple medical problems or on immuno-suppression drugs, a very high index of suspicion is necessary. And this is especially so, as the reliability of a travel history to SARS-affected areas has lessened. So if there is any uncertainty, this is especially so, as the reliability of a travel history to SARS-affected areas has lessened. So if there is any uncertainty, there should be no gaps on either side of the mask. When worn correctly, it is comfortable and provides good ventilation. Before the SARS crisis, surgical masks were sold at about 60 cents each, and come only in adult sizes. But because of SARS, the price rose to between S$1.50 and S$3 each. These masks are effective in preventing the spread of infectious diseases by droplets such as the flu. The patient/sufferer wears the mask to prevent him/her from spreading the disease to those around. Masks also prevent the wearer from touching their noses and mouths. An effective barrier mask has nose clips allowing no room for gaps. Masks made of woven materials such as cotton or gauze do allow viral particles through them, and so while they may look cute and decorative with cartoon characters, cloth masks will not give adequate protection.

So in the tradition of the Japanese, when a person has a cold or cough and needs to go out and mingle in public places, he or she will wear a surgical mask. The purpose is to not spread germs into the air when he or she coughs or sneezes. This is civic consciousness of a very high degree and this practice is worth emulating.

**Masks**

On 6 April 2003, the Sunday Times Life Section ran an educational piece on masks and showed pictures of different types of masks available for sale in the pharmacies. But are they necessary or even effective?

Three types of masks were showcased; the paper mask, the surgical mask and the N95 mask. The paper mask allows anything with a diameter less than 5 microns (or 5000 nanometers) to pass through the paper and into the respiratory system. It offers little protection against viruses, as it has no filter (unlike the 3-ply surgical mask). It tears easily because of moisture from saliva. People who serve food can use it for hygiene purposes but not those with a cough or cold.

The surgical mask is what surgeons are supposedly used to wearing. It prevents droplets and viruses more than 4 microns in diameter, from passing through. It is made of paper with a gelatinous layer. It must be changed every four hours or once it becomes wet with fluid. For those who wear spectacles, water vapour will keep forming on their lenses. When wearing, the mask must be opened with the pleats facing downwards to cover the face completely. The nose clip must be adjusted to conform to your nose and there should be no gaps on either side of the mask. When worn correctly, it is comfortable and provides good ventilation.

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**N95 Mask**

The WHO approved the N95 mask for use by medical staff as well as patients with confirmed or suspected SARS. N95 masks generate static electricity, which is effective in stopping very small particles from getting on the surface of the mask. They are made of polypropylene fabric, using a non-woven technology that increases the density and filtering function. Small particles above 0.3 microns cannot pass through (0.3 microns equals 300 nm). N95 masks are used to protect against highly transmissible respiratory infections such as tuberculosis (which as mentioned before is 200nm in size). “N” actually stands for NIOSH – The National Institute for Occupational Safety and Health of the USA, and “95” reflects the filter efficiency of the mask. So “N95” means the mask is 95% efficient at filtering out particles of a size of approximately 0.3 microns and above. And a N100 mask has a 99.7% efficiency of filtering out these small particles. They are tested using an aerosol of sodium chloride. The coronavirus is about 100nm in size and when expelled from patients, it is usually bigger than this in size because it is enveloped in saliva as droplets. But if the droplet dries up in the environment to leave the virus intact, the mask is still more than sufficient (if correctly worn) to prevent the virus reaching the respiratory tract through the mouth and nose (but the mask does not protect the eyes) because of the static electricity of the mask.
N95 masks were sold at pharmacies for S$2.95 each but the price rose to between S$4 and S$5 when SARS hit Singapore. Mask fitting is a critical process for N95 masks to prove effective. Hence it comes in different sizes, each with its code number. To wear the mask, you need to press the mask firmly against your face with the nosepiece on the bridge of your nose. The two bands are then positioned, the top band high on the back of your head and the lower band below your ears. Both hands are used to mould the metal nosepiece to fit the nose shape. To test fit the mask, both hands are cupped over the mask and with vigorous exhalation, no air should leak around the margin of the mask. If air leaks, the nosepiece and bands are adjusted to see if a better fit is possible. If this is not possible, change to a different size of mask and repeat the procedure. When there are no air leaks, a confirmatory test is necessary. In this test, after you have worn the correct size mask properly, a transparent hood with leaks, a confirmatory test is necessary. In this test, after you have tested to your face. Remember the size and number of this mask e.g. for 3M brand, it may be 8210 or 8110S, or 1860. So if you change the brand of mask, to ensure your own protection, you must undergo the same stringent fit testing again.

Therefore, in the MOH guidelines issued on 26 April 2003 in a booklet form, there are clear guidelines on the use of this Respirator (High Filtration) mask. On page 12, it states: “The N95 respirator or equivalent mask must be used according to the manufacturer’s instruction and fitted so that there is a proper seal between the mask’s sealing surface and the wearer’s face. It must be secured over both the nose and mouth.” Under “Fit Testing”, it states seven points worth restating here:

1. Every health care worker must be fit tested for the appropriate size.
2. A qualified person must carry out fit testing for every health care worker.
3. Once fit tested appropriately, the health care worker must use the same model and size.
4. The self-seal check/fit check is mandatory for every staff on every occasion: on first fitting on the respirator, on reapplying the respirator and when the respirator is dislodged.
5. The fit test should be repeated before a different model of mask is used.
6. The wearer must be clean shaven. Beard, stubble or long moustaches may cause leakage into the respirator.
7. Individuals with a compromised respiratory system, such as asthma, should consult a physician before wearing the respirator.

In the hospital setting, it is the responsibility of the Chairman of Medical Board to ensure that every healthcare worker dealing with SARS patients, is fit tested before he or she can interact with such patients. In the private sector, the Singapore Medical Association took on this role of ensuring that doctors had access to proper fit testing. In an email announcement from SMA on 25 June 2003, it stated that SMA had organised 10 sessions of mask fit testing and the final two were being arranged on Saturday 28 June and 5 July from 2 to 4 pm at the Alumni Medical Centre. So after SARS has been controlled, each of us should now be equipped with a mask of a certain brand and size fitted to our facial anatomy such that it is indeed effective protection when properly worn at the appropriate times. Further, each of us should know where to get supplies and who to contact. In another SMA announcement dated 30 May, 3M N95 1862 masks cost $54 per box of 20 respirators, while 3M N95 8810 costs $39 per box of 20 respirators. Another brand Draeger N99 Piccola FFP3V cost $84 per box of 20 respirators.

Wearing the mask makes normal breathing difficult. All air getting into your respiratory tract has to go through this filter to be effective. Hence wearers need periods of respite from the mask, maybe after wearing it for 20 to 40 minutes. Once worn in the presence of a SARS patient, the mask should be considered potentially contaminated with infectious material and touching of the mask should be avoided. After removing the mask with gloved hands, it should not be reused. If there is no contamination, soiling or damage, reuse may be considered and again the MOH guidelines on page 13 state that to do so, “implement a procedure for safer reuse to prevent contamination through contact with infectious droplets on the outside of the respirator”. Another way is to use a surgical mask over the respirator and then discard the surgical mask.

When these N95 masks were first marketed, their primary use met the CDC guidelines for mycobacteria tuberculosis control. As a respirator, it is intended to reduce wearer exposure to certain air-borne particles in a size range of 0.1 to more than 10 microns including those generated by electrocautery, laser surgery, and other powered medical instruments. It is also designed to be fluid resistant to spray, splash, spatter and aerosol of blood, body fluids and other infectious materials. For now, we have used it to combat the SARS coronavirus and we appear to have been successful.

SURGICAL MASKS

In the Lancet issue of 3 May 2003, an article was published titled “Surgical masks likely to protect against SARS”. The author is Dr WH Seto from the Queen Mary Hospital in Hong Kong who did a case control study using 13 staff members infected with SARS and 241 uninfected staff members who had been exposed to 11 index patients with SARS. “Gloves, gowns and hand washing together are not as effective as masks and surgical masks provide the best protection for exposed health care workers. Masks seem to be essential for protection. The other three measures (without the mask) add no significant protection.” He reasoned that this finding fits well with droplets transmission because droplets are generated at the face level, thus making the mask crucial for protection.
NEW FINDINGS
But the virus is now thought not only to spread by droplet but also by fomites so that people can catch the virus without face-to-face contact with a sick person. The WHO released findings from experiments in Hong Kong, Japan, Beijing and Germany that showed that the SARS virus can survive on common surfaces at warm temperature for 24 hours or even days. It can also remain viable in human waste for as long as four days. (Straits Times, 5 May 2003, pg 3, col 1-7) So it might be possible to become infected from touching a tabletop, doorknob or other objects. Also it could spread through apartment buildings, hospitals and other facilities. The virus appears to survive longer as the acidity in the stool decreases. The Japanese scientists showed the virus could survive for extended periods in the cold. The virus died at 37ºC and above (that is why the body mounts a fever), started to deteriorate at 4.4ºC, but seemed to remain viable indefinitely when temperatures dropped below 0ºC. Scientists in Beijing reported similar results.

So Dr Klaus Stohr, the WHO’s top SARS scientist said that a key unknown was how much virus was necessary for someone to become infected. The virus has the capacity to stay in the environment but we do not know whether it can survive in sufficient quantities to be dangerous. He emphasised that by far, the primary mode of transmission was through droplets that spray out when an infected person sneezes or coughs.

So to summarise the mask matter, for sick people, give them a surgical mask so that those around them can be protected from their bugs coughed or sneezed into the air. For healthcare workers, protect yourself with a well-fitted respirator mask. Ensure adequate supplies of the size that fits you. In Taiwan, villagers strapped bras to their faces to guard against the SARS virus due to the shortage of surgical masks. (Straits, 9 May 2003, pg 8) It is incorrect for use as surgical masks (unless Dr Seto’s results are confirmed) and bras are not the correct substitute either. “Have mask, will travel (on business)” so said a headline on the Straits Times of 7 May 2003 (pg H1). It reported that a banker travelling to Shenzhen arrived with a facemask providing industrial level protection. Depending on how long he is there, one mask may prove insufficient for his needs.

THE 3 ‘G’S
Gloves and gowns and goggles are meant to protect hands, body and arms, and the eyes from splashes of body fluids and direct contact with patients and secretions, beds and other furniture. Guidelines for their use are adequately covered in the MOH publication referred to earlier. Goggles or eye protection should cover over spectacle if these are routinely worn. Gloved hands should not touch the eyes or eyelashes at any time. Gowns should cover body, upper arms and forearms down to the wrists and be tucked under the gloves. Except for the addition of goggles, gloves and gowns are part of universal precautions, which became important and critical when HIV came to Singapore over 20 years ago.

UNIVERSAL PRECAUTIONS
These apply to protect against exposure to blood and body fluids:
1. Appropriate basic precautions are required to prevent skin and mucous membrane exposure when contact with blood and other body fluids of any patient is anticipated. Gloves should be worn for touching blood and body fluids, mucous membranes or non-intact skin of all patients, for handling items or surfaces soiled with blood or body fluids and for performing venipuncture and other vascular access procedures. Gloves should be changed after contact with each patient. Masks and protective eye wear or face shields should be worn during procedures that are likely to generate droplets of blood or other body fluids, to prevent exposure of mucous membrane of the mouth, nose or eyes. Gowns or aprons should be worn during procedures that are likely to generate splashes of blood or other body fluids.
2. Hands and other skin surfaces should be washed immediately and thoroughly if contaminated with blood or other body fluids. Hands should be washed immediately after gloves are removed.
3. All healthcare workers should take precautions to prevent injuries caused by needles, scalpels and other sharp instruments or devices during procedures; when cleaning used instruments; during disposal of used needles; and when handling sharp instruments after procedures.

For laboratory workers there are yet other precautions:

a. Biological safety cabinets should be used whenever procedures are conducted that have a high potential for generating droplets.

b. Mechanical instead of mouth pipetting devices should be used for manipulating all liquids in the laboratory.

c. Laboratory work surfaces should be decontaminated with appropriate chemical germicide after spills and when work activities are completed.

d. Equipment must be properly cleaned and decontaminated after use as per manufacturer’s instructions.

e. All persons should wash their hands after completing laboratory activities and should remove protective clothing before leaving the laboratory.

SELECTION OF GLOVES
Medical gloves include those marketed as sterile surgical or non-sterile examination gloves made of vinyl or latex. General purpose utility (“rubber”) gloves are also used in the healthcare setting but they are not promoted for medical use. There are no reported differences in barrier effectiveness between intact latex and intact vinyl used to manufacture gloves. Thus the type of glove selected should be appropriate for the task being performed.
These are the general guidelines recommended:

1. Use sterile gloves for procedures involving contact with normally sterile areas of the body.
2. Use examination gloves for procedures involving contact with mucous membranes.
3. Change gloves between patient contacts.
4. Do not wash or disinfect surgical or examination gloves for reuse. Washing with surfactants may cause enhanced penetration of liquids through undetected holes in the glove. Disinfecting agents may cause deterioration.
5. Use general purpose utility gloves ("rubber") for housekeeping chores involving potential blood contact and for instrument cleaning and decontamination procedures. Utility gloves may be decontaminated and reused but should be discarded if deteriorated.

For SARS prevention, examination gloves are recommended as they are tight fitting over the wrist and can overlap the long sleeves of the gown, leaving no part of our forelimbs exposed. At TTSH, staff are issued with ABT and Shamrock gloves, non-sterile and made of latex. For sterile surgical gloves, Ansell and Maxitex gloves are used, both of latex material also.

There is a different type of gloves available locally where chemicals that are antibacterial and antiviral are released in the glove. It is called ProTek disposable gloves, distributed by SembCorp Express (Tel: 6462 8463). The ProTek glove is an innovative product proven effective to control bacteria and virus cross contamination. It is powered by the patented Microlite system with unique properties. It actively controls and reduces disease-causing bacteria both on hands and gloves. It is activated by normal light and it generates a patented microatmosphere that kills bacteria both inside the glove and on the entire surface of the glove. Microlite is a sustained release system that releases chlorine dioxide, the active ingredient that kills six types of microbial organisms: viruses such as HIV, polio, rotavirus, herpes and echo; bacteria like E coli, salmonella and staphylococcus; spore formers like bacillus and clostridium; moulds like aspergillus and chaetomium; protozoa like giardia, cryptosporidium and algae. In the Microlite system technology, the molecular photocells are activated by light which then generates a chlorine dioxide microatmosphere. The use of chlorine dioxide is known to be safe, is stable in normal atmospheric conditions and is commonly used to treat drinking water. It does not produce by-products or mutagens. There are two material forms of ProTek gloves – polyethylene (which is cheaper) and polyvinyl chloride.

So besides gloves being just a barrier precautionary measure, ProTek gloves go one step further in generating chlorine dioxide, which kills certain microorganisms, on both the inside and outside of the gloves. Of course it has not been tested against the SARS virus so I mention these gloves for information only and not as a recommendation.

REMOVING PPE

There are definite steps of putting on and removing the PPE. When putting on PPE, the purpose is to protect oneself rather than keeping the gloves sterile for the patient's benefit (i.e. asepsis). Nonetheless, gloves are still worn last. The mask is worn first and properly adjusted to ensure proper fit. Then goggles are next, if they are required. Ensure that the goggles and the mask both provide protection without compromising the safety of each, i.e. the mask should not be moved or displaced by the goggles. Next comes the gown, and finally the gloves, with overlap of gloves over the sleeves of the gown.

In removing PPE, the gown comes off first and is disposed of without its external surface touching any part of the body. It goes into a container/bag meant for biohazardous waste. Next off are the gloves, followed by handwashing to ensure clean hands next touch the face. The goggles are removed next (to be cleaned, disinfected and reused), and finally the N95 mask. In between removal of the goggles and the mask, the hands should not touch the face nor rub the eyes. After the mask is off, you need to decide if it is to be reused or thrown away. If the latter, it enters the bag with the gown and gloves. If it is for reuse, it must be kept clean, preferably in a Ziploc bag, and sealed. Hands are washed again after touching the mask (as the outer surface is deemed to be contaminated).

Remember that it is important after having touched any of these “soiled” equipment, which are potentially infectious on the external surface, not to use your hands (whether gloved or not) to touch any part of your face including the eyes, nose and mouth i.e. mucosal surfaces. You can only do so after the hands are thoroughly washed and deemed clean rather than contaminated (through having touched some part of your PPE in situ on your body).

CONCLUSION

This article has been written based on the experience of the SARS epidemic as it affected Singapore. We were declared SARS-affected on 20 March 2003 and then SARS-free on 31 May 2003. As mentioned in Parliament at the end of June 2003, we spent over S$190 million on direct purchase of equipment of which the PPE were the majority. There is also the Powered Air Purifying Respirator (PAPR) which is worn in really high risk environments with aerosolisation occurring, like in the MICU, the operating theatres or when doing bronchoscopies.

I hope the information given can be thoughtfully used should another outbreak of infectious disease occur. SMA has a list of suppliers and distributors of PPEs, and hopefully also, a system of bulk purchasing co-ordinated by the Ministry of Health such that in the global market place, we can buy the equipment when the need arises, at appropriate prices. If nobody wants to sell them to us in Singapore, then we may have to plan for local manufacture of these PPE. If nature afflicts us with outbreaks and we need so much resources to manage them, can we imagine the havoc of bioterrorism ordained by men upon us? How much more prepared must we be and what does it take to reach such levels of preparedness? Who is thinking about these scenarios? We should.
SARS and MOH (Part 6)

By Prof Chee Yam Cheng, Editorial Board Member

Editorial note:
The following article was submitted on 5 August 2003. Contents are current at the time of submission.

On 22 February 2003, in the British Medical Journal (BMJ), page 416, was a report titled: “Pneumonia causes panic in Guangdong province.” It mentioned a serious pneumonia epidemic that seized people with fear and there were already eight deaths. During the first week of February, the public became aware of a mysterious respiratory illness, which apparently had a very high mortality and caused death within hours. Symptoms included cough, fever and breathing difficulty. An epidemic of rumours began as there was a notable absence of public statements and official information. The media was unable to communicate much. The timing coincided with Chinese New Year and a week-long public holiday. So people spread their fears and newfound information by telephone, mobile phone, text messages, e-mail and word-of-mouth.

What were these rumours? One, the condition had no apparent cure but vapourising white vinegar would help kill the infective agent. So there was a dramatic increase in sales of white vinegar, cold and flu preparations, and Chinese herbal tea. Prices increased by up to 12 times the original price. Two, people wore protective facemasks, avoided crowded restaurants and other crowded places. Any mask it seemed would do. There was economic damage. Three, many of the victims of the illness were hospital staff and a number of them had died. As a result, outpatient departments almost emptied. Four, 100 people had been struck by the mystery illness at the World Trade Centre building in the middle of Guangzhou. The centre’s management responded by disinfecting the whole building and they subsequently vapourised white vinegar through its ventilation system.

On 11 February 2003, an official statement was made by the Guangdong Department of Health. The officials announced that the first case had occurred in November 2002, but as it was common for influenza-like infections to afflict the community in the winter months, there had been no undue concern. As of 22 February, there had been 345 cases in eight cities throughout Guangdong, which has a population of 80 million.

These were the early days of SARS, as yet unnamed, and as yet an unknown disease. However, just as this report in the BMJ surfaced on 22 February, three Singaporeans had travelled to Hong Kong and been guests at Hotel Metropole in Kowloon on 20 and 21 February, coinciding with the stay of a doctor who had SARS (who later died in Hong Kong on 4 March), and who transmitted the disease to at least 13 guests. The three became the first Singaporean victims of SARS, travelled home and got themselves warded in hospital (Singapore General Hospital and Tan Tock Seng Hospital) in March. On 6 March, Ministry of Health (MOH) was notified about the three persons. On 14 March, MOH was notified about another six persons, including two healthcare workers (HCWs) who were admitted to Tan Tock Seng Hospital (TTSH) for atypical pneumonia. All had close contact with the first case who had returned from Hong Kong.

On 20 March, Singapore joined the list of countries affected by SARS – China, Hong Kong, Toronto and Vietnam. On 22 March, MOH designated TTSH/CDC the hospital for the intake and solitary isolation of all suspect and probable SARS cases. On 24 March, MOH invoked the Infectious Diseases Act to quarantine all contacts who had been exposed to SARS patients. On 24 April, the Infectious Diseases Act was amended for violators of the Act to face increased penalties. This was the result of an outbreak at the Pasir Panjang Wholesale Centre on 20 April.

The World Health Organisation (WHO) on 6 March 2003 issued an alert on an outbreak of atypical pneumonia among healthcare workers in a hospital in Hanoi. On 12 March, it issued a global alert on an emerging infectious disease characterised by fever and atypical pneumonia. On 31 May, Singapore was declared free of SARS, after six people imported the disease to Singapore between 25 February and 29 April, all of whom had visited Hong Kong (including Guangdong in two cases, and Beijing in one case). Three of the cases were imported before this new disease was known, and the patients were admitted to hospital a mean of four days after the onset of symptoms, and placed in isolation six days later. One of these cases resulted in extensive secondary transmission (“super spreader”) in Singapore.

With this backdrop on the early days of SARS in Singapore and its containment to hospitals, until 20 April when the market became a site of disease transmission also, and then onto 11 May when the last case was notified (thus making 31 May our SARS-free date i.e. two incubation periods totalling 20 days), let us discuss how MOH dealt with this biological attack.

ACCOLADES

“And investor confidence in the capabilities of Singapore ministers in managing unexpected difficulties has increased after they watched how we handled the SARS crisis.” – SM Lee Kuan Yew. (Straits Times, 24 July 2003, pg 17, col 1-8.)

“To contain the spread of SARS, the government in Singapore authorised comprehensive measures; real-time flow of information through a dedicated website; temperature checks twice daily at home and in the workplace; thermal screening of all travellers at terminals; triage centres outside the entrances to hospitals for temperature checks to identify and separate SARS patients; and meticulous contact tracing and home quarantine of those exported to SARS. These measures
worked because Singaporeans trusted their government and complied with rules to combat the spread of SARS.” – SM Lee Kuan Yew. (Straits Times, 26 July 2003, pg 30, col 2-5.)

“Hng Kiang, you and your team have done a tremendous job under very trying circumstances. Thank you.” – PM Goh Chok Tong. (Straits Times, 23 July 2003, pg 1, col 1-7.)

“Experts polled give Singapore healthcare top marks.” This was the headline in Straits Times on 14 April, quoting an article from AFP and NYT. The survey was carried out by Hong Kong based Perc and followed a report that the American State Department did not, in the face of SARS, evacuate officials from its diplomatic mission in Singapore because of the quality of the country’s medical care (pg 3, col 4-6). The survey said the SARS outbreak was a “stress-test” for the region’s medical system. Of all the Asian countries, expatriates in Singapore expressed the greatest degree of confidence in the medical system’s ability to treat major illness. A considerable distance behind Singapore were Japan and Hong Kong. Singapore was however, behind the United States, Britain and Australia.

“US businesses praise Singapore’s efforts.” (Today, 25 April 2003, pg 8.) This report stated that US businesses in Singapore endorsed the extraordinary measures taken by the government to contain the spread of the SARS virus. The American Chamber of Commerce said in a statement that it would communicate all details of Singapore’s efforts to its global network as well as to US government agencies to guide corporate travel policy. The Chairman of the Chamber of Commerce said, “Singapore has taken a leadership role globally in the fight against SARS and its approach is a model to be adopted by other countries.” The Chamber said Singapore should be recognised for a “robust, highly coordinated and proactive strategy” to contain the outbreak, including the closing of schools, home quarantines and prompt tracking of the transmission chain. It praised the “open and transparent approach towards release of information about SARS”, efforts to reach out to the community and business sectors, and willingness to work with international healthcare authorities.

“BBC hails Singapore Government action.” (Straits Times, 27 April 2003, pg 3.) Singapore was praised by a BBC primetime television news programme for having “the toughest measures in the world” to halt the spread of SARS. The BBC said that Singapore was “even trying to block the virus from leaving the country”. The programme also carried an interview with Dr Ali Khan of the WHO, in which he praised the Republic’s efforts in fighting the spread of the disease. “I think the Singapore government has done an excellent job and I really would not characterise it as draconian. I would say they have put in state of the art public health measures with complete transparency.” Final words from the BBC were “Authoritarian, maybe, but it might just beat this alarming virus.”

The European and British Chambers of Commerce added their praise for the Singapore government’s transparent and proactive handling of the SARS outbreak, saying that if anyone could contain the virus, Singapore could. (Straits Times, 30 April 2003, pg 4, col 6-7.) Both Chambers believed that the way in which the Singapore authorities and the people had dealt with the crisis to date, clearly demonstrated that Singapore deserved a renewed vote of confidence from foreign investors in years to come.

On 16 May, in the Straits Times front page, is a headline: “Singapore’s rapid response to virus boosts credit rating.” It stated that Singapore’s swift handling of the SARS outbreak had helped it win a triple A rating, the highest level from global financial ratings agency Fitch. It described the speed with which Singapore confronted and isolated the outbreak as “impressive.” It also noted that the outbreak had hit consumer and business confidence hard, depressing tourism and forestalling continued recovery. It also cut Singapore’s 2003 growth forecast from close to four per cent to around two per cent.

**THE MINISTER SAID**

“We will see more cases in ICU, this is a natural progression. The message for Singaporeans is, this is going to be quite a long haul. It is not something for which you can declare victory in a matter of days, or one or two weeks.” (Straits, 25 March 2003, pg 2, col 3-4.) (As of 24 March, the number of SARS cases stood at 65, with 12 in critical condition.)

“Some are taking it a little too complacently and some are extremely concerned. Those who are taking it complacently may say, ‘Look, if I’m feverish, it doesn’t matter. I still go to work, I still send my children to school.’ That is irresponsible and selfish. The only way we can handle this crisis is if everybody works together.” (Weekend TODAY, 29-30 March 2003, pg 4, col 1-5.) (At this time, the fourth index case had reached Singapore and she caused a scare by taking a taxi from Changi Airport to Singapore General Hospital after arriving home from Beijing on flight CZ 355.)

“The disease is more infectious than we thought.” (The New Paper, 31 March 2003.) (At this time, the third patient had died and the term “super infector” was revealed to the public. There were three “super infectors” who each had spread the bug to about 20 people. “A super infector is one who is a good host of the virus and hence is much more infectious than others.”)

**THE INCOMING ACTING MINISTER SAID**

“We are leaving no stones unturned to make sure that no cases would have slipped out of the hospital into the community.... In a few weeks’ time, we will begin to cross into yellow. But the important thing is, if we need to turn orange or red again, we know what to do. Of course, a true stand down situation is green but that’s when the world is declared, really completely, SARS-free... A lot of scientists are worried that winter will bring an outbreak. So we cannot assume that the victory is complete. Until we go through that, we can never be sure.” (Straits Times, 9 July 2003, pg H1, col 2-7.)

“If tomorrow we’re hit by a serious virus that is airborne, I think we’re not ready... We’re lucky that SARS has helped us identify major areas of weaknesses: It allowed us to zero in on those areas of weaknesses. Those are the areas we will have
to fix. (This referred to the shortage of isolation rooms and facilities.) We’re tightened up for a SARS-like infection. That’s not a problem.”

“But it couldn’t have been helped. We had no choice. It was an unpleasant decision, for the larger good of everybody. It had to be done.” (He was referring to the ban on hospital visitors, as a result of which the thousands of non-SARS patients who were cooped up in their rooms were miserable.)

“The relatives may get infected, and then we have another casualty. What for?” (This referred to the very unpleasant decision to ban physical contact between SARS patients and their relatives, even in the last hours of those who died.)

(Note: Above quotes are from “We should thank our lucky Sars”, The New Paper, 20 July 2003, pg 2-3.)

MISSION STATEMENT
As you enter the College of Medicine Building and reach the red-carpeted staircase, overhead you will see a banner proclaiming the MOH mission statement: “Developing the World’s most effective healthcare system to keep Singaporeans in good health.” When SARS hit Singapore, did MOH live up to this?

It is always easy to say, “too little, too late”, and “fast, but not fast enough”, when trying to assess the performance of MOH in its handling of the SARS crisis. Yes, its mission statement is very clear about its objectives. Were 33 deaths too many? Were 206 infected too many? Could we have done just as well with less draconian measures? I will not attempt any answers. What MOH has done is clear for us to see. If there are suggestions on how to do even better, I am sure MOH would value your insights and feedback directly to the people who matter. Their email addresses are public knowledge.

SARS DEBATE 28 MARCH 2003
In The New Paper front page was the headline: “Is Singapore handling outbreak well?” That was just six days after the crucial announcement that TTSH was SARS central. That meant emptying TTSH of all its patients who were deemed well enough to be discharged. This, as subsequent events showed, led to cases sprouting up in Changi General Hospital (CGH), Singapore General Hospital (SGH) and National University Hospital (NUH). In early April, there was this concern that patients moved from TTSH could have carried the disease to other hospitals even though they showed no symptoms of it. This was especially the case if they suffered other medical/surgical illness that led to atypical presentations of SARS. But on 22 March, could we have known that? No diagnostic kit or PCR for SARS was yet available. The WHO definitions of probable and suspect cases were entirely clinical.

As reported, the debate had two sides. One said MOH and the Ministry of Education (MOE) were doing a decent job keeping on top of the SARS outbreak. Just two days before, MOH and MOE announced that all schools up to Junior College level would be closed – a dramatic turn around. “So whatever date is chosen to close the schools, someone will say it’s too early, someone will say it’s too late... There’s no straight answer. I don’t think for one moment that whoever had to decide to close schools did it lightly.” – AA President Gerard Ee.

On the other hand, Nominated Member of Parliament P Chandra Mohan Nair was reported as having said, that from day one until now, more information could have been disseminated to the public. The MOH and MOE should have been less paternalistic. He figured that the paternalism was well-meaning but said it was misplaced. “Probably the government does not want to alarm the world. So they don’t disseminate as much information as some other countries would.”

Of 10 Members of Parliament polled, none had anything negative to say about how MOH and MOE were handling the situation. However, it was reported that while MOH was not over-reacting, tertiary students felt that MOE was under-reacting to the situation.

SLOW INFORMATION? SLOW ACTION?
On 7 April, the Straits Times on page 14, ran an article by Ms B Henson, its news editor, titled: “All the right moves for SARS but info’s a bit slow, no?” At that time, all SARS cases were centralised at TTSH, and on 5 and 6 April, a cluster of febrile patients in two wards at SGH were being transferred to TTSH. When Ms Henson got wind of this, she asked the appropriate question at the MOH Press Conference on 4 April and received a negative answer. Then on 5 April, came the MOH press statement that a total of 20 nurses and one doctor in SGH from Wards 57 and 58 had developed fever. They were referred and were admitted to TTSH as suspected SARS cases.

“The kindest thing I can say about this sudden announcement is that the Ministry gets its information later than the media.” PM Goh, at the Istana on 6 April, stressed that the government will be transparent with information on the outbreak. He also cleared the air over the surprise SARS death at NUH on 31 March, and noted that the authorities had apologised for the “miscommunication.” For a good two days, the Health Minister maintained that nobody knew about the woman’s contact with SARS till the eve of her death. That was because although NUH knew, “It just forgot to tell him.” Ms Henson’s point is quick dissemination of information – and accurate information – is almost as important as transparency in a health emergency.

PM Goh’s assessment of MOH at this time was that “given the circumstances, the Health Ministry has done well.” Given the unknown nature of the virus, the Ministry could not be expected to have all the answers from the start. “So on the whole, I would say there will be room for us to do better as we learn more, but, on the whole, I think they have managed to contain the problem. They work very hard. The resources are stretched.”

On 22 April, TODAY reported on its front pages: “Why the lengthy delay...Minister asked about SARS at Pasir Panjang.” With fears of a cluster of SARS infections at the Pasir Panjang wholesale vegetable market looming, questions were being asked: Had the government been somewhat slow in taking action? Should not the market have been closed earlier, and not
at least 10 days after the vegetable wholesaler who started the infections was diagnosed with SARS? However, the Minister did not give a direct answer. He said contact tracing had been done. And he appealed thus, “This is very difficult work. Please give my men a chance. They are not detectives.” His appeal underlined the extent of the spread of SARS within the community, a departure from the earlier trend when most SARS transmissions occurred within the healthcare setting, or within the patients’ family network, usually within homes.

On 1 May, an analysis written by a Straits Times senior writer (pg 29) was titled: “Close info gap to kill those SARS rumours.” Three instances were cited where the writer felt the gap was left open. The first concerned the taxi driver who ferried a case from Changi Airport to SGH. The question was: after a taxi driver did come forward, was he the one actively involved? The second was the woman from China who vanished from the CDC. The questions were: Is she still at large? If she is, how can that happen? Were the authorities shackled, or worse, did departmental bureaucracy trip them up? Was the hunt left to the police or the Health Ministry’s Inspectors? Was a concerted effort mounted to locate her? And the last case was the Pasir Panjang market wholesaler. “But the health officials saw no need at first to check the market, because they were told he did not mingle very much with people there. Still, he infected the taxi driver who had ferried him and his wife from their flat to the market. But what really happened here? The information gap needs to be closed. Then, and only then, can we kill the rumours that feed people’s fears.”

SARS TASK FORCE
On 7 April, the Straits Times front page was headlined: “High level task force for SARS.” It was a report on PM Goh’s meeting with journalists at the Istana the day before, to explain Singapore’s approach to tackling SARS. This happened in retrospect to be about the midpoint of the epidemic as there were 106 cases (with six dead). (The final number was 206 infected, with 33 deaths.) The ministerial task force was headed by Home Affairs Minister, with other Ministers from Health, Education, National Development and Manpower as members. Four junior members were also appointed to the Committee – two doctors, Dr Ng EH and Dr B Sadasivan, as well as two Senior Ministers of State, Mr T Shanmugaratnam and Mr Khaw BW. Their job was to find answers to “what if” questions, anticipate the worst case scenarios, and have contingency plans.

SARS COMBAT UNIT
The Ministerial SARS Combat Unit (MSCU) was formed to deal with a worsening situation and the government was pouring its resources into fighting the disease in hospitals where it had created the most trouble. It was led by Mr Khaw BW, incoming Acting Health Minister from 1 August 2003, and three other doctors, all Ministers of State. Each had hospitals under their charge as follows: Dr V Balakrishnan (SGH), Dr B Sadasivan (KK Women’s and Children’s Hospital, CGH and TTSH), Dr Ng EH (private hospitals) and Mr Khaw (NUH and Alexandra Hospital.) Unfortunately, Institute of Mental Health (IMH) was left out in the cold. Mr Khaw said the priority was to bring down hospital infections and eventually eliminate them. The first task was to protect hospital workers and raise “Site Infection Control in all hospitals to as high a standard as possible.” The next step was to detect SARS victims as quickly as possible and transport them to TTSH to be isolated. (The New Paper, 20 April 2003, pg 2) As this was happening in Singapore, China had sacked its Health Minister. (Straits Times, 21 April 2003.) And in Singapore, TTSH as SARS central was doing its job very well. There was no cross-infection in its SARS ward for the past five weeks, and none in its non-SARS wards for three weeks.

MOH POWERS
MOH too has its SARS task force comprising senior staff (doctors and administrators) of public hospitals. It is chaired by the Director of Medical Services (DMS). It started functioning in the middle of March 2003. Later, the private hospital officials were also invited to sit in. It also had various representatives from WHO and from CDC. Chief of Medical Corps, Singapore Armed Forces (SAF) was also represented. It was necessary to mount a national response to this biological attack, as the virus respects no borders, no organisation, no rank or class of people. And any breach in the chain of defence means added stress to the system, added costs to the economy, and immeasurable suffering to many.

The Infectious Diseases Act (IDA) is the sole legislation under which MOH exercises its wide ranging powers. For measures deemed necessary but are not adequately covered in the Act or its regulations, MOH can go to Parliament and have these passed (as it did this time). Through the Act, the DMS issues directives to whosoever needs them, to ensure enforcement of the measures required. For example, directive 104/03 relates to SARS and Policy on Restricting Inter-Hospital movement of Health Care Workers. It is dated 3 June (after we were declared SARS-free), and this directive superseded that dated 19 April, and was to be read in conjunction with another dated 28 May relating to postings of Medical Officers, Registrars and House Officers (whose changeover normally on 2 May was delayed by the SARS outbreak). Another directive 108/03 relates to SARS and movement of non-SARS patients between acute care hospitals and institutions. It is dated 19 June, and superseded that dated 19 April on the inter-hospital transfer of inpatients, and that dated 23 April on the readmission policy on patients from SARS-exposed hospitals.

Of course, one of the most powerful orders is the Home Quarantine Order (HQO) issued to persons who are or are suspected to be cases or contacts of those with SARS. There are six types of HQOs, and for the DMS to execute them, he delegated powers to certain officials and I happened to be one of them. So each month, I received a letter from the DMS titled: “Appointment as Health Officer and Delegation of Powers under Section 4 of the Infectious Diseases Act (Cap 137)”, whereupon I had power to isolate and detain persons at
TTSH (section 15 (1)) and to issue HQOs to TTSH patients following their discharge (section 15 (2)).

Another important order under the Infectious Diseases Act was that relating to the “Disposal of bodies of persons who died while being, or suspected of being, cases or contacts of SARS”. Here, the DMS prohibited the conduct of wakes for certain categories of deceased persons. He also mandated that the body must not be embalmed, and cremation must take place immediately after the body had been prepared. However, burial was allowed only in cases where there was strong religious objection, e.g. where the deceased was a Muslim.

Yet another was the “No visitor” rule, which was implemented on 29 April, to prevent visitors from being infected while in a hospital. Of the 199 probable cases (including seven imported cases), 77.9% were infected in the healthcare implemented on 29 April, to prevent visitors from being infected was allowed only in cases where there was strong religious objection, e.g. where the deceased was a Muslim.

Yet another was the “No visitor” rule, which was implemented on 29 April, to prevent visitors from being infected while in a hospital. Of the 199 probable cases (including seven imported cases), 77.9% were infected in the healthcare setting. (Straits Times, 24 May 2003, pg 36, col 6-7.) Hospitals therefore made available other means of visitation like videoconference within the hospital, where the visitor, in a dedicated room, could communicate with the patient in his hospital bed. On 1 June, this rule at hospitals was lifted and each patient was allowed one visitor a day, who also had to be the same one, throughout his stay. However, the ban remained for adults hospitalised for SARS. (Straits Times, 31 May 2003, pg H4, col 1-3.) By late July, the rule was further relaxed to four registered visitors, but at any one time, only one could visit.

OTHER IMPORTANT ROLES

Internally, MOH must show leadership to the doctors, nurses and other healthcare professionals practising in Singapore. Communications top-down was tops. Many directives were issued, many press briefings were held, and press statements issued. The media had their fill of information, data and were given access to top officials to ask questions and clarify issues. What about the health professionals? For those in public institutions and large organisations, I suppose the MOH SARS task force did fulfill this aspect partly. But for the rest out there?

MOH had to coordinate the whole process involved in the administration of public health for Singapore. Initially, what was lacking was efficient and timely contact tracing. It was impossible for the hospitals with staff focused on patient care to do public health duties, which were extremely time-sensitive. It would be pointless tracing contacts if they had already spread the disease. So, I was glad to see a huge army of men deployed from the SAF for this purpose. This happened on 25 April, more than four weeks into the battle with SARS. At this point in time, the SARS statistics were 36 in hospital wards, 17 in ICU, 120 discharged, 19 dead, and the total number with SARS was 192.

Externally, MOH had to be concerned with tourists and travellers to and from Singapore. All entry and exit points had to be manned with healthcare staff. Initially, nurses were deployed, but again, I was glad when MINDEF took over this function. On 10 April, it was reported that 50 medics from the SAF were working with the polyclinic nurses to help screen passengers at Changi Airport. (Straits Times, 10 April 2003, pg 9, col 4.) We do not have so many public health nurses to do such health checks and the polyclinics themselves are in need of clinical nurses.

Talking of checkpoints, it was good that direct links with Malaysia were established over the SARS issue, with PM as well as Minister for Health discussing concerns with their counterparts across the Straits.

Yet, the media tried many a time to blame Singapore for exporting SARS to Malaysia. For example, the MOH press release of 22 May in paragraph 6 states: “The Star, New Straits Times, The Sun, Berita Harian and Utusan Malaysia reported on 17 May that a 29-year-old Bangladeshi businessman at KLIA had a fever and a cough on arrival from Singapore on 14 May.” And in paragraph 8: “...he has since been diagnosed with dengue fever and not SARS...” Another example is from the press release of 28 May in paragraph 3: “The Star and New Straits Times reported on 5 May 2003 that a 35-year-old lorry driver from Negeri Sembilan, who had delivered scrap metal to Singapore, was a suspect SARS case.” And in paragraph 5: “...he did not have contact with any SARS patient in Singapore.” Paragraphs 6 to 9 then tell of a 22-year-old Malaysian woman, working as a cashier in the Ang Mo Kio Light Rapid Transit (LRT) station, who became ill on return home on 1 May, and that she had been in contact with a Singaporean friend with SARS who died on 24 April. The MOH’s investigations showed that no such person visited Singapore recently and there is also no record of such an employee. There is also no LRT station in Ang Mo Kio. The Star and New Straits Times further reported about an 85-year-old Singaporean man who visited Malaysia on 27 April, fell ill on 1 May and was warded as a probable SARS patient. MOH stated that in the end, his diagnosis was chronic bronchitis. And of course, media like The Nation and Bangkok Post, as well as The Times of India, also tried to “blame” us for exporting SARS to their countries.

It is only MOH that can set the rules for the behaviour of healthcare workers in Singapore. If one hospital tried to do so on its own, this was no guarantee the others would follow suit. Further, what is deemed the best practice for all aspects of SARS control and treatment should be applied across the board. Only MOH can tell private practitioners to stay put and practise from one location. Only MOH can direct that patients be transferred to TTSH, or from a hospital to a nursing home or to a community hospital. Only MOH can dictate that public transport not be used to ferry suspect SARS patients and those febrile in need of SARS screening, to TTSH from home, private doctors’ clinics or another hospital. And MOH did so.

LOSING THE BATTLE

On 22 March when TTSH was declared SARS central, a total of 44 people with SARS had been reported to MOH. On its website, MOH stated in paragraph 3: “Though the SARS situation in Singapore is contained, the MOH is stepping up precautionary measures to cut off secondary transmission especially among hospital staff and reduce risk of any community spread.” And a list of measures followed. Almost four weeks later on, the
17 April MOH press release stated that there were a total of 171 cases, 15 deaths, and 61 still hospitalised. Then on 19 April, the total rose to 177, but of the five additional cases reported, one was a 45-year-old male who worked at Pasir Panjang Wholesale Centre. In the same press release, in paragraph 9 under the heading: “To prevent community spread of SARS”, "The Prime Minister appealed to all Singaporeans to fully play their part in Total Defence against SARS. He said that we need to defend against all three threats: First, to prevent travellers from bringing the infection into Singapore. Second, to prevent the infection in the hospitals. Third, to prevent community spread, for example by people under quarantine who break their quarantine.”

“We have got to show in the weeks to come that we are on top of the problem...The stakes are very high. We cannot afford to fail.” – PM Goh (Sunday Times, 20 April 2003, pg 1.)

As reported in The New Paper on 20 April, page 2, PM Goh had spoken with an urgency he had rarely betrayed before. If Singapore did not overcome SARS, it could become the worst crisis ever faced. The disease was taking away both lives and livelihoods. It had become a threat to Singapore’s economy because of a “crisis of fear.” “If we fail to contain SARS in Singapore, it may well become the worst crisis that our country has faced...but we can contain this problem...and if we succeed... life can be lived normally,” said the PM. Singapore was losing up to $1.5 billion this year because of SARS. “It is not just a crisis of SARS. It is a crisis of fear. People fear catching SARS, so the question is, how do we deal with the crisis of fear?” Tourists, investors and businessmen avoid SARS-hit countries. The feeling of safety must start from the time the tourist lands here. To achieve this aim, the region had to get its act together. Thus, the ASEAN summit on SARS was held in Bangkok on 29 April to share information and agree on cross border controls for implementation.

On 22 April, an unlikely event occurred. The Prime Minister of Singapore wrote an open letter to all Singaporeans and residents. Besides commenting on the HQO and non-cooperation by some with these orders, he also mentioned that “at the next Parliamentary sitting on 24 April, we will be putting through amendments to the Infectious Diseases Act. The amendments are to provide for composition fines so that those who break HQO can be fined without having to be charged in court. The amendments will also provide for jail terms for those who repeatedly break the Orders. Given the critical SARS situation, we will be putting through the amendments on a Certificate of Urgency which will allow all three readings of the Amendment Bill to be effected at the April 24 Parliament sitting.” (Streats, 23 April 2003, pg 1.)

The situation was critical and it was felt that harsh measures were necessary to break the cycle of infection.

**WINNING THE WAR**

As I had alluded to earlier, it was not possible for MOH staff to work with the team of 80 from the National Environment Agency to execute the slew of measures deemed essential. It was not a case of no power. The IDA gave MOH all the power, and if more power was required, the IDA could be amended; and it was amended on 24 April 2003.

More manpower was urgently needed to deal with time-sensitive health matters. And this extra manpower did not reside in MOH. We were all fully over-stretched.

If you were to examine the organisation structure of MOH, you may be struck by the fact that its operational arm is very small. Yes, it can give orders but who will obey? Legislation without enforcement is next to useless. And to enforce compliance to the many orders and directives is a manpower intensive exercise. It cannot be automated fully nor allowed to run on autopilot.

On 25 April (over a month later from 22 March), that manpower arrived. It occupied the ground floor of the MOH. The operations room was set up in 48 hours and 160 soldiers were added to the team of 80 from the National Environment Agency and MOH. What was this 200 percent increase in work force for? Contact tracing. This was essential so that HQOs could be served in a timely and appropriate manner. It is difficult enough to remember what you did today, who you saw, where you went, and so on. How reliable could contact tracing be if you were asked three or four days later to recollect your activities and contacts over the last four days?

So Colonel Neo Kian Hong (he has since been promoted to Brigadier General), Commander of the 9th Division brought his merry men to form the “quarantine army”, running the new centre of the country’s operations, to get hold of every single person who had been in touch with a SARS patient. They worked in shifts from 7 am to 11 pm, and their sole objective was to trace within 24 hours (and this is vitally important) of receiving the name of a SARS patient, everyone who had been in close contact with him. This meant every name (and address – in order to serve the HQO) of every person that the SARS patient (be he highly suspect or probable) could remember having met from the time he took ill (and maybe even while he was incubating the illness the previous 10 days, unless we can be very sure when the infectious period started in each case).

The army came to the rescue when MOH realised its battle against time to trace the 2,000 people affected by the Pasir Panjang Wholesale Centre closure could not be won without reinforcements. For once SARS spreads through the community, we risk losing control of it, and will not be able to isolate and contain it. Despite help from the army, not everyone was found. Some illegal workers who were at the centre the night it closed (19 April) were identified. Others had just disappeared.

Said the MSCU chief, Mr Khaw, “We are on high alert at all borders, airport and so on but a few may slip through. The moment they slip through, we have to quickly be able to detect them, then immediately trace their contacts so that we can isolate them for observation in case a small percentage ... become patients. We are going to exploit the full capabilities of our network databases. We have school data banks...
and establishment data banks. We will be making use of that to help us speed up this business.” *(Sunday Times, 4 May 2003, pg 19.)*

Cisco, a private security firm, was given the list of names and addresses of those to be served HQOs. It sent guards to serve the orders and fixed the cameras for the twice-daily checks to make sure the affected people stayed at home.

At a meeting in Kuala Lumpur on 26 April, chaired by Malaysia, the regional Health Ministers from ASEAN, Japan, China and South Korea agreed to an unprecedented regional effort to halt SARS. Proposals included travel restrictions, screening for departing passengers at airports, seaports and river ports, health declarations, and so on. Further, they had even exchanged telephone numbers so that they could be instantly in touch. *(Straits Times, 27 April 2003, pg 1.)* These proposals met with approval by the national leaders at the regional summit in Bangkok on 29 April.

It was important that for victory to be achieved, both the home front and the whole region be SARS-free. All countries had to ensure that it was neither an exporter nor an importer of the SARS virus.

**CONCLUSION**

With all these measures and more, Singapore’s last SARS patient was diagnosed on 11 May 2003, and hence, after an incubation period of 20 days without new cases, we were taken off the WHO list of SARS-affected countries on 31 May. Before that, came the SARS scare at IMH (it turned out to be an influenza, not SARS outbreak). We were not the first country WHO took off the SARS list. Hanoi, Vietnam was the first, on 28 April. Then came Toronto, Canada, only to suffer a relapse of SARS. It was off the list only on 2 July. Hong Kong on 23 June, and China on 24 June, became SARS-free. Taiwan came off the list last on 5 July. Does it matter? Are comparisons valid or worthwhile? Could we have spent less, or caused less misery, suffering and pain? Our SARS mortality of 32/206 (15.5%) compares with Toronto and Hong Kong, but far exceeds that of China (6.5%), Vietnam (7.9%) and Taiwan (12.4%).

It would seem that I have mixed up MOH with the government in this article. All national health matters under government control are executed through the Ministry of Health. And so, whatever challenges faced by MOH are also brought to the attention of government for solutions, strategies and success stories. If anything, this crisis showed how MOH cannot stand alone.

All said and done, I would like to end by quoting DMS in his letter to all doctors, dated 18 July 2003. He wrote: “This time I am writing to thank you for your kind understanding and strong support and cooperation with the various measures that had to be instituted in our fight against SARS. I would also like to acknowledge the very important role which you have played in helping to contain SARS in Singapore.” ■
SARS and W.H.O. (Part 7)

By Prof Chee Yam Cheng, Editorial Board Member

Editorial note:
The following article was submitted on 25 August 2003. Contents are current at the time of submission.

The United Nations (UN) is based in New York whereas the World Health Organisation (WHO) is based in Geneva, Switzerland. As a UN agency, it relied on goodwill and sovereign resources whenever crises struck. As WHO, it was a convener of international expertise most times. It published many reports, long after the Committees that deliberated on the contents, had completed their task.

As a medical student and young doctor, I was always browsing through its Technical Report Series, which covered communicable and non-communicable diseases. It dealt with toxins, poisons, environmental and also occupational health issues. The address of the WHO Representative is given as 144 Moulmein Road, right here beside Tan Tock Seng Hospital (TTSH) and next door to the Tuberculosis Control Unit. An alternate address is Newton P.O. Box 31.

The WHO has two main divisions – one dealing with non-communicable diseases, whose present worldwide studies have to do with deep vein thrombosis in passengers on long haul travel, be it by air, road or rail; and the other with communicable diseases, aptly named Communicable Disease Surveillance and Response (CDSR). Its address is given as WHO, 1211 Geneva, 27 Switzerland, and its e-mail as cdsdocs@who.int. In this article when I refer to the WHO, in the context of SARS, it has to be to this division of the WHO. SARS has shown WHO at its best being not good enough. It has need of a change in strategy. With the change in WHO leadership on 21 July 2003, it is hoped that the new Director-General Dr Lee Jong Wook, will take the WHO beyond the critical stage of convenor of international conferences into one in a better position to collaborate closely with its member countries in disease monitoring and reporting.

For now, let us go back to the beginning.

EARLY DAYS
The first cases of SARS emerged in mid-November 2002, when the first case of atypical pneumonia occurred in Foshan city, Guangdong Province, China on 16 November. The first official report of the outbreak in the province, said to have affected 305 persons and caused five deaths, was received by WHO on 11 February 2003, from the Chinese Ministry of Health. About 30% of cases were reported to occur in healthcare workers. (The confirmation of cases that was consistent with the definition of SARS was made after China allowed the WHO team to visit the province on 2 April.)

On 12 February, WHO was told the outbreak in Guangdong affected six municipalities and laboratory tests proved negative for influenza. On 14 February, WHO was informed that the outbreak was clinically consistent with atypical pneumonia. Further investigations ruled out anthrax, pulmonary plague, leptosprosis and hemorrhagic fever.

On 20 February, Hong Kong officials informed WHO of an outbreak of two cases (one fatal) of avian influenza following the detection of influenza A (HSN1) in members of a family who had recently travelled to Fujian Province, China. The next day, a 65-year-old medical doctor from Guangdong checked into the ninth floor of the Metropole Hotel in Hong Kong. He stayed in Room 911. He had treated patients with atypical pneumonia prior to departure from Guangdong and was symptomatic upon his arrival in Hong Kong. Days later, guests and visitors to the hotel’s ninth floor (at least 12 of them) had seeded outbreaks of cases into the hospital systems of Hong Kong, Vietnam and Singapore. As guests flew home to Toronto and elsewhere, the disease was spread internationally. The initial hot spots of SARS were characterised by rapid increases in the number of cases, especially in healthcare workers and their close contacts. In these areas, SARS first took root in hospital settings, where staff, unaware that a new disease had surfaced, and fighting to save the lives of patients, exposed themselves to the infectious agent without barrier protection. From these initial outbreaks, chains of secondary transmission outside the healthcare environment began.

On 26 February, a 48-year-old Chinese American businessman was admitted to the French Hospital in Hanoi with a three-day history of respiratory symptoms. He came from Hong Kong where he had visited a friend staying on the ninth floor of the Metropole Hotel. Two days later, Dr Carlo Urbani, a WHO official based in Vietnam, was alarmed by several cases of atypical pneumonia in the French Hospital, where he had been asked to assist. Dr Urbani notified the WHO Regional Office for the Western Pacific (ROWP), which is based in Manila and also overseas Singapore. The WHO headquarters in Geneva moved into a heightened state of alert.

On 1 March, a 26-year-old former flight attendant was admitted to TTSH with respiratory symptoms. She had been a guest on the ninth floor of the Metropole Hotel. On 4 March, another 26-year-old and resident of Hong Kong, who had visited a friend at the Metropole Hotel, was admitted to the Prince of Wales Hospital with respiratory symptoms. For whatever medical indications, he was treated with a jet nebuliser four times daily over the next seven days.

On 5 March, the Chinese American businessman, in a stable but critical condition, was air-evacuated to the Princess Margaret Hospital in Hong Kong. Seven HCWs (healthcare workers) in Hanoi who had cared for him took ill. Dr Urbani
continued to treat cases at the French Hospital in Hanoi. Over in Toronto, an elderly woman who had stayed on the ninth floor of Metropole Hotel died at the Scarborough General Hospital. Five members of the family were infected and admitted to hospital. On 7 March, HCWs at Hong Kong’s Prince of Wales Hospital started to have respiratory symptoms progressing to pneumonia. On 8 March, 14 staff at the French Hospital fell ill with acute respiratory syndrome (this is where the name SARS originated) and a WHO team arrived in Hanoi to support Dr Urbani. By 10 March, at least 22 staff in the French Hospital became ill with respiratory symptoms. At this time, the Chinese Ministry of Health asked WHO to provide technical and laboratory support to clarify the cause of the Guangdong outbreak. (This is over 100 days since the first case surfaced on 16 November 2002.)

On 11 March, Dr Urbani left Hanoi for Bangkok where he was to give an update and presentation on tropical diseases. Instead, he took ill upon arrival and was immediately hospitalised. He fought SARS valiantly but succumbed on 29 March.

On 12 March, WHO issued a global alert about cases of severe atypical pneumonia following mounting reports of cases among HCWs in the Hanoi and Hong Kong hospitals. This followed an assessment of the Asian situation by WHO teams in Hanoi, Hong Kong and Beijing. At least 20 HCWs in Hanoi’s French Hospital and 23 at a hospital in Hong Kong, were ill with similar acute respiratory syndrome.

GLOBAL RESPONSE: INFRASTRUCTURE
In April 2000, WHO launched the GOARN (Global Outbreak Alert and Response Network) as a mechanism to link together in real time, 112 existing networks which together possess much of the data, expertise and skills needed to keep the international community alert to outbreaks and ready to respond. By electronically linking together existing networks, WHO is able to maintain close vigilance over the evolving infectious disease situation and to mobilise outbreak verifications and response activities as and when required.

For gathering epidemic intelligence, a customised search engine that continuously scans World Internet Communications for rumours and reports of suspicious disease events is available. It is the GPHIN (Global Public Health Intelligence Network), a computer application developed by Health Canada and used by WHO since 1997. GPHIN operates as a sensitive real-time early warning system by systematically searching for key words in over 950 news feeds and electronic discussion groups around the world. Human review and computerised text mining are used to filter, organise and classify the over 18,000 items it picks up everyday, of which over 200 merit further analysis by WHO. GPHIN provided some of the earliest alerts to the November 2002 outbreak in China.

In outbreak alert and response, every hour counts, as the window of opportunity for preventing deaths and further spread closes quickly. GPHIN has brought great gains in timeliness over traditional systems where reports need to progressively filter upwards before finally being notified to WHO. GPHIN currently picks up in real time the first hints of about 40% of the roughly 200 to 250 outbreaks subsequently investigated by and verified by WHO each year. While early alerts are important, GPHIN also allows WHO to step in quickly to refute unsubstantiated rumours before they have any chance to cause social and economic disruption.

During an outbreak response, WHO uses a custom made geographical mapping technology to assist in the location of cases and rapid analysis of the epidemic’s dynamics. This epidemiological mapping technology is also used to predict environmental and climatic conditions conducive for outbreaks. An event management system, introduced in 2001, is now used to gather and communicate data throughout the course of outbreak investigation and response. The system generates a dynamic picture of operations, aids organisation of logistics, and provides a systematic way to prepare better, respond faster and manage resources more effectively.

GLOBAL RESPONSE AGAINST SARS
From 12 to 15 March 2003, an initial emergency plan of WHO called for an attack on the ground and in the “air”. WHO sent teams of experts and specialised protective equipment for infection control in hard-hit hospitals to countries requesting such assistance. In the “air”, WHO used the model of its electronically interconnected global influenza network to quickly establish a similar “virtual” network of eleven leading laboratories, connected by a shared secure website and daily teleconferences, to work around the clock on identification of the SARS causative agent and the development of a robust and reliable diagnostic test. This network in turn served as a model for similarly electronically linked groups set up to pool clinical knowledge and to compare epidemiological data.

WHO also issued daily updates on its website to keep the general and travelling public informed, and where possible, to counter rumours with reliable information.

PRESS RELEASES FROM WHO
12 March 2003. This release told of WHO’s efforts since February to confirm what the outbreak of severe pneumonia was about and of how the outbreak in Vietnam evolved. It gave a clinical picture of the disease as one with a flu-like illness (rapid onset followed by muscle aches, headache and sore throat). Laboratory findings may include low platelet and low white cell count. In some cases, this is followed by bilateral pneumonia, in some cases progressing to acute respiratory distress requiring assisted breathing on a respirator. And on this day, the Department of Health, Hong Kong, SAR (Special Administrative Region) reported on an outbreak of respiratory illness in one of its public hospitals. As of midnight on 11 March, 50 HCWs had been screened and 23 were found to have febrile illness. They were admitted to the hospital and
eight were found to have developed early chest X-ray signs of pneumonia. Three other HCWs self-presented to hospitals with fever and two of them had chest X-ray signs of pneumonia. It also mentioned that in mid-February, the Government of China reported 305 cases of atypical pneumonia in Guangdong, and in cases that died, it was due to chlamydia infection. WHO also stated that there was no link so far between these outbreaks in Hanoi and Hong Kong. WHO made two recommendations: patients with pneumonia who may be related to these outbreaks be isolated with barrier nursing, and any suspect cases be reported to the national health authorities.

15 March 2003. This release included the case definition of a suspect case (but used the cut-off date as illness dating back to 1 February 2003) and probable case. In addition, other symptomatology, besides fever and respiratory symptoms, included headache, muscle stiffness, loss of appetite, malaise, confusion, rash and diarrhoea. (The last two were to assume more prominence later when Dr Alex Chao died and an outbreak occurred at the Amoy Gardens in Hong Kong.) As of 15 March, reports of suspected cases of SARS had been received from Canada, China, Hong Kong, Indonesia, Philippines, Singapore, Thailand and Vietnam. It was also reported that an “ill passenger and companions who travelled from New York, United States on to Frankfurt, Germany were removed from their flight and taken to hospital isolation.” Then came this important statement by the Director-General of WHO, Dr Gro Harlem Brundtland, “This syndrome, SARS, is now a worldwide health threat. The world needs to work together to find its cause, cure the sick and stop its spread.” The press release went on to say that “there is presently no recommendation for people to restrict travel to any destination. However in response to enquiries from governments, airlines, physicians and travellers, WHO is now issuing guidelines for travellers, airline crews and airlines.”

16 March 2003. Country reports, including Singapore, were given in this release. As of 15 March, reports of over 150 cases of SARS have been received by the WHO, and four deaths had been reported. SARS was first recognised on 26 February in Hanoi, Vietnam. For Singapore, the Ministry of Health (MOH) reported on 13 March of three cases of SARS in patients recently returned to Singapore after travelling to Hong Kong. As of 15 March, 13 additional cases had been reported and all 13 of them had contact with one or more of these three initial cases. All 16 cases were reported to be in stable condition and were cared for in isolation. The other mention was under the heading “New York, USA – Frankfurt, Germany”. It said that on 15 March, a HCW from Singapore who was visiting New York boarded a flight from New York to Frankfurt. The HCW was known to be unwell and to have had close contact with a reported case of SARS in Singapore. German health authorities had this HCW transferred to an isolation unit in Frankfurt as soon as the flight landed.

Under international response, the press release stated that the following organisations were contributing personnel and materials to Vietnam: (1) Centres for Disease Control and Prevention, Atlanta, United States; (2) Centre for International Health, Australia; (3) Epicentre; (4) Institut National de Veille Sanitaire, France; (5) Institut Pasteur, France and Vietnam; (6) Medecins Sans Frontieres, (7) National Health Service, Department of Health, United Kingdom; (8) Robert Koch Institute, Germany; and (9) Central Field Epidemiology Group Smittskyddsinstitutet (SMI), Sweden.

Further, bilateral assistance had been mobilised from France and Japan, and WHO was providing epidemiological support to the health authorities in Hong Kong.

WHO had no recommendations to restrict travel to any destination. 16 March was a Sunday and the start of the one-week school holidays in Singapore. WHO gave the commitment that it would update its website daily and has done so to date.

IN SINGAPORE

All 16 cases in Singapore were being kept in the isolation rooms at the Communicable Disease Centre, TTSH. Doctors and nurses attending to them were observing “enhanced infection control procedures.” Dr Leo YS, Senior Consultant, said, “If we suspect a case of atypical pneumonia, we will immediately isolate the patient.” Doctors and nurses wore respiratory masks, gowns and surgical latex gloves. Only immediate family members were allowed to visit the patients and they too followed the same safety protocol. MOH advised Singaporeans against travelling to Hanoi, Hong Kong and Guangdong unless absolutely necessary. Further, Singaporeans who had travelled to these places were advised to seek immediate medical attention if they had fever, muscle aches, cough, sore throat or any breathing difficulty, or if they had been in close contact with someone diagnosed with atypical pneumonia. (The New Paper, 16 March 2003, pg 15.)

On 15 March 2003 at 2 am Geneva time, the Singapore government notified WHO by urgent telecommunication, of a 32-year-old physician who had treated cases with SARS in Singapore all subsequently linked to the Hong Kong hotel. This doctor had travelled to the US for a medical conference and at the end of the conference boarded a flight to Singapore in New York. Before departure, he had indicated to a colleague in Singapore by telephone that he had symptoms similar to the patients he had treated in Singapore. The colleague notified the health authorities. WHO identified the airline and flight (Singapore Airlines), and the physician and his two accompanying family members were removed from the flight at a stopover in Frankfurt, Germany. As a result of this prompt action, Germany experienced no further spread linked to its first imported cases.

Later in the morning of 15 March, with this background and chronology of events mentioned earlier, a decision was made by WHO to increase the level of the global alert issued on 12 March.
A RARE EMERGENCY ADVISORY

The decision was based on five different but related factors. First, the causative agent and therefore the potential for continual spread, of this new disease were yet unknown. Second, the outbreaks appeared to pose a great risk to HCWs who managed patients, and to family members and close contacts of patients. Third, many different antibiotics and antivirals had been tried empirically and did not seem to have an effect. Fourth, though the numbers were initially small, a significant percentage of patients (25 out of 26 HCWs in Hanoi, and 24 out of 39 HCWs in Hong Kong) had rapidly progressed to respiratory failure, requiring intensive care, and causing some deaths in healthy persons. Finally, the disease had moved out of its initial focus in Asia and appeared to have spread to North America and Europe.

SARS was poorly understood. The hope was that this new disease like many others of the recent past, would fail to maintain efficient person to person transmission, or that it might attenuate with passage and eventually self contain. Not knowing much about the disease, its cause and future evolution, the need was great to introduce a series of emergency measures to contain SARS outbreaks in affected areas and prevent further international spread. WHO thus decided on 15 March to issue a rare emergency travel advisory as a global alert to international travellers, healthcare professionals and authorities.

22 MARCH 2003

This was the day TTSH was declared SARS central. The WHO press release was titled “Update 7 – SARS virus isolated, new diagnostic test produces reliable results.” From the Guangdong Professor and one of his contacts (both died), the virus was isolated in a special cell line and a basic test was devised by the Hong Kong scientists. Results would be shared among the 11 leading laboratories in a network set up on 17 March. What would have normally taken three months had been achieved in a matter of days. “This spectacular achievement is an example of what the world can do when the intellects of nations around the world are focused on a single problem,” said Klaus Stohr, a WHO virologist coordinating the global laboratory network. As of this day, Hong Kong was the most seriously affected area with 222 cases.

CHINA

In late March, Chinese authorities updated data on cases and deaths for the previously reported outbreak in Guangdong since November 2002, raising the cumulative totals from 305 to 792 cases and from five to 31 deaths. Chinese scientists, epidemiologists and clinicians also became full partners in the three working groups studying SARS. On 2 April 2003, a WHO five-person team was given permission to travel to Guangdong to confer with officials there about the SARS outbreak. The Chinese government had given highest priority to the SARS response. The first joint MOH-WHO team visited Hebei Province in mid-May. A system of alert and response for emerging and epidemic-prone diseases was being developed for all of mainland China. Electronic reporting of new cases and deaths by province was now a daily occurrence. Equally important, health officials were holding televised press conferences, thus taking the important step of increasing the awareness of the population and hospital staff of the characteristic symptoms, the need to seek prompt medical attention, and the need to manage patients according to the principles of isolation and strict infection control. The report of the first WHO expert team to investigate the SARS situation in Guangdong province reached the following conclusion:

“If SARS is not brought under control in China, there will be no chance of controlling the global threat of SARS. Control of a new and rapidly disseminated disease like SARS is challenging, especially in a country as large and as diverse as China. Effective disease surveillance and reporting are key strategies in any attempt to control the spread of a serious new communicable disease such as SARS.”

AIRPORTS

Near the end of March, WHO recommended screening measures at airports for passengers departing from areas with recent local transmission, and issued advice to airlines on steps to take should a suspect case be detected in flight. Twice in April and once in early May, to prevent further international spread, WHO issued the toughest travel advisories in its 55-year history when it recommended postponement of all but essential travel to designated high risk areas.

22 APRIL 2003

This was the day the WHO press release gave “Update 36 – Situation in Singapore and China.” For Singapore, it mentioned that a large wholesale fruit and vegetable market was closed following a small cluster of three cases linked to the market. To date, eight probable and 14 suspect SARS cases had been linked to the market. This first case in the cluster was a 64-year-old worker at the market who died on 12 April. In an effort to contain the outbreak, health authorities had issued some 1,200 home quarantine orders. As of this day, Singapore had reported 186 cases of probable SARS with 16 deaths. As for China, the reported number of cumulative cases was 2,001 with 92 deaths. SARS had spread to some of China’s poorest provinces including Western Guangxi, Northern Gansu, and Inner Mongolia.

WORLD HEALTH ASSEMBLY 19-28 MAY 2003

This 26th annual summit was held in Geneva. Minister of State for Health, Dr B Sadasivan, attended as did other participants from the 192 member states of WHO. On 21 May, Dr Jong-Wook Lee, a medical doctor and national of the Republic of Korea who has worked nearly 20 years in WHO, was elected Director-General, replacing Dr Gro Harlem
Brundtland. He said he would immediately expand and strengthen GOARN. The recent experience of fighting SARS featured prominently in discussion. Two resolutions were passed. The first was on the revision of the International Health Regulations, the international law which governs public health; and the second specifically on SARS. The resolution confirms and underlines the WHO’s authority to verify disease outbreaks from all available official and unofficial sources, and when necessary, to determine the severity of an outbreak through on-the-spot investigations to ensure it is appropriately controlled.

The resolution on SARS recognises the disease as “the first severe infectious disease to emerge in the twenty first century”, and called for the full support of all countries to control SARS and other emerging and re-emerging infectious diseases.

During the Assembly, WHO announced the creation of a new US$100 million public-private initiative to fight SARS and build capacity for disease surveillance and outbreak response in China and the surrounding region. “SARS exposes fundamental weakness in the global health infrastructure,” said Dr JW Lee, WHO Director-General Elect. “This new fund and other innovation initiatives like it will help prepare the world to respond to future emerging diseases.”

The Assembly also paid tribute to Dr Carlo Urbani, the medical doctor based in the WHO office in Vietnam who was the first to recognise the new disease that was to be named SARS, and died as a result of contracting the disease in the line of duty on 29 March 2003.

**Note:** Part 7 will be continued in the next issue of SMA News.
SARS and W.H.O. (Part 7)

By Prof Chee Yam Cheng, Editorial Board Member

Editorial note:
The following article was submitted on 25 August 2003. The first half of Part 7 was published in the September issue, and the rest is continued here. Contents are current at the time of submission.

18 JUNE 2003 “UPDATE 83 – 100 DAYS INTO THE OUTBREAK”

WHO first alerted the world on 12 March to the SARS threat. From the 55 cases recognised on that day, alarmingly concentrated in hospitals in Hong Kong, Hanoi and Singapore, the outbreak exploded within a month to cause some 300 cases and more than 100 deaths in 20 countries on all continents. By that time, the public face of SARS was symbolised by a mask. The causative agent was conclusively identified on 17 April. Overall case fatality was 15%. The number of cases passed 4,000 on 23 April, 5,000 on 28 April, 6,000 on 2 May, and 7,000 on 8 May, with cases reported from 30 countries. At the peak of the global outbreak, near the beginning of May, more than 200 new cases were being reported daily. There were 8,000 cases on 22 May.

During June, the number of new cases gradually declined and this was not a “natural phenomenon” that could be attributed to a change in the virulence or infectivity of the SARS virus, as often happens with new diseases that quickly “burn out.” Instead, the dramatic reduction in SARS cases was the result of monumental efforts on the part of governments and HCWs supported by a well-informed and cooperative public.

SARS is the first severe and readily transmissible new disease to strike a globalised society. As such, its history to date illustrates the favourable conditions, both for the devastating spread of a new disease and solidarity in its contaminant, that have come to characterise a closely interconnected, interdependent and highly mobile world. On the negative side, the volume of international air travel allowed SARS to spread around the world with unprecedented speed. The close interdependence of economies and markets amplified the economic impact of SARS considerably, while instantaneous electronic communications elevated public concern often to the point of panic and fear, and further added to the social and economic disruptions caused by SARS.

SARS has vividly depicted a truism of the infectious disease situation in a globalised world: an outbreak anywhere places every country at risk. The world’s electronic interconnectedness contributed to the effectiveness of the first global alert to SARS. The initial 12 March alert, followed three days later by a stronger and more specific warning, provided a clear line of demarcation in the early history of SARS. Areas with cases prior to the alert experienced the most devastating outbreak. These occurred in Hong Kong, Hanoi, Singapore, Toronto and China.

One of the most important lessons learned to date is the decisive power of high-level political commitment to contain an outbreak. The centuries old control measures of isolation, contact tracing and follow up, quarantine and travel restrictions proved effective even when applied on a monumental scale. Vietnam broke the chain of transmission on 28 April, as did the Philippines on 20 May and Singapore on 31 May.

SARS has repeatedly demonstrated its resilience with the resurgence of cases in Toronto. Single highly infectious persons have been known to set off trains of transmission that have led in the worst cases, to almost 100 additional infections. In Singapore, five patients accounted for 103 of the total 206 cases in the outbreak.

WHO sees a need for at least a full year of surveillance to determine whether the disease has established endemicity and to ensure that no cases have spread undetected to countries with poor surveillance and reporting systems. As of today, there is still no reliable point of care diagnostic test. Pending the availability of such a test, every case of atypical pneumonia has the potential to arouse suspicion and spark a panic. Any hospital-based cluster of febrile patients with respiratory symptoms will need extensive investigation. Any person with a fever or cough could be barred from international travel.

WHO CRITERIA FOR SARS LISTING

Although Singapore suffered a setback in its quest to become SARS-free earlier than 31 May 2003, what were the criteria WHO used to declare countries free of local transmission of SARS? When Singapore was heading towards 31 May, the US was no longer advising its citizens to avoid non-essential travel here on 8 May. (This travel advisory was issued on 13 March.) Further, the US CDC downgraded Singapore to the alert list, which only spells out health concerns and precautions. Julie Gerbeding, CDC Director, said that Singapore is off the list as it has contained its SARS outbreak. Yet on 8 May, Singapore was still on the WHO list of SARS-affected countries and our last case was yet to be diagnosed on 11 May.

On 8 May, Singapore had fewer than 60 SARS patients in hospital; reliable data; fewer than five cases in three days, including imported cases; and had not exported the bug. However, there was one criterion still unfulfilled – no new
case for 20 days, that is, twice the incubation period of SARS. Only then would Singapore be declared SARS-free. (Straits Times, 8 May 2003, pg 3.) En route to 31 May, we were almost derailed by an external party – “KL to report Singapore to WHO.” (Straits Times, 22 May 2003, pg 4.) The Deputy Director-General of Health of Malaysia cited three cases that he said slipped through Singapore’s screening systems undetected. Therefore, Malaysian authorities said they intended to send a report on the matter to the WHO.

Taiwan, the last country to come off the list on 5 July also had to meet the five criteria. On 3 June, Taiwan said it had met four of the five criteria required to lift the WHO SARS travel advisory against it. (Straits Times, 4 June 2003, pg A2.) The chief of the Cabinet’s SARS contingency committee said Taiwan had registered a downward trend in the epidemic, and had no more than five cases for three straight days. The island had also not exported the disease and was able to trace almost all new infections. Taiwan was trying to meet the last requirement, which was to keep the number of hospitalised SARS cases to no more than 60.

CASE DEFINITIONS CHANGE
Patients suspected of having SARS should be isolated when they test positive for the coronavirus that causes the disease, said the WHO. (Straits Times, 3 May 2003, pg 4.) Until then, only those whose X-rays showed signs of pneumonia, or were severely ill were put in isolation wards. This followed a major change in case definition so that a “probable” SARS case now included someone who tested positively for the virus even if his chest X-ray looked normal. Previously, X-rays had to show signs of infection in the lungs for a patient to be classified as a “probable” case. This decision resulted in more patients being considered “probable” rather than “suspected” cases, meaning more patients would be put in isolation to reduce the chances that they will infect others. This move was part of an effort to further reduce the chances that an infected person would spark a new outbreak of SARS. As a result of this new case definition, Singapore’s total number of SARS cases rose from 206 to 238, and therefore the fatality rate has fallen from 16% (33/206) to 13.8% (33/238). WHO had originally stated a mortality rate of 6% to 10% for SARS but revised this to 15%, after taking into account the length of time that patients have survived. So the death rate was 14% in Singapore, 15% in Hong Kong and 8% in Vietnam. (Straits Times, 9 May 2003, pg A4.) Furthermore, WHO reviewed the incubation period and continued to conclude that the maximum is 10 days.

MORE BITE FOR WHO
Although WHO issued the global alert on SARS on 12 March 2003, it had no explicit authority to do so. Until the change, the International Health Regulations that outline the WHO’s authority and the responsibilities of its 192 member states required nations to report only three diseases – smallpox, cholera and the plague. Further, WHO had no power to independently verify that a government’s measures to contain a disease outbreak were adequate. All this has changed. At the World Health Assembly in May, the 192 member states voted unanimously to give WHO the power to act promptly should a new health crisis arise. This constitutes the first significant expansion of WHO’s mandate in 30 years. If necessary, WHO can now proactively send its own teams into problem areas to verify if enough is being done to prevent a health threat to other countries. This resolution could not have happened without SARS. (Straits Times, 29 May 2003, pg 3.)

So WHO will attempt to build up capability in disease control modelled on the US Centres for Disease Control and Prevention based in Atlanta, Georgia. The SARS episode showed WHO at its best and not so good. It rallied governments and the aviation industry quickly in running up clinical firewalls. But it had to borrow epidemiologists and microbiologists from member nations and private research institutes. Singapore was one of the members tapped for its research expertise. A UN agency could not be effective relying on goodwill and sovereign resources whenever crises struck. WHO aims to be a supranational CDC. With the new capacity, the WHO will be in a better position to collaborate closely with its member countries in disease monitoring and reporting. China’s shortcomings, which surfaced during the SARS outbreak, were as much the WHO’s deficiency. (Editorial “WHO in the Age of SARS” – Straits Times, 23 July 2003, pg 12.)

As part of this new capability, WHO wants Singapore to become a full member of its global outbreak alert and response network (GOARN) and Singapore has agreed. (The New Paper, 25 May 2003, pg 35.) As a full member, Singapore would join countries such as the US, UK, Japan and Australia, which provide experts to help when there are disease outbreaks around the world.

TREATMENT
Initial research shows that steroids are most effective against SARS when given five or six days after a patient develops the first symptoms of the disease. (The New Paper, 13 July 2003, pg 18.) The report further said that ribavirin and steroids do not cure SARS but may help fight infections caused by the disease.

CONCLUSION
I hope readers will have a better idea of how WHO operates to control communicable diseases. Every public pronouncement by the WHO has tremendous social and economic impact.
As a small nation state, we can scarcely shoulder the burdens of negative publicity in any shape, form or size. It is indeed an accolade to be invited by WHO to be part of its new capability. We must do our best to live up to that trust. We need to thank the many WHO staff who worked with us and helped us in Singapore. We thank them most sincerely.

They are: Dr Osman David Mansoor, Dr Stephen Lambert, Dr Cathryn Murphy, Dr Julia Fitzner, Dr Garrett Noel Smyth, Dr Suzuki Nahoko, Dr Kande-bure O’Bai Kamara, Dr Ali S. Khan, Dr Daniel H. Rosen, Dr Lisa Rotz, and Ms Marta White.

**QUOTATIONS FROM WHO**

1. **Dr Rob Condon**, epidemiologist with the Manila-based WHO Western Pacific Office.

“We are still trying to identify the cause but it is behaving very much like a virus that is passed through respiratory methods.”

“We have also advised hospitals that the number of caregivers and visitors be reduced to a minimum. It would be good if family members could view the patients through a glass screen without contact that would put them at risk.”

“We are leaving travel advisories to the individual governments but we are providing advice to them. Singapore’s travel advisory is definitely reasonable considering the circumstance.” *(The New Paper, 16 March 2003, pg 15.)*

2. **Dr Gro Harlem Brundtland**, Past WHO Director-General.

“Carlo Urbani’s death saddens us all deeply at WHO. His life reminds us again of our true work in public health. Today, we should all pause for a moment and remember the life of this outstanding physician.” *(Quoting Washington Post COX Newspaper, L A Times and ASP – Straits Times, 31 March 2003, pg 5.)*

3. **A WHO spokesperson.**

“WHO is not 100 percent sure that all of the cases in that estate are SARS related.” *(Referring to the Amoy Gardens cases that had “complicated” matters – Today, 1 April 2003, pg 2.)*

4. **Dr Aileen Plant**, coordinator of the WHO team sent to help Hanoi with the outbreak.

“The French Hospital is quite an enclosed community with people working close together. It may be that rather than spreading the virus externally, they infected each other. In the end, we’re guessing, and we couldn’t really know until the outbreak pans out in Hong Kong and Singapore.” *(Straits Times, 2 April 2003, pg 6.)*

5. **Dr Robert Breiman**, leader of WHO team in Guangdong, China.

“The Chinese in Guandong have yet to hand over to the WHO team laboratory samples that are needed to analyse the virus. China also lacks the technology to test viruses. China must hand over the specimens for tests and allow equipment to be brought in.” *(Straits Times, 7 April 2003, pg 6.)* *(WHO was finally granted permission to enter Guandong on 2 April 2003.)*

6. **Dr David Heymann**, Executive Director of Communicable Diseases at WHO.

“China has finally been forced by international pressure to change its attitude and cooperate with the international country’s efforts to contain the spread of SARS. By the time President Hu jintao urged full-scale corporation with the WHO, five months had passed since the SARS outbreak erupted in Guandong last November. And after Premier Wen Jiaboa made it the first item on the agenda of a recent state council meeting, approval was at last given for WHO officials to carry out investigations in the stricken province. These are very positive steps taken by China.” *(Straits Times, 7 April 2003, pg 8.)*

7. **Dr Gro Harlem Brundtland**, Past WHO Director-General.

“China is cooperating with WHO in efforts to hunt down the origin of the SARS outbreak. But China should have accepted international help before the deadly outbreak spread worldwide. Would it have been better if WHO had been given an opportunity with its experts to enter into Guandong and be able to help the authorities there? The answer is yes. It would have been helpful, and it should have happened earlier in my opinion.” *(Straits Times, 8 April 2003, pg 4.)*


“I think the Singapore Government has done an excellent job and I really would not characterize it as draconian. I would say they have put in state of the art public health measures, with complete transparency” *(Straits Times, 27 April 2003, pg 3.)*

9. **Dr David Heymann**, when in Bangkok to brief ASEAN leaders.

“It appears from reports we have from Hong Kong, Singapore, Toronto and Vietnam that the epidemic has peaked in those countries and now they’ve having fewer cases every day, and in some countries, no new cases, such as Vietnam. In most countries now,
they’ve had one or two peaks and they’re on the way down. We believe...they will stay down. We are receiving more and more reports now of cases in China, and it doesn’t appear that it’s peaked in China yet. We’re very satisfied with what China is giving us but we know that there’s more.“ (Straits Times, 29 April 2003, pg 1.)

10. Mr Pascale Brudon, WHO representative in Vietnam.
“Vietnam has been able to show the world that there is hope that SARS can be contained... It is a very good day for all of us in Vietnam. Vietnam’s speed of action, leadership and transparency shown by the government had been crucial.” (Straits, 29 April 2003, pg 1.) (Vietnam was the first country declared SARS-free.)

11. Dr Klaus Stohr, WHO’s top SARS scientist.
“It’s the first time we have hard data on the survival of the virus. Before that, we were just speculating. This means that if the virus is being kept at lower temperatures, we have to think about next winter. These studies are very important for designing strategies for cleaning and disinfecting.” (Straits Times, 5 May 2003, pg 3.)
“We are sailing a boat while we are building it.” (Straits, 5 May 2003, pg 8.)

12. Mr Iain Simpson, WHO spokesman.
“Toronto would be back on the list”. (Straits Times, 27 May 2003, pg 3.) (WHO could put Toronto back on the list of areas where SARS is spreading just 12 days after it was taken off after it confirmed 8 new cases of SARS and reported 3 deaths.)

13. Mr Henk Bekedam, WHO’s chief representative in China.
“I dare to say that the SARS epidemic is over its peak. We can see this globally and also in China.” (Straits Times, 6 June 2003, pg A2.)

14. Dr David Heymann, at the WHO Global SARS conference in Kuala Lumpur.
“The WHO’s global alert in March may have been the most important factor in preventing the spread of the disease around the world. Tomorrow, the March 12 alert will have been in place for 100 days and already, the WHO expects the outbreak to be over soon. No other country except Taiwan has had an outbreak since 15 March though there have been imported cases. It will take 12 months to determine whether SARS has been eradicated, as it is not known whether the bug will return with winter.” (Straits Times, 18 June 2003, pg 6.)

15. Dr Gro Harlem Brundtland, Past Director-General of WHO.
“Attempts to conceal cases of an infectious disease for fear of social and economic consequences must now be recognized as carrying a very high price. This includes loss of credibility in the eyes of the international community, damage to the health and economies also for neighboring countries, and a very real risk that outbreaks within the country’s own territory can spiral out of control.” (Straits Times, 18 June 2003, pg 6.)
SARS @ TTSH (Part 8)
By Prof Chee Yam Cheng, Editorial Board Member

Editorial note:
The following is an abridged version of the original article. The full text was published in the Medical Digest of Tan Tock Seng Hospital – July/August/September 2003 issue.

I had written about Tan Tock Seng’s (TTSH) role in the war against SARS in an earlier article published in June 2003. It chronicled events from late February 2003 till 6 April 2003. By Monday 7 April 2003, all the Singapore General Hospital (SGH) cases had been transferred over to TTSH, and with the patients came the Tiger Force of doctors and nurses led by the Senior Consultant Surgeon Mr C Y Wong of SGH. In this article I will trace events up till 31 May 2003 when Singapore was taken off the World Health Organisation’s (WHO) list of countries with local transmission of SARS.

BACKDATED CHRONOLOGICAL EVENTS

1 – 3 March 2003 – Two Singaporeans warded at TTSH.

4 March 2003 – First HCW (healthcare worker), a nurse, was infected.

6 March 2003 – Ministry of Health (MOH) informed by TTSH that these two patients have developed atypical pneumonia after travelling to Hong Kong. MOH informed TTSH (and other hospitals) to isolate patients and to take the necessary infection control measures. Contact tracing started and it was found that the patients had stayed in the same hotel in Hong Kong.


14 March 2003 – MOH informed of six more cases of atypical pneumonia and issued travel advisory.

15 March 2003 – MOH Task Force formed. MOH informed TTSH doctor that one of our doctors from the Department of Infectious Diseases was suspected of SARS on board flight from New York-Singapore transiting at Frankfurt. He had seen and managed the cases warded at TTSH.

At TTSH, barrier nursing was instituted.

21 March 2003 – No new HCW infected.

22 March 2003 – TTSH designated as the central hospital for all suspect and probable SARS cases. Added infection control measures for staff instituted – mask, gloves and gown.

24 March 2003 – First discharge of suspect SARS case who had recovered and fulfilled the WHO criteria for discharge from hospital. Infectious Disease Act was invoked to apply home quarantine orders to be implemented, not only for the isolation of contacts exposed to SARS patients but also for SARS patients discharged from hospital.

‘No visitor’ rule in force for inpatients.

Outpatient clinics ceased running. (This was a Monday.)


26 March 2003 – Sixth imported SARS case from flight CZ 355 warded at TTSH.
So in the arduous task of contact tracing, it was established that these four links of transmission were finally broken: patient to doctor, patient to nurse (because the patient was not diagnosed to be suffering from SARS when early symptoms were present), patient to patient, and HCW to patient. The important mindset change here was to re-designate wards with SARS patients as “hot” wards (and therefore full precautions by HCWs) and all other wards as unknown SARS wards rather than non-SARS wards.

GHOST TOWN
A week after TTSH was closed to the general public on 22 March, the hospital as well as Novena Square became quiet. The noise and bustle was gone. Few bodies moved about on Level 1. So the businesses gradually shut their doors. Taxi drivers did not want to come to TTSH even if a nurse or a doctor instructed him to do so from Yishun, Ang Mo Kio or wherever he/she boarded. Buses along Moulmein Road did not want to stop at the designated bus stop.

Life began to light up again only in May. The ghosts had gone and people were coming. The Starbucks in TTSH was the last to reopen – on 19 June. (After all, during SARS, people drank Sarsi, not coffee.)

IN-HOSPITAL TRANSMISSION OF SARS
As we put in place various infection control measures leading finally to the m3g mantra, these were the dates when the in-hospital chain of transmission of SARS were broken.

23 March 2003 – This day was the last transmission of SARS from a patient to a doctor. That is, if the incubation period for SARS in this doctor was ten days, then he got infected on 13 March and became sick on 23 March. However, if the incubation period in this instance was three days, then he got infected on 20 March and took ill on 23 March.

24 March 2003 – Last case of patient to patient transmission.

1 April 2003 – Last case of a patient getting infected from a HCW.

5 April 2003 – Last case of patient infecting a nurse who then became a patient herself on this day.

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IN-PATIENT POLICY CHANGE
When we were declared SARS central, we emptied the wards of inpatients. We stopped all outpatient admissions and the only source of inpatient admissions was through the Emergency Department (ED) of TTSH. However, few if any members of the public dared venture to our ED. Even private ambulances and taxis were directed away from TTSH by their occupants. So our inpatient pool gradually decreased in size.

On 8 April, TTSH housed 157 patients, with 37 probable, 74 suspect cases and 46 more under observation. There were 35 admissions the day before, four of them TTSH staff. In the ICU were 14 patients, 13 probable and one under observation. Sixteen were discharged, including five TTSH staff. Fifty-six patients from SGH had been transferred to TTSH. On 12 April, we had 172 cases with 58 probable, 81 suspect and 33 under observation. Cases were still coming to us from other hospitals – National University Hospital (NUH) and SGH. Why was this so?

It was the result of a change in an important policy. This policy stated that all inpatients of TTSH before 15 March had to be transferred back to TTSH for inpatient care should they be in any other hospital outside TTSH. The reasoning was like this. As had happened with the SGH cluster, one discharged inpatient of TTSH became ill again and got himself admitted to SGH for a surgical problem. He turned out to have been infected with SARS while in TTSH before 22 March, incubated the illness while at home and became warded in SGH where his fever manifested days later and the disease evolved to the clinical picture of SARS, despite his
surgical condition. So the SGH cluster was born with patients, HCWs and visitors coming down with SARS.

WARD CLASSIFICATION
As it was preferable to nurse SARS patients in isolation rooms, we soon ran short of isolation beds. It was not fair to observe patients who were not diagnosed as SARS together in case one among them actually had SARS and spread it to the others. So all our single bedded wards got converted almost instantaneously into isolation wards.

The ward configuration therefore had to cope with the following groups of patients, based no more on paying status, but on the medical indications for need of isolation and intensity of care. We had nine categories of wards:

1. SARS paediatric patients.
2. SARS adult patients requiring isolation.
3. SARS patients with risk of absconding. (Remember the infectious Diseases Act had not been amended yet. This was done in Parliament on 24 April 2003.)
4. SARS probable patients.
5. SARS suspect and observation patients.
6. Ex-inpatients of TTSH who were hospitalised 21 days prior to current date including those transferred back to TTSH from the other hospitals, as explained earlier with policy change.
7. Existing SGH patients transferred over the weekend of 5 and 6 April.
8. Remaining non-SARS TTSH patients, renamed later as unknown SARS patients.
9. Quarantine wards.

In addition we had our four ICUs merged and running as one large ICU. The original four are Medical, Surgical, Coronary and Neurosurgical.

The paediatric cases were managed entirely by the team of doctors and nurses from KK Women’s and Children’s Hospital (KKWCH), and later NUH. The SGH cases were likewise managed by SGH staff. But all this care had to be coordinated as they were using our facilities and we met each other for regular meetings to ensure MOH guidelines were implemented.

ED ADMISSIONS
Our ED suddenly became empty by 24 March. Everybody was afraid to come to TTSH but it took almost two days for this message to reach everybody out there. At ED, no patient could be turned away so we saw them. On 14 March after the WHO alert, ED had begun physically segregating at risk patients (fever with travel history) from other patients while they were waiting to see the doctor. On 23 March, the first tents were erected under the ED porch – to segregate patients outside the main building (which is air conditioned) and conduct ED activities out there. By 26 March, our ED became the national screening centre for SARS and actively turned away other patients. Before that, patients with fever were screened at the Communicable Disease Centre (CDC).

Thereafter, patients were “forced” to come to ED either from the airport, seaport, Causeway or from GPs and polyclinics who called for special transport to send patients here for screening. ED remained in this mode of operation and daily reports to our operations room were filed. For example, from the report of 5 April, 166 were seen the day before. One hundred and fifty-three were for SARS screening of which 46 were staff. Out of these 153, 26 were admitted of which 14 were nurses. And from the report of 13 May, the figures were 198 seen of which 177 were for SARS screening. Twenty-six were referred from the GPs, three from the airport and four from the Causeway. All were discharged. From Bowen Secondary school, 22 students were screened. All were discharged. Thirty were admitted, all for observation, including five HCWs.

For SARS admissions, the Standard Operating Procedure (SOP) was:

1. All SARS admissions will not be categorised at ED.
2. All SARS admissions were to be vetted by the ID (Infectious Diseases Team).
3. All SARS patients were admitted into individual isolation rooms.
4. The nurses would inform the Nursing Officers on duty regarding where the vacant beds in TTSH were so that the patient could be appropriately transferred (with all the precautions necessary) from ED directly to the ward.

For unknown SARS admissions, the SOP was to decide which of the following three groups the patient qualified as:

1. For the unknown SARS group, if the patient was on Home Quarantine, admission was to the unknown SARS ward’s isolation room.
2. If the patient had fever or pneumonia, the admission was to the unknown SARS ward’s isolation room.
3. If the patient did not belong to either of the above, then admission was to the general unknown SARS ward.

We salute our staff working at ED, frontline in every sense of the word. Nurses, doctors, administrative staff, porters and others did us proud.

STAFF COMMUNICATIONS
It is always of paramount importance that staff know what is going on and what is about to happen. MOH continued to issue many new directives and changes to existing directives so that it became easy for the staff to become confused. But this did not happen because of excellent staff communications. Every available channel was used: from e-mail, which was CEO communicating with all staff, on a daily basis, to messages, letters in the lifts, message boards in the wards, and of course formal face-to-face staff briefings by the CEO and relevant senior staff. For example, on 14 April, three sessions were held at 8 am, 2.45 pm and 4.30 pm at
their temperatures, and if still raised, to report sick to
were to put on a surgical mask, rest for two hours, recheck
(driven by another family member).
ED TTSH. If the staff were at home, they came to ED via
They were not to use public or their own private transpor
t ambulance by ringing the hotline numbers 91788477/8.
For all other staff with temperatures above 37.5
but was above 37.5
were first classified as non-SARS but later after the painful
and/or social) did not permit us to discharge them. They
with us before 22 March and whose conditions (medical
observation. In addition, we had a remnant who had been
SARS, and those who were probable, suspect and un
covered. From the SGH and NUH clusters, we recategorized
beds for SARS patients, we began “collecting” patients with
DISCHARGES
For some time after TTSH was declared SARS central and we
had discharged as many patients as possible in order to have
beds for SARS patients, we began “collecting” patients with
SARS, and those who were probable, suspect and under
observation. In addition, we had a remnant who had been
with us before 22 March and whose conditions (medical
and/or social) did not permit us to discharge them. They
were first classified as non-SARS but later after the painful
lesson of the SGH and NUH clusters, we reclassified them
as unknown SARS. Left with these patients types, we were
told by MOH that we had to observe the “in, no out” rule.
This meant patients could be admitted into TTSH but could
not be discharged — a type of “constipating” rule. Before
long we would run out of isolation beds and other types of beds. So we needed some pragmatic discharge rules
which would not allow community spread of SARS either to the general public, or the aged homes or to other
healthcare facilities.
As at 10 April, the discharge policy was as follows.
The patient had to be afebrile for the past 72 hours, the
chest X-ray had to be stable or improving from a non-SARS
condition, and the total white cell count had to be normal.
The patient was informed that he/she could be contacted on
a daily basis by our Home Surveillance team for the
coming three weeks following hospital discharge, for
the purpose of checking on his/her temperature and state
of health.
The above discharge criteria were not applicable for
non-SARS patients who had been in a cubicle in which a
suspect/probable SARS patient was subsequently diagnosed.
The non-SARS patient was then deemed to be a contact of
SARS and had to remain at TTSH for another ten days from
the last day of contact.
On 19 April, a new set of guidelines was issued. CEO
and I as Chairman Medical Board, were issued letters from
MOH signed by the DMS, delegating to us further powers
under Section 15 of the Infectious Diseases Act to issue Home
Quarantine Orders (HQOs) for ten days to TTSH patients with
concurrent chronic conditions upon their discharge, because they were suspected to be contacts of SARS. This daily
name list was forwarded to MOH so that they could liaise
with CISCO to ensure that those served with HQOs
complied. Patients under HQO were not allowed to go to
polyclinics when under quarantine for any dressings or
minor procedures.
For patients in the “hot” wards of TTSH (where SARS had
been diagnosed previously), the above discharge criteria
were applied to them plus ten days HQO upon discharge.
After the ten days were served, the patients were reviewed
at TTSH with checks for fever, and abnormalities on CXR
to exclude SARS, and if SARS was not probable, then the
patients were continued on a further ten days of home
surveillance. (This was the policy in operation as at
5 May 2003.) (“Hot” wards were defined as those which
had produced probable SARS patients or had clear exposure
to SARS patients or had clusters of suspect SARS staff
or patients.)
As for deaths in TTSH, those with SARS had clear
policies regarding autopsy, embalming, wake and funeral
arrangements. What about those who died but were
unknown SARS patients? MOH has no legal powers
to instruct the family members of deceased patients
who had not been diagnosed with SARS, on funeral
arrangements. So the best advice we could give the

MEDICAL LEAVE
As SARS affected many HCWs during the outbreak, it was
important to stop HCWs becoming infected, and if
infected, to stop them from passing SARS to fellow
colleagues, patients, family and friends. HCWs are human
and do fall ill. Many of our colleagues came down with
SARS. Five HCWs died.
TTSH needed to monitor the medical leave of staff
closely on two important counts. One was to detect SARS
early in HCWs and get them warded. The other was to look
for “clusters” of febrile patients among staff in their different
work sites to alert us to possible local transmission of disease
at that site. Our Human Resource Department only accepted
medical leave issued or endorsed by the TTSH staff clinic
or ED.
All staff had to take their temperatures thrice daily and
record it for submission to the department head. And this
included their temperatures when they were at home,
for example, on Sunday, or off duty, or on annual leave.
Should staff (especially foreign staff working at TTSH) stay
with other HCWs from TTSH, or other restructured
institutions, this fact was to be made known to department
heads. If anyone in the flat falls ill, the department head
would be notified, and contact tracing, isolation, monitoring
and surveillance of the other flat occupants would be done
if deemed necessary. Sick staff given MCs were to remain
in isolation at home with temperature monitoring (MC was
given because their temperature had not reached 38. C
but was above 37.5 C). Should their fever rise above 38. C,
they would be asked to come to ED again for consultation.
For all other staff with temperatures above 37.5. C, they
were to put on a surgical mask, rest for two hours, recheck
their temperatures, and if still raised, to report sick to
ED TTSH. If the staff were at home, they came to ED via
ambulance by ringing the hotline numbers 91788477/8.
They were not to use public or their own private transport
(driven by another family member).

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relatives was that the body should not be embalmed, should be double bagged, and the coffin sealed. Burial should occur within three days of death. Compliance was voluntary.

RENAL PATIENTS

Patients with chronic renal failure and those on cancer chemotherapy are immuno-suppressed and hence constitute two very important vulnerable populations to infection like SARS. Also it is likely that SARS infection in these patients would have atypical presentations. Suddenly, our fledging renal unit was thrown the important challenge of managing our patients in need of chronic dialysis because no other hospital or facility wanted them. (The previous rules mandated that they return to TTSH for their total care including dialysis.)

All persons who entered the chronic haemodialysis centre (later moved from ward 6C to the Artificial Limb Centre) had to be screened for SARS contact history and checked for fever. Those febrile above 37.5°C were not allowed into the centre but were reviewed by staff fully protected with PPE. The centre should have separate entry and exit points and patients on different shifts should not mix nor interact. Waiting areas had to be separate. No casual visitors were allowed. Only one person (after temperature check and screening) was allowed to help the patient and their personal particulars were recorded in case contact tracing was subsequently required. All patients undergoing dialysis had to wear surgical masks, and be assigned specific staff and specific chairs and machines. Patients undergoing dialysis had their temperatures checked pre and post dialysis. And if febrile, they were sent to ED for management. The machines, chairs and equipment had to be thoroughly disinfected before the next shift of patients was admitted. All HCWs had to be screened and fully protected. The PPE had to be changed for each new patient dialysed. For patients exposed to SARS, MOH needed to be notified. A Field Response Team would be sent down to the centre. All HCWs and patients present had to give personal particulars that could facilitate contact tracing. If a patient or HCW of the centre was diagnosed as SARS, the centre would stop functioning till MOH gave the clearance. Dialysis patients who were contacts of SARS cases outside of dialysis centres, and those discharged from SGH, TTSH and NUH, were placed on HQO for then days. During these ten days, they had to come to TTSH as outpatients for their regular dialysis, transported to and from their homes by dedicated ambulances. These patients were monitored by us for 21 days from the last known date of potential exposure to SARS with a review on the fourteenth day.

HCWs exposed to SARS at the dialysis centre were served mandatory HQO for ten days from the date of last contact. However should the HCW be a critical staff, MOH may be appealed to, to allow the HCW to continue to work but with extra close monitoring for ten days. The moment this HCW became febrile or unwell, he/she ceased to work and was managed by ED.

Finally, patients on peritoneal dialysis and HQO were required to monitor their temperatures thrice daily (at 8 am, 2 pm, 8 pm) at home. The dialysis centre would call them twice daily to monitor their condition. If they became unwell or febrile, they were to isolate themselves at home, wear a surgical mask and notify the centre and come by dedicated ambulance to ED TTSH. For similar peritoneal dialysis patients with no history of contact with SARS patients and not on HQO, they should go to the ED of their primary hospital, and not TTSH, should they fall ill.

ISOLATION ROOMS

The new TTSH was built with two isolation/high dependency rooms per ward. These are extra to specific wards like the ICU wards where next to the ICU beds are high dependency beds, rather than isolation beds. CDC also has isolation beds but these proved insufficient. So the plan was to put in cabins at CDC and these were ready for use in the first week of May 2003. Eighty isolation rooms were created in less than three weeks, of which 40 had medical gases as well. The other plan was to take the existing six-storey block under Ren Ci (old TTSH block) which had already been renovated as a community hospital type facility and convert all wards to isolation facilities. This was done and became operational on 17 August. On level one was an intensive care unit, as well as a surgical operating theatre. This facility was renamed CDC 2. So now outside of main TTSH building are 80 isolation rooms at CDC 1 and another 64 at CDC 2. The cost for these is about $30 million. (Straits Times, 24 July 2003, pg. H2, col. 5-6.)

As events turned out, by early May the epidemic in Singapore had already petered out. The last SARS patient was diagnosed on 11 May. The MOH press statement on 7 May stated that the latest date of onset of a probable SARS case was 27 April 2003. The number of patients who had recovered from SARS was 150. Twenty-six patients remained in hospital with nine in intensive care. Three hundred and eighty-five discharged patients were under home quarantine, and the total number under home quarantine was 1,015. The total number of probable cases was 204, and 27 patients had died.

PASIR PANJANG WHOLESALE MARKET

On 19 April, a cluster of febrile family members whose household head worked at the market was admitted to TTSH. MOH made the decision to close the market for ten days. All stall holders and employees at the market should stop functioning till MOH gave the clearance.
were placed on ten days of HQO. The same day, the Ministerial SARS combat team was set up and announced. SARS screening at our ED rose to 207 on 21 April, compared to 114 the previous day. Forty-four workers from the market came for screening and seven were admitted as suspects. The following day, ED saw 183 patients for SARS screening. Twenty-nine were related to the market, and one was admitted as a suspect SARS. And following our Prime Minister’s open appeal to residents to be socially responsible, ED SARS screening cases rose to 290 on 24 April.

**INSTITUTE OF MENTAL HEALTH OUTBREAK**

The MOH press release of 13 May began with “there are no new probable cases of SARS today.” Then it mentioned that a cluster of 24 patients and six nurses at the Institute of Mental Health (IMH) had developed fever which was detected over the two-day period from 11 to 12 May. Of these, 23 patients were from wards 60 and 64, and one was from ward 65. All were referred to TTSH ED for assessment, after which all, save three nurses (who were given medical leave), were warded at TTSH for observation. Two IMH doctors from these wards were also warded. Further, all patients who had been discharged from IMH from 23 April till 2 May were called up for review at TTSH. Also, those discharged from 3 May onwards, were put on HQO for ten days starting 10 May. Home and close contacts of febrile staff and patients were also on HQO. Both the CEO and CMB of IMH became our inpatients.

The final number from IMH admitted to TTSH over the next few days were 20 staff and 33 patients. All were for observation, none with probable or suspect SARS. Tests for coronavirus on several IMH patients with chest X-ray changes were negative. Several staff were found to be positive for influenza B virus. The clinical picture of the IMH cohort was not typical of SARS. Many had running noses and for almost all, the fever had subsided by 16 May. A few had TB and dengue fever.

**HOPES DASHED**

On 17 May, we were hopeful that on 18 May, WHO would declare Singapore SARS-free. It had been already 65 days since TTSH went into the emergency mode of operation. The press release from MOH stated that “MOH has now established that the cluster of IMH patients and staff who came down with fever from 11 to 12 May is not due to SARS. A total of 34 inpatients and 20 staff from IMH were admitted to TTSH for observation for fever. All the patients were in stable condition. Since yesterday, 25 have been discharged. So far, PCR testing for coronavirus has been negative in samples taken from 40 patients. Of nine patients who were tested, six were positive for influenza B virus.”

Then on 18 May came the big disappointment. MOH released the following statement. “A patient who has been admitted to TTSH since 11 May 2003 has been diagnosed to have probable SARS today.” This patient became unwell on 5 May, was admitted to TTSH on 11 May with X-ray changes of early pneumonia. He had travelled to Malaysia on 18 April, 1 and 5 May. PCR testings for coronavirus on 11 and 12 May were negative. He deteriorated and entered MICU on 13 May and was intubated on 15 May. Repeat samples sent for PCR tested positive on 17 May. The same sample was retested on 18 May and was positive again. Using a different PCR test kit, two additional samples taken on 18 May were also positive. And blood serology on 18 May was also positive for antibodies to SARS.

As his history of contact with SARS was negative, MOH made a public appeal for contacts of his and released his name and work place address. In the end, even after 31 May, we were not able to trace where he got the infection.

**CONCLUSION**

The situation continued to improve. Home surveillance monitoring for patients discharged from all restructured hospitals and those seen at ED except TTSH was lifted. We remained the lone facility prepared for battle with SARS. Staff from other hospitals like Alexandra Hospital, SGH, and KKWCH (and NUH for paediatrics and obstetrics) returned to their bases. On 31 May 2003, Singapore rejoiced. It was off the WHO list of countries with local transmission. We were SARS-free.
SARS @ TTSH (Part 9)

By Prof Chee Yam Cheng, Editorial Board Member

Editorial note:
The following article was submitted on 11 November 2003. Contents are current at the time of submission.

had left off discussion of events in the last article on Tan Tock Seng Hospital (SARS @ TTSH – Part 8) on the day Singapore was declared SARS free on 31 May 2003.

For the next one week, there was much in the press, both local and foreign, that in one way or another was related to SARS. The Straits Times front page highlighted the Transport Minister announcing that almost one third of the flights cancelled after the SARS outbreak were being restored and that the Singapore government was funding airlines with $10 million in incentives to bring more passengers and flights to Singapore. Then there were reports about the Outram campus of Singapore Health Services being reorganised and regrouped, as well as CEO, Singapore Health Services becoming concurrently the Acting CEO of Singapore General Hospital (SGH). He was made CEO SGH on 1 November 2003. On Channel 5 and Channel 8 news were reports that our anti-SARS measures were here to stay as lessons of Toronto had to be taken seriously. Temperature checks would continue in schools, markets, government buildings, construction sites and hotels. Also on Channel 5 was the first programme in a series “True Courage”, dramatising Singapore’s first SARS case as a “super-infector”, relating the prejudice and pain she endured as she realised she had infected more than 100 people directly or indirectly.

The buoyant mood swept through Singapore’s struggling shopping centres as the World Health Organisation’s (WHO) announcement coincided with the start of the six-week Great Singapore Sale. People were out in force, with a triple increase in sales and traffic at Takashimaya compared to the month before. Traffic at Wisma Atria jumped 22% in one week from 49,000 shoppers. Life seemed to have returned to normal for most Singaporeans with crowds flooding to libraries and shopping malls.

But Singapore, now declared SARS-free, was not letting down its vigilance. Singaporeans continued to take precautions by consistently taking their temperatures and exercising personal hygiene. The Minister of Trade and Industry was reported by AP as saying that even though Singapore might have defeated its SARS outbreak, it had not let down its guard and was prepared to act in case the disease resurfaced. The Minister of State for Health said that it was important for Singapore to become a SARS-resistant country. This meant that even if someone with SARS came to Singapore, Singapore would have in place measures for detection and the prevention of an outbreak.

It was also reported that some Singaporeans raised concerns that some medical facilities located near public housing estates could pose a danger to the community in the event of a SARS outbreak. The Minister of State for Health gave his assurance that there was no danger to the community because SARS could only spread through close contact with a SARS patient and healthcare facilities were located several hundred metres away from housing estates. He also stressed that the battle against SARS was “really a long haul battle” and that the government would need the support of Singaporeans and their understanding to have anti-SARS measures in place, particularly in the healthcare system. An unusual feature of the SARS outbreak has been the spread of SARS within the hospital setting and within healthcare facilities with healthcare workers sharing in the death toll of the disease.

This brings me now to the focus of this article, which is how TTSH is to be prepared for any SARS outbreak in the future. So let me state a few principles up front as lessons learnt.

LESSONS LEARNT

Firstly, TTSH cannot be allowed to forego its general hospital status and become totally committed to the care of patients with SARS (or whatever new disease may come along). With the busiest Emergency Department in Singapore and 1,064 beds in the main building, this huge loss of resources created tremendous pressure on all other public healthcare facilities. These other hospitals had to cope with their normal loads, plus redirected loads from TTSH. In addition, they had to guard against any likely SARS patients who did not seek help at TTSH for whatever reasons. (This was not always the fault of the patients as clinical presentations of diseases could be atypical.)

Secondly, TTSH in its brand new facility (we moved over in April/May 1999) was not built to handle outbreaks of infectious diseases. The new building is a general hospital. Isolation rooms are built two to each ward and are meant to handle cases with MRSA, TB, and so on. Also, there are only 28 such isolation rooms. Further, it proved almost impossible to direct traffic flow of public and staff into and out of the hospital as there were many entrances and exits (for the convenience of all). This is unlike the old Middleton Hospital with one gate and a guardhouse.

Thirdly, all staff have a role to play. There are just insufficient resources to ask, for example, only the doctors in the Division of Medicine to care for all the inpatients. Besides doctors, other staff had to be quickly trained and redeployed. New jobs were created. Contact tracing, surveillance telephone calls, daily reports to the Ministry of Health (MOH), and so on, needed lots of staff. Suddenly, clinical epidemiology in real-time became
paramount and critical if every contact had to be traced, served quarantine orders and monitored for compliance. Rostering changed overnight. Hours per shift were longer. If teamwork was one of the most critical factors for success, this was ably demonstrated. And so, if rewards and recognition were subsequently handed only to a few, if judgements of who was to be awarded what were perceived as less than fair, then teamwork would suffer.

Fourthly, the lesson to learn, and learn again, is effective, sincere, and timely communication. If well done, it breeds credibility and confidence. If poorly done, it leads to distrust and disdain. Staff want to know the truth, the true situation, the risks and the battle score. And they want the information before it reaches the media and the public.

The last lesson I wish to highlight is that there should be sufficient resources – human capital as well as equipment (Personal Protection Equipment, or PPE, in particular), and that these be effectively utilised. All bodies should participate and share the load. Otherwise it will be difficult to preserve the camaraderie and teamwork so characteristic of TTSH staff. As for equipment, rational and proper use is essential. In Taiwan, nurses refused to work possibly because they had insufficient protection. Conversely, in Toronto, staff were allowed to wear concurrently two gowns, or two gloves, or two masks (surgical over N95). This also does not make sense.

Let me return to the first two lessons regarding facilities and modus operandi.

MIDDLETON HOSPITAL
This facility began in 1907 as a quarantine camp for the isolation and treatment of cases of smallpox, cholera and plague which were prevalent at that time. The government’s view then was dangerous infectious diseases were to be managed by the Municipality. So it isolated a piece of land at Moulmein Road for this purpose (and a highly valued piece of real estate today, being located in prestigious District 2). The Municipality put up the buildings, many of which exist today as low rise pavilion type wards akin to those in old TTSH. This took from 1907 to 1931 to complete. Wards and staff quarters were also built. The government gave provision, drugs and met public utility changes, while the Municipality took care of all other expenses.

With the subsidence of smallpox, cholera and plague, patients with other types of infectious diseases began to be admitted. Smallpox has been eradicated from the world. Cholera is still here with us and a new strain, the El-Tor strain has since emerged. Plague is gone from Singapore, but in 1997, there was an outbreak in India and we had to be prepared to receive cases imported into Singapore but none materialised. Of the new admissions, the prevalent diseases were diphtheria, typhoid, poliomyelitis and dysentery. We remember the bed with a hole in it for the buttocks so that diarrhoeal stools could be accurately measured and adequate fluid/electrolyte replacements given to the dehydrating patients. This bed is still preserved in our TTSH museum for all to view. Then, there was the iron lung for the unfortunate polio victims who could not breathe at all.

From its modest beginnings, this isolation camp developed over the years into a hospital for the treatment of infectious diseases. Its construction milestones were as follows:

1. The kitchen was expanded and modernised in 1954.
2. Changing rooms and a staff canteen were added in 1955.
3. The first cubicle ward was opened on 11 October 1956.
4. The mechanised stream laundry became operational in 1956.
5. A new dysentery ward was constructed in 1956.
6. The disinfecting station was improved in 1957.
7. The laundry with new equipment was enlarged in 1967.
8. A new administration block with storerooms was constructed in 1967.

Not long thereafter, as a fourth year medical student, I set foot on this campus, then called Middleton Hospital after its first Municipal Health Officer, Dr WRC Middleton. Dr Leong was then the Chief Medical Officer on the grounds and our lectures on infectious diseases were held under a big tree near the main administration block, which you could drive around in a car. It is central and faces the main gate. Dr Monteiro, who still works at the CDC today, was also there on its staff. To many Chinese, this hospital was known as “Or Sai” or “black lions”, as there were indeed two black lion statues at its gate on either side of its pillars. (These have since been removed.)

CDC
On 1 January 1985, Middleton Hospital merged with TTSH and was renamed the Department of Communicable Disease (DCD), on par with its other departments like Surgery and Medicine. It had 272 beds and is mainly a clinical facility catering to the care of patients – in and outpatients with communicable disease, human immunodeficiency virus (HIV) and other outbreaks (e.g. chickenpox, measles). With the birth of HIV in the 1980s, MOH had decided to centralise all such patients at DCD and this policy continues to this day. A special operating theatre was purpose built for HIV patients. Surveillance of HIV is also carried out by staff here. A Straits Times report on 22 September 1987 mentioned that there were then nine known HIV carriers in Singapore and only one had developed full blown AIDS.

CDC – PRE SARS
In 1992, with the restructuring of TTSH, two long established sections of Tuberculosis Control and Epidemiology were merged with the DCD to form the Communicable Disease Centre (CDC), which reported directly to the MOH. That is, from 1985 to 1992, they were part of TTSH, but from 1 February 1992, they were removed from TTSH and put directly under MOH. A major renovation was done to upgrade its physical infrastructure and facilities. The administration block was also improved to house administration, finance, personnel as well as public relations and payment departments.

The Trafalgar Home at Lorong Buangkok was closed and its patients transferred to a newly renovated 24-bed “C” class on 24 December 1992. In 1993, two B1 beds at Ward 76 were converted into four B2 beds so that four classes of
wards were now available. A new lecture hall and meeting room were added on the grounds.

In April 1995, the CDC was removed from direct command of MOH into the restructured TTSH administration under its CEO Dr Judy Lim. So two departments were born – the Department of Infectious Diseases and the Department of Clinical Epidemiology, both under the Division of Medicine. Today, there are five wards at CDC with 123 beds and 37 isolation rooms/single beds in single storey buildings over 90 years old. Even before TTSH relocated to its present new facility, plans were on the drawing board for the redevelopment of the CDC. However, this has taken some time to bear fruit.

After the Nipah outbreak in 1999 and now SARS in March 2000, plans have had to be revisited and revised yet again. In 2000, two isolation rooms were commissioned for the isolation of patients with airborne infection, with optimal engineering requirements of negative pressure, HEPA filters and UV treatment.

**CDC – POST SARS**

One great lesson learnt from the SARS outbreak was the need for isolation facilities in Singapore. CDC had only 151 beds, many in open dormitory style. For isolation policy, the requirements are as follows: “Isolation of all suspected/probable cases in negative pressure isolation rooms with HEPA – filtered air (continuous monitoring.) Separate bathrooms and ante room (two down separating patients from the rest of the hospital). This is ideal, but if not available, as is the case in many hospitals, a single room with an extractor fan appears to be satisfactory. The central air-conditioning should be turned off. Where single rooms are not available, cohort nursing is practised but the space between the beds should be at least two metres and very strict droplet and contact precautions observed at all times.” It was therefore obvious that Singapore did not have sufficient, high quality isolation rooms.

So the decision was taken to take back from Ren Ci Hospital the old TTSH ward block situated next to the new TTSH building. This used to house Wards 41-46 and Wards 51-56, the Training and Education Centre, and the old Emergency Department. It had been renovated by the Ren Ci management into a Community Hospital but had not begun operations. Several times in 2002, an operational date was set but nothing materialised. So when SARS broke out, this facility was still in mothballs. MOH spent close to $30 million to ready TTSH for any SARS outbreak by adding 64 new isolation rooms, 18 ICU rooms and an operating theatre in this facility, now re-designated CDC 2. *(Straits Times, 24 July 2003, pg H2, col 5-6.)* So CDC 1 and CDC 2 were born.

**CDC 1**

By 4 May 2003, CDC had completed renovation and rebuilding. As CDC 1 had lots of empty grounds, two new wards were created using containers and pre-fabricated building materials. They are Wards 91 and 92, each containing 20 isolation rooms. Each isolation room is equipped with an individual air-conditioning system, attached shower and toilet facilities, medical gas supplies, nurse call bell and intercom, telephone and TV ready infrastructure. Attached are the nurses’ station, staff rest and doctor call rooms. Besides these 40 isolation beds, a screening centre was built with the following facilities: triage and registration counter, consultation and examination room, X-ray rooms, a laboratory, a pharmacy, and rest and shower facilities for staff.

By 20 May, another 40 isolation rooms were fully renovated and constituted Wards 93 and 94. Thus, CDC 1 in total now has 80 isolation rooms.

**CDC 2**

The shell of the old hospital was retained. Renovations created the 64 isolation rooms by partitioning the wards of the original six-storey block. Plumbing was revamped to put toilets in all rooms. The other two blocks have new layouts to facilitate the handling of high and low risk patients, including the addition of triage stations where the initial history and vital signs are taken. Air-conditioning systems had to re-routed to ensure a one-way circulation of air in the whole facility so that staff and patients get fresh and not stale air. These measures are to prevent the spread of the infectious SARS virus. So operationally, there should be any patients thought to have SARS, they would be managed at CDC 2. This would allow TTSH proper in the new main building with 1,064 beds to carry on its usual function, as well as allow National Neuroscience Institute (or NNI, which is housed in the same building) to be operational during any SARS outbreak. So the 200-bed Ren Ci Community Hospital never functioned. Instead, on 16 August 2003, it opened as CDC 2 with a very much reduced bed complement and patients from TTSH were transferred across to free TTSH of beds meant for the care of acute medical and surgical non-infectious patients.

In CDC 2, there are 18 ICU beds (level 1), 13 single isolation rooms per floor from levels 2 to 5 (52 beds), as well as 12 rooms on level 6 (24 beds), giving a total of 76 beds.

Therefore, for CDC 1 and CDC 2 combined, there are new facilities to isolate 156 patients and care for another 18 ICU patients. Added to this are the old CDC 1 Wards 72, 73 and 74, which together have another 48 isolation/cohort beds. We now have a grand total of 222 beds.

**THE NEW CDC**

We moved into the new TTSH building, built on the original TTSH football field, in 1999 in time to tackle the Y2K bug, which turned out to be a non-event. It took some 15 to 20 years of planning before the hospital was finally built. The topping out ceremony took place on 24 May 1997, and having 13 levels above ground and four below ground, this meant work had started some four years earlier. There was a private bet between two senior doctors in 1990 that we would not have moved into the new building by 2000. Well, we just made it before year 2000 dawned upon us. So, how long now for the new CDC to be built?

Soon after TTSH plans for rebuilding were approved, thinking started regarding what to do with CDC at Moulmein
Road. Its present land plot is very large and commercially valuable. As mentioned earlier, the old Middleton Hospital began in 1907, and it appears it will last 100 years before a new replacement will take over. In today’s globalised world where an outbreak of one infectious disease has the potential to very quickly spread to every country in the world, how should we handle such a situation in very small Singapore where air travel is rapid and efficient? Is a quarantine centre concept viable? Can we “catch” people who are infected, fast enough to quarantine them somewhere before the community is exposed to the infection and infected? And if quarantine is feasible, then where? St John’s island? If unlike SARS (where droplet spread and contact are the modes of disease transmission), it is an airborne infectious disease or some act of biological terrorism, then what?

Is the current infrastructure, now that we have CDC 1 and CDC 2 operational (and $35 million spent in a hurry to have these up and running), adequate to effectively handle another SARS outbreak? Hopefully, the answer is yes. But what about a different infection, with larger numbers infected and in need of isolation? Would 222 isolation beds be enough? Singapore is a small nation but densely populated. Is a centralised outbreak management an effective strategy? Maybe it was for the Nipah outbreak (a zoonosis) and SARS (a nosocomial infection). So how should we plan to handle control, prevention, detection and management of infectious diseases? There is a small plot of land reserved next to TTSH and facing the Ministry of Home Affairs (our very own twin towers along Irrawaddy Road) for a new CDC. How should we proceed?

Should the new CDC handle the bioterrorism threat as well? There are eight important respiratory agents that have been or could be used in bioterrorism. These are: anthrax, tularaemia, pneumonia plague, brucellosis, Q fever, smallpox, ebola haemorrhagic fever and coccidioidomycosis. Most of us doctors have never seen a case in Singapore. In the past, bacillus anthracis, francisella tularensis, variola major, yersinia pestis and ebola virus have been evaluated and/or used as biological weapons. These organisms can be spread by aerosol dispersal, and under ideal meteorological conditions, could infect thousands of individuals. Smallpox, ebola haemorrhagic fever, and plague can also be transmitted by person-to-person contact. All of these diseases can cause significant morbidity. However, only anthrax, smallpox, plague and ebola haemorrhagic fever are highly lethal. Vaccines are available for smallpox, anthrax and plague. Vaccines have also been developed for tularemia, Q fever, and brucellosis but they are not readily available. Antimicrobial treatments are available for anthrax, plague, tularaemia, Q fever, brucellosis and coccidioidomycosis. However, drug resistant strains of F tularensis and B anthracis could make treatments ineffective. Supportive care is the only treatment available for smallpox and ebola haemorrhagic fever. (Online resources available for bioterrorism can be found at www.bt.cdc.gov; www.idsociety.org; www.hopkins-biodefense.org and www.niaid.nih.gov)

Note:
Part 9 will be continued in the next issue of SMA News.
SARS @ TTSH (Part 9)

By Prof Chee Yam Cheng, Editorial Board Member

Editorial note:
The following article was submitted on 11 November 2003. The first half of Part 9 was published in the December issue, and the rest is continued here. Contents are current at the time of submission.

STAFF ISSUES

Let me now discuss the other two points raised regarding staff issues. Staff were reconstituted into different teams for the work at hand, given adequate Personal Protection Equipment (PPE) and taught how to use them effectively. Furthermore, they were checked to ensure that PPE was properly worn at all times. It is easy to have policies, but more difficult to have them implemented, and most difficult of all, is to ensure consistency in compliance – all the time, every time, with no slip-up. One weak link, one forgetful moment, and the chain of protection is broken. Vigilance is paramount. Staff need to be alert, not sleepy, stressed or overworked.

I have explained about PPE in earlier articles. The other critical pillar of staff protection is that sick staff should detect their sickness early and stop work at Tan Tock Seng Hospital (TTSH) immediately. As SARS is a nosocomial infection, spread is great within the hospital from staff (doctor, nurse, allied health professionals, porters, amahs, clerks, and others) to staff, and from staff to patient, and staff / patient to visitor and vice versa. To break this cycle, staff must be monitored for possible SARS because their work place is a high-risk area.

So, the staff clinic becomes a critical piece of the defence armour against SARS. Rules like the following were implemented for strict compliance. Every sick staff must be made known to senior management, and their whereabouts and contacts monitored.

1. All staff had their oral temperatures taken thrice daily – on coming to work, before leaving work, and once in between.

2. If staff had fever, cough, breathlessness, generalised muscle aches or upper respiratory tract symptoms, they had to report directly to Emergency Department (ED) TTSH for management. ED TTSH was the screening centre for SARS for the whole of Singapore, including our staff.

3. If staff had other complaints, they had to see the doctor at the staff clinic, which closed mid-March and reopened on 14 April 2003. In retrospect, it appears that diarrhoea was a presenting complaint in some 20% of the cases, and if the staff had no fever, they still would have seen this clinic instead of ED. As the staff clinic was closed outside of office hours, all sick staff after office hours went to ED.

4. Medical certificates (MC) / leave from family physicians were not accepted unless it was endorsed by the doctor of the staff clinic. The reason behind this was for us to be sure of the reason for the MC as we would then pick up “clusters” of sick staff by symptoms or work location. For example, a doctor and a nurse in the same ward might both be sick at the same time, but no one would know why, nor the fact that they were from the same ward. By having the HR Department collate these MCs, it was hoped a clearer picture of localised nosocomial infection would emerge.

5. The staff clinic doctor would duly endorse MCs issued by obstetric / gynaecology specialists for conditions relating to pregnancy. The clinic would also endorse MCs given by TTSH specialists. Details of diagnosis / symptoms would be listed in the MC.

6. All heads of department had an important duty to monitor the health and temperature of their staff. Everybody in TTSH knew their body temperatures, and if at any time, it went above 37.5°C, they were not to move about, but wait for half an hour and retake / recheck their temperatures. If still raised, they were to put on a surgical mask and head for the ED. Strangely enough, the morning temperatures of female staff were raised but they cooled off soon after. The reason was that they had just ovulated. So, in a way, a basal body temperature chart was monitored and the females had the bonus of knowing how their cycles were coping with the stress of SARS.

7. Staff given MC were deemed to be on home quarantine, that is, the laws of the Home Quarantine Order (HQO) applied to them and they were to remain home, monitor themselves and their temperatures, and report back to ED TTSH should their temperatures rise beyond 38°C. The purpose was to detect SARS early and start isolating the staff at home (HQO), even before SARS could be diagnosed.

Contact tracing was essential so that HQOs could be served in a timely and appropriate manner.
As Chairman of the Medical Board at TTSH at that time, I received lists of doctors admitted into TTSH, classified into categories like suspect SARS, probable SARS and for observation. And yes, we were worried and concerned for all our staff. In the end, I think less than half of the 239 SARS cases in Singapore were staff.

**STAFF OBSERVATION FACILITY**

Staff were being shunned during the early stages of the SARS outbreak. Buses would not stop by TTSH, and taxi drivers did not want to bring staff (or anybody else for that matter) to TTSH. Some neighbours and even family members kept themselves away from our staff. It seemed as though overnight, we became “unclean”, and as in the days of leprosy, we had to ring a bell to announce our presence and everybody would quickly disappear from sight. Fortunately, with better understanding of the disease, better education of the public, and strong support from our government and political leaders, this unwarranted fear of us died away. Soon, the pendulum swung in our favour. We were praised, presents were heaped upon us, and accolades flowed.

As some members of the public felt that the HQO was too troublesome or inconvenient to be served out at home, they could opt to go to Loyang Aloha Village and rent a bungalow to relax in. The HQO had stipulated that those living in the same house, especially children, were considered as contacts and so could not leave the house too. This impacted on their schooling. In the same vein, staff on MC being deemed in effect to be on HQO (although not a physically served one as such) may have wanted not to be at home.

The National Healthcare Group (NHG) therefore set up the staff observation facility (SOF). This was a stay-in facility at Pearl’s Hill. For staff on HQO (because they were patients well enough for hospital discharge, or were contacts of patients), or on MC with fever, who wished to stay away from home, this 28-unit facility was available to them. Located at Block 201 Pearl’s Hill Terrace, each unit was fully furnished with a bathroom and kitchenette. Meals were provided but not laundry service. It was in operation from 26 April till 30 June 2003. However, it was under-utilised with 15 occupants in total.

**JUNE SCHOOL HOLIDAYS**

With Singapore declared SARS-free on 31 May 2003 by WHO, the school holidays meant that staff could go on leave again with their families. So, some rules were put in place to allow this to happen, while maintaining vigilance against SARS. There were five rules:

1. Staff on leave locally or overseas had to be contactable at all times and monitor their temperatures daily. This was to ensure immediate contact tracing to detect fever clusters among staff who may have been incubating the disease, only to manifest it when on leave.
2. There was no restriction imposed on travel to non-SARS countries.
3. No official travel to SARS-affected countries was allowed, whether for business or for training.
4. Personal travel to SARS-affected countries was not approved unless in extenuating circumstances. Should such travel be approved, upon return to Singapore, the staff had to stay home for ten days using annual leave, before returning to work. If there were good reasons, this leave could be granted as half-day unrecorded leave.
5. If a staff travelled to a non-SARS country, which subsequently became classified as a SARS-affected country, then the ten-day home quarantine above would apply. In both cases, should staff fall ill with SARS, the normal medical leave and benefits would apply.

Staff could take annual leave once again, but overseas travel needed approval and proper precautions.

**CHILDREN OF STAFF**

TTSH has a childcare centre on-site on Level 4. When SARS hit TTSH, this centre was closed (22 March 2003). The services relocated to Boon Keng Road for the time being, starting 21 April. Because their parents were healthcare workers of TTSH, these children were also at risk of contacting SARS. So, health declaration forms and temperature taking were the norm daily. Learning Vision International, which runs the centre, won the COOL award for best practices in SARS prevention. This award by SPRING Singapore is based on a nine-point requirement for best practices. Hence, our staff were reassured that their children were given adequate protection against SARS. The centre reopened at TTSH on 4 August.

**SARS-FREE SINGAPORE**

In June, at TTSH, although Singapore was taken off the WHO list of SARS-affected countries, we continued to maintain the “orange alert” level of infection control. MOH relaxed its rules on movements of healthcare workers (HCWs) and patients across institutions but temperature surveillance
of workers was mandatory (MOH Directive 104/03 dated 3 June 2003). Nursing students and medical students were slowly allowed back into hospitals, but were restricted to specific wards and not allowed to be free roaming. Their movements were tracked across the hospital just in case contact tracing had to be done. Because of SARS, the usual elementary clinics for medical students in the third year could not be carried out in hospitals. They either went to GP clinics or used each other to test their basic skills. Furthermore, the new house officers enlisted into the workforce in May could not be posted to us at TTSH, and so did the first two months of their four-month posting in other hospitals.

As Toronto was off the SARS list and then on it again, we had to be extra cautious not to let our guard down. Patients prior to discharge needed to be cleared for SARS infection, especially those with chronic illnesses which may mask SARS symptoms. For them, their stools PCR had to be negative twice before discharge. Furthermore, if they were bound for the nursing homes, they also had to be afebrile for 72 hours and have a normal, or abnormal but stable, CXR. Our ED began normalising operations by admitting emergency cases to medical and surgical divisions. By mid-June, ambulances were allowed to call at TTSH again, and finally the day arrived when we could tell all and sundry to come to TTSH if they needed help. All these new admissions were housed in separate wards to those already hospitalised in May 2003 and before. There was no mixing of new and “old” inpatients. Two definitions in operation were afebrile, meaning temperatures less or equal to 37.5°C, and chronic illness, meaning chronic lung conditions, diabetes, heart failure, chronic liver or kidney disease, chronic rheumatological or autoimmune disorders, malignancies, and patients on immunosuppressive drugs like steroids.

Our outpatient facility was fully reopened on 2 June 2003. For the previous two weeks, we had been recalling our “old” patients to return for follow-up and our attendances gradually increased. To facilitate faster temperature checks, instead of using aural thermometers, we opted for thermal scanners the way the Changi Airport uses them. These have been installed, properly calibrated and in use up till now. Taking temperatures of all and sundry several times a day, and stickers of multiple colours to affirm one’s body temperature have become a way of life for us, TTSH staff, as well as all our visitors.

MEMORIAL SERVICE

On 19 June 2003, the staff of TTSH gathered in great members for the memorial service for two of our staff who gave their lives in sacrifice against the SARS virus. It was an event to mark the close of one chapter, not only for the staff but also the families of Dr Ong and Nursing Officer Hamidah. We appreciated their presence. We had very much wanted to convey to them and share with them our feelings of great loss. Today, there remains a plaque with both their names, suitably placed in the foyer of the lecture theatrette on the first level.

RESURGENCE?

On 14 May 2003, WHO removed Toronto from the list of areas with recent SARS transmission because 20 days had lapsed since the most recent case of locally acquired SARS was isolated or a SARS patient had died, suggesting that the chain of transmission had terminated. However, unrecognised transmission continued in a particular hospital, which on 23 May, was finally closed to all new admissions other than patients with newly identified SARS. HCWs at this hospital were placed under ten-day work quarantines and instructed to avoid public places outside work and close contact with friends and family, and to wear a mask whenever public contact was unavoidable. As of 9 June, of 79 new cases of SARS that resulted from exposure at this hospital, 78 occurred before these measures were implemented on 23 May.

On 18 June, MOH issued Directive 108/03 on SARS outbreak transmission continued in a particular hospital, which on 23 May, was finally closed to all new admissions other than patients with newly identified SARS. HCWs at this hospital were placed under ten-day work quarantines and instructed to avoid public places outside work and close contact with friends and family, and to wear a mask whenever public contact was unavoidable. As of 9 June, of 79 new cases of SARS that resulted from exposure at this hospital, 78 occurred before these measures were implemented on 23 May.

On 18 June, MOH issued Directive 108/03 on SARS and movement of non-SARS patients between acute care hospitals and institutions. This superseded earlier directives dated 19 April on the inter-hospital transfer of inpatients, and another dated 23 April on the readmission policy on patients from SARS-exposed hospitals. Patients with co-morbid conditions and who may have SARS may present with many atypical clinical features. The frequent and free movement of such patients between healthcare institutions represents therefore the single most important factor in the propagation of SARS outbreaks.

The directive stated that a patient who requires readmission within 21 days of discharge from an acute care hospital / institution must be readmitted to the same hospital / institution. In general, an inpatient should not be transferred from one acute care hospital / institution to another, except for the following situations. The first is a medical emergency where the patient will receive treatment at the hospital he presents at. The second is if there is no medical capability, for example dialysis, at this hospital, then the transfer should be within the same cluster hospital / institutions. The third is that private hospital patients can seek subsidised care in a public hospital, and so be allowed transfer. If it is still deemed necessary to transfer a patient who does not meet the exceptional criteria above, the approval of MOH must be sought.

The receiving hospital of such patients must be within the 21 days of transfer and patients must be managed in an isolation room, unless or until the following three conditions are satisfied. Firstly, they must be afebrile for at least 48 hours. Secondly, a chest X-ray is clear of pneumonic changes or respiratory distress syndrome. Thirdly, for patients with co-morbidities, stool or nasopharyngeal aspirate must be negative for coronavirus PCR.

As a further precaution, discharged SARS patients of TTSH who needed hospitalisation within 21 days of discharge had to be admitted back to TTSH. With these precautions in place, it has been back to the new “normal” hospital practice in all hospitals including the main building at TTSH. While we may be prepared for another droplet outbreak of SARS, we hope it will not happen again.

ACKNOWLEDGEMENT

We wish to thank Tan Tock Seng Hospital for granting us permission to use the photos in this article.
Introduction

This article is written in December 2003, a year after SARS first reared its head in Southern China, when patients suffering from a flu-like illness were thought not to have a new disease. It was on 10 February 2003 that the government of Guangdong province and Guangzhou city announced the epidemic situation of this disease in Guangdong. The disease was not named as yet and Dr Carlo Urbani (from the WHO) had not yet come to Hanoi, Vietnam to investigate the outbreak there, which occurred in early March. Up to 9 February, there had been 305 cases with five deaths in Guangdong province, of which 225 cases with two deaths were from Guangzhou.

When WHO finally declared the global health alert on 12 March, it also issued the clinical case definition for the disease, now named SARS – Severe Acute Respiratory Syndrome. The clinical criteria then used was fever of more than 38ºC, lower respiratory tract illness (cough, difficulty in breathing, shortness of breath), radiographic evidence of lung infiltrates consistent with pneumonia/respiratory distress syndrome or autopsy findings consistent with these, and no alternative diagnosis could fully explain the illness. All four criteria had to be fulfilled to define a patient with SARS. A suspect SARS patient did not fulfill all the four criteria, especially the lung pathology. And important in the clinical history was a history of contact with a SARS patient or travel to a SARS-affected country.

Today, the SARS case definition has changed because the laboratories are able to do certain tests for the coronavirus, which has been identified as the causative agent for this new disease, the first in the 21st century. I will therefore elaborate on the R & D of SARS – the research and diagnostic achievements to date.

SARS Case Definition

This is taken along three aspects – clinical, laboratory and epidemiological. A patient with SARS is defined as a case that meets the laboratory criteria of SARS and is not required to meet all the components of the clinical criteria (stated above) and epidemiological criteria. A patient suspected of SARS is a case that meets the epidemiological criteria, but not all the components of clinical and laboratory criteria.

What then are the laboratory criteria? A patient is diagnosed as suffering from SARS when he has symptoms and signs that are clinically suggestive of SARS and has positive laboratory findings for SARS coronavirus based on one or more of the following diagnostic criteria.

1. PCR positive for SARS-CoV. PCR positive using a validated method from:
   (i) at least two different clinical specimens (e.g. nasopharyngeal and stool); or
   (ii) the same clinical specimen collected on two or more occasions during the course of the illness (e.g. sequential nasopharyngeal aspirates); or
   (iii) two different assays or repeat PCR using a new RNA extract from the original clinical sample on each occasion of testing.

2. Seroconversion by ELISA (Enzyme Linked Immunosorbent Assay) or IFA (Indirect Fluorescent Antibody Assay):
   (i) negative antibody test on acute serum followed by positive antibody test on convalescent phase serum tested in parallel; or
   (ii) fourfold or greater rise in antibody titre between acute and convalescent phase sera tested in parallel.

3. Virus isolation:
   Isolation in cell culture of SARS-CoV from any specimen and PCR confirmation using a validated approach.


Finally, the epidemiological criteria relate to persons with an epidemiological link to a case of SARS. This judgement of contact history is based on the risk assessment made by the specific epidemiologist investigating the case using two criteria:

1. Travel (including transit in an airport) within ten days of onset of symptoms to an area with current or previously documented or suspected community transmission of SARS (see Table 1).
2. Close contact within ten days of onset of symptoms with a person known or suspected to have SARS.

So although WHO declared Singapore free of local SARS transmission on 31 May 2003, in the above table, US CDC takes a later date for Singapore.
ANIMAL RESERVOIRS
A SARS-like virus had been found in a broad range of animals, ranging from snakes and birds to mammals. Fourteen United Nations and Chinese experts visited farms and markets in Guangdong, the epicentre of the virus in South China, in search of a possible animal carrier of the virus. They were surprised to see so many different species were capable of infection. The French expert Mr François Monton said: “What is surprising is we got positive results from mammals, birds and reptiles. This is very strange because usually we don’t find viruses affecting so many animals.” Mr Hume Field, an expert from Australia’s Animal Research Institute said: “There may be many animals that are capable of being infected but they might not be capable of transmitting the virus to people.”

Koch’s Postulates Fulfilled
Dutch researchers proved that the new coronavirus is the source of SARS by completing tests that met all accepted scientific standards. (Straits Times, 16 May 2003, pg A4 col 1-3.) Virologists at Amsterdam’s Erasmus Medical Centre, led by team leader Albert Osterhaus, said: “It is important in terms of combat strategies against the disease that you can unequivocally define what the primary cause is. It will speed up diagnostics. It will speed up antivirals development and it will speed up vaccine development because now we know what we have to focus on.” The tests they carried out met standards set by Koch’s postulates. It involved cross-checking to ensure that the disease can be clearly traced to a given virus and not to other pathogens that may lurk in samples taken from patients. Other groups working on SARS met the first three criteria of isolating the virus from diseased hosts, cultivating it in host cells and proving that the agent passes through a laboratory filter that traps bacteria. Professor Osterhaus announced they had successfully carried out the other three Koch tests. These were: inducing the disease in the same or a comparable host; re-isolating the pathogen from the sick animals; and detecting a specific response to the virus from the body’s immune system. These experiments were carried out on macaque monkeys.

This laid to rest the theory that an atypical paramyxovirus or chlamydia species found in samples from SARS patients in China and Hong Kong, caused SARS.

DIAGNOSTIC KITS
Once it was clear that the coronavirus was the causative agent of SARS, scientists began in earnest to sequence its complete genetic code. Roche Diagnostics announced that it could roll out diagnostic test kits within six to eight weeks of the genome sequence. Current diagnostic measures depend on antibodies in cell and tissue cultures but are severely limited by the fact that they are only able to detect the presence of SARS 14 to 21 days after infection. By that time, most patients would have reached a critical stage of illness.

Roche was using the molecular testing approach to detect SARS two to three days after infection by identifying the genetic material of coronavirus. The test result could be ready in one hour. This would be one step ahead of the diagnostic kit which Artus, a German biotechnology company, was developing. The Artus kit required two hours to diagnose SARS. Both kits employ the polymerase chain reaction (PCR) technique. The Roche version employs also the light cycle, an instrument that allows the diagnostic results to be processed in a significantly shorter time. This same process is used by Roche to diagnose patients with HIV, hepatitis A virus and tuberculosis.

In PCR, a target sequence of 100 – 600 base pairs uniquely specific to the coronavirus would be replicated with primers marking each end of the target sequence. The sequence flanked by the two primers is then amplified. (Medical Tribune, May 2003, pg. 13.)
In Singapore, it was reported on 3 April 2003 (Straits Times, pg. 4) that “Singapore may have SARS test soon.” Diagnostic tests that can confirm infection in patients were being validated but would only be ready in a fortnight. Singapore General Hospital’s (SGH) virologist Dr Ling AE was reported to have said that the diagnostic tests which were already being used on some suspected SARS patients here, were based on kits of DNA unique to the coronavirus. The tests were being validated on known SARS patients and then used to confirm SARS infection in patients already in hospital. Dr Ling said they had succeeded in growing the virus. Also tests on antibodies produced by patients locally, as well as molecular tests on the virus itself, showed that the offending virus was the same as samples drawn from victims in Hanoi and Bangkok.

Mention must be made of the contributions of our Infectious Disease doctor who en route back from New York in March 2003 was detained and quarantined in Frankfurt, Germany, because he had SARS. From him came multiple samples of blood and other body fluids, which contributed to the kit as a diagnostic test for antibodies to the SARS virus.

**WHO CONFERENCE ON SARS RESEARCH**

This took place in Singapore on 19 June 2003 jointly organised by the Ministry of Health, A*STAR and National University of Singapore (NUS). Five plenary lectures were delivered on the molecular biology of the coronavirus, priorities in SARS research, aetiology of SARS, vaccine development and SARS therapeutics. Dr Michael Lai from the Department of Molecular Microbiology and Immunology, University of Southern California, Keck School of Medicine, Los Angeles, told us that the SARS virus represents a novel group of coronaviruses that is distinguishable from known human and animal coronaviruses. Evolutionally, it is situated at an equal distance from Groups II and III coronaviruses. As a family, coronaviruses usually cause respiratory and enteric infections. Of the four to five structural viral proteins, the S (Spike) protein is responsible for receptor binding and induction of neutralising antibody; it is a candidate protein for vaccine and a prominent determinant of viral tissue tropism and pathogenesis.

The experience from animal coronavirus suggests that coronaviruses tend to develop persistent infections, with a long-term carrier state. Viruses may continue to evolve as a result of recombination and mutation. The viruses may cause disease as a result of both direct cytocidal effects and immune-mediated mechanisms, the latter especially evident with feline and murine coronaviruses. Vaccines vary in efficacy. However, for feline coronaviruses, the vaccines may actually potentiate the disease.

Earlier on 29 May 2003, a report titled: “SARS: From civet to man or other way round” began by saying: “News coming out this week makes the transmission line increasingly clear. The coronavirus jumped from civets to humans and the rest became history as SARS raged around the world.” (Straits Times, pg. 16, col. 2-5.) The virus was uncovered in five out of six civets – nocturnal animals related to the mongoose, which have characteristically striped faces, long tails and cat-like bodies – but not in five other species in the same live animal market in Shenzhen, Guangdong, Southern China. The Head of Microbiology at the University of Hong Kong, which collaborated with the Shenzhen Centre for Disease Control in this study, believes that genetic information shows that the coronavirus “has been jumping from the civet to human.” Comparing the SARS coronavirus genome with that of the civet coronavirus reveals two findings. First, all 17 SARS viral genome sequences in the public domain show that based on the specific mutations they share, the virus falls into two broad mutation groups. One strain is linked to the Metropole Hotel in Hong Kong from where the global outbreak started, and the other to the Mainland Strain, which remains distinct from the former and accounts for most of the cases in China. These two strains suggest two independent jumps from animal to man, but not necessarily, both from civets.

Secondly, the virus in civets showed four strains identical to the two human strains except that they all had a sequence of 29 base pairs that both human strains do not have. It is more likely for a virus to lose genetic material in jumping across species, than for it to add genetic material in making that jump. This implies that a jump from civets (where the virus has the 29 base pairs) to humans (where it does not) is more likely than the other way around – that loss came specifically from a gene that makes the S (Spike) protein forming part of the virus shell that permits the virus to enter human cells. This missing piece seems to have made the virus so infective that human-to-human transmission became possible. Although 29 out of a total of 29,000 base pairs in the SARS genome may be miniscule, they could make all the difference between an innocuous virus and a deadly one.

In the New England Journal of Medicine, 10 July 2003, on pages 187-8, three doctors from the Chinese University of Hong Kong reported on the genome sequence variations of their patients with SARS. They confirmed that at least two strains of SARS coronavirus had emerged, and that by mid March 2003 (when Singapore was hit), these two strains of the SARS coronavirus had already been found in patients in Hong Kong. This observation meant that there was more than one source of infection present at the beginning of the SARS epidemic in Hong Kong. Therefore, they concluded that even if there had been no outbreak in the Metropole Hotel, SARS could have probably broken out eventually in Hong Kong. This was based on using the glycoprotein sequences as a molecular epidemiologic tool.

In the plenary lecture on SARS vaccine development presented by the Director of the WHO Initiative for Vaccine Research, Geneva, Switzerland, she stated that WHO would give support to activities concerned with (a) repositories of well characterised biological specimens, (b) a database of viral genomic nucleotide sequences, (c) studies on SARS immunology and pathogenesis, (d) standardisation of laboratory
assays to evaluate immune responses, (e) standardisation of animal models, (f) product development, (g) facilitation of clinical trials in developing countries, and (h) regulatory issues related to the licensing of SARS vaccines. I suppose these principles are applicable to any new infectious disease that afflicts mankind. Particular to SARS is the phenomenon of the “super-spreader”, which Singapore was unfortunate to have had at least one from the beginning of the epidemic. Why and how does this happen? Can we identify such a person early in the course of illness?

SARS LABORATORIES
As SARS has proved itself to be a deadly disease (just like smallpox was in yester-years), specimens of this coronavirus are kept in various research laboratories around the world coordinated by the WHO. Handling of such specimens is therefore serious business. Bioterrorists would love such a virus for their intended operations. Although WHO has issued guidelines on biosafety for laboratories, two lapses have occurred – one in Singapore and the other in Taiwan. Both sparked off fears of a SARS outbreak globally.

WHO strongly recommends Biosafety Level 3 (BSL3) as the appropriate containment level for working with live SARS-coronavirus. Laboratories currently conducting research on this virus represent the greatest threat for renewed SARS-CoV transmission through accidental exposure associated with breaches in laboratory biosafety. So, WHO has strongly recommended that national governments maintain a registry of such laboratories. Any laboratory accidents, such as accidental spillage of material suspected of containing SARS-CoV should be reported to the appropriate authority and all people potentially exposed to SARS-CoV resulting from such accidents should be closely monitored for 10 days for evidence of infections.

BSL 2 FACILITIES
According to the WHO Laboratory Biosafety Manual, the following procedures could be performed by personnel trained in the use of appropriate BSL 2 work practices:
1. Routine diagnostic testing of serum and blood samples (including haematology and clinical chemistry).
2. Manipulations involving neutralised or inactivated (lysed, fixed or otherwise treated) viral particles and/or incomplete, non-infectious portions of the viral genome.
3. Final packaging of specimens for transport to diagnostic laboratories for additional tests. Specimens should already be in a sealed, decontaminated primary container.

However, certain BSL 3 work practices may be performed in BSL 2 facilities. Examples of activities requiring BSL 3 working practices for work with SARS-CoV in BSL 2 facilities include:
1. Aliquoting and/or diluting specimens.
2. Inoculation of bacterial or mycological culture media.
3. Performance of diagnostic tests that do not involve the propagation of viral agents in vitro.
4. Nucleic acid extraction procedures involving untreated specimens.
5. Preparation and chemical or heat fixing of smears for microscopic analysis.

BSL 3 PRACTICES
These include:
1. Any procedure that may generate aerosols or droplets should be performed in a biological safety cabinet (e.g. sonication, vortexing);
2. Laboratory workers should wear protective equipment, including disposal gloves, solid front or wrap around gowns, scrub suits or coveralls with sleeves that fully cover the forearms, head covering and, where appropriate, shoe covers or dedicated shoes, eye protection and a surgical mask, or full face shield, because of the risk of creating aerosols or droplets exposure when performing specific manipulations.
3. Centrifugation of specimens should be performed using sealed centrifuge rotors or sample cups. These rotors or cups should be unloaded in a biological safety cabinet.
4. Work surfaces and equipment should be decontaminated after specimens are processed. Standard decontamination agents that are effective against enveloped viruses should be sufficient if used according to the manufacturer’s recommendations. Generally, 5% bleach solutions are appropriate for dealing with biohazardous spillage.
5. Biological waste contaminated with suspect or confirmed SARS specimens or with SARS-CoV should be properly treated before disposal.

The following activities should be performed in containment laboratories (BSL 3) by personnel trained in the use of appropriate BSL 3 work practices:
1. Performance of diagnostic tests that involve propagation of viral agents in vitro and in vivo.
2. Work involving the replication of SARS-CoV in cell culture and/or storage of cell culture isolates.
3. Recovery of viral agents from cultures of SARS-CoV specimens.
4. Manipulations involving growth or concentration of SARS-CoV.

WHO SARS LABORATORY WORKSHOP
This was held in Geneva on 22 October 2003. Participating laboratories included the Virology Section, Department of Pathology, Singapore General Hospital, laboratories from the People’s Republic of China and Hong Kong SAR. The workshop brought together 27 members of a new enlarged laboratory network from 15 countries and the region, and a further seven observers. In its report under the heading “Biosafety in the laboratory and inventory of SARS-CoV cultures” is the statement: “The importance of laboratory biosafety was
clearly demonstrated with the occurrence of a laboratory acquired case of SARS-CoV infection in Singapore last month.” Four recommendations were issued:

1. To endorse the WHO biosafety guidelines for handling of SARS specimens which states that SARS-CoV should be cultured under biocontainment level 3, and that diagnostic activities which do not involve culturing the viruses should be under-taken at a minimum of biocontainment level 2 using level 3 work practices.

2. That cultures of SARS-CoV should be stored at a minimum of biocontainment level 3, and that clinical specimens known to contain SARS-CoV be preferably stored at a similar level; but if not possible, that they and clinical specimens suspected of containing SARS-CoV be stored at a minimum of biocontainment level 2 within a secure (locked) environment.

3. That national governments maintain an inventory of laboratories working with and/or storing live cultures of SARS-CoV, and that the inventory should include clinical specimens known to contain SARS-CoV.

4. That while not wishing to restrict the research and diagnostics of SARS-CoV, that national governments institute a process by which laboratories wishing to work with SARS-CoV be licensed to do so.

And on 18 December 2003, the WHO re-emphasised this in its website, titled: “WHO post-outbreak biosafety guidelines for handling SARS-CoV specimens and cultures.”

SINGAPORE LABORATORIES

On 10 September 2003, the news was bad. The Straits Times first page headline was: “It’s SARS, but an isolated case.” A 27-year-old laboratory researcher and post-doctoral student at the NUS Department of Microbiology tested positive for SARS. He had been hospitalised on 3 September. His research involved the West Nile virus. On 23 August, he had spent 30 minutes at the Environmental Health Institutes (EHI) laboratory in Science Park II. On 26 August, he was back at the NUS laboratory and developed fever at about midnight. He saw a family doctor on the 27th, the Emergency Department at SGH on the 29th, a Chinese sineh on 1 September, and on the 3rd, returned again to SGH where he was warded. On 8 September, the SARS test results came back positive and he was transferred over to the CDC at Tan Tock Seng Hospital (TTSH). The next day, extra tests confirmed he had SARS and the Health Ministry issued quarantine orders to 25 people who had been in contact with him. Eight were family members, two were at the sineh’s clinic, eight were at the ED of SGH, three were hospital visitors, and four were discharged patients of SGH. (Straits Times, 10 September 2003, pg. H1.)

As events turned out, it was indeed just an isolated case and WHO’s confidence in our authorities’ ability to keep the situation under control was justified. The spokesman for the Western Pacific, Mr Peter Cordingley told the Straits Times: “Like the Singapore authorities, we believe this is an isolated case. There is no established human-to-human transmission of the virus. We are confident the Singapore authorities can keep the situation under control. The WHO has no plans at this stage to even consider issuing a travel advisory against Singapore”. (Straits Times, 10 September 2003, front page.)

The Dean of the Faculty of Medicine said there was “zero chance” of infection at the Department of Microbiology because researchers there worked only on dead viruses, which were not infectious. The National Environment Agency’s Director General in whose BSL 3 laboratory (where live virus is kept), the researcher worked, said: “There seems to be some coincidental link, but I would be really surprised if it is from the laboratory.” He gave three reasons. One, the researcher was working with the West Nile viruses, not the SARS virus. Two, the researcher had visited the laboratory on 23 August, six days after anyone had done SARS work at the institute. It was unlikely that the SARS virus could survive for more than two days, let alone six, and infect the researcher. Third, the laboratory was well designed and followed strict procedures as laid down by the WHO and the US CDC. The next day, the Straits Times further reported that the BSL 3 procedures at the NEA laboratory meant those working on the virus had no contact with it and NEA was confident that the strict safety measures it had, made lab infections unlikely. (Straits Times, 11 September 2003, pg. H 2, col. 3-7.)

“WHO and US experts to fly in to help check labs” – This was the response by the Ministry of Health (MOH). (Straits Times, 12 September 2003, pg. 4, col. 6-7.) Four of them came to help MOH investigate the practices, facilities and equipment at the EHI at Science Park II and the microbiology laboratory at NUS. This independent panel was to “establish whether the laboratories could have been the source of infection.” The panel duly completed its investigations and the EHI laboratory was found to have had breaches in its safety procedures. This led to calls for punitive action on those responsible but there was no punishment. The Minister for the Environment came out publicly with an apology and took the responsibility for the safety lapse. The patient/researcher fully recovered and nobody else got infected.

In the Straits Times report on the panel’s findings, EHI was found most wanting in safety standards. Four labs were reported upon, and in response to certain statements in the report, the respective chiefs gave their statements as follows. (Straits Times, 24 September 2003, pg. H2.)

At EHI: Strict new measures needed at high risk BSL 3 and BSL 2 laboratories. Dr Ooi EE, head of EHI said: “Our plan is first of all, to shut down the BSL 3 facility and decontaminate, but more importantly, go back and focus on dengue while we review our long term plans and look for a facility for BSL 3 work.”

At SGH: The Pathology Department needs a dress code for BSL 3 laboratories and regular refresher safety courses. Professor Tan SK, CEO, SGH said: “We’ll ensure we implement the recommendations as soon as possible.”
At NUS: Staff and students of the Microbiology Department lack a culture of safety. Professor John Wong, Medical Faculty Dean said: "We have our office of safety, health and environment, and we’ll work with it to develop further the recommendations."

At DSO: The facility, which also handles organisms with bioterrorism potential, is generally safe. Mr. Quek TB, CEO, DSO National Laboratories said: "Most recommendations are already being planned or in the process of being implemented."

**TAIWAN LABORATORY**

After WHO had its conference in October 2003 on “Biosafety in the Laboratory” following the case in Singapore and issued its guidelines, yet another researcher got infected, this time from a laboratory in Taiwan. He was a 44-year-old military researcher, Lieutenant-Colonel Chan, who works at the highly secretive Institute of Preventive Medicine under the National Defence Medical Centre, a top military medical research body.

Five researchers came to Singapore for a meeting with fellow researchers on flight CI 661 (China Airlines) on 7 December and returned to Taiwan on flight 662 on 10 December. Lt Col Chan recovered from SARS, and his Singapore friends at the meeting who were quarantined did not contract SARS.

The safety breach? Carelessness, said the Taiwan officials. (Straits Times, 18 December 2003, pg. A3, col. 1-6.) A test tube containing a SARS sample had spilled in the laboratory where he was working. He did not wear protective gloves or a gown. “He was in a hurry to get ready for the Singapore trip, so he was rushing to finish his disinfection work and was careless,” said Taiwan CDC Chief Su Yi-Jen. Lt Col Chan who works at the highly secretive Institute of Preventive Medicine under the National Defence Medical Centre, a top military medical research body.

**WHAT RISKS AND ANY PUNISHMENT?**

In Straits on 23 December 2003, Mr Robin Gauguly wrote a piece titled: “SARS: Let us be 100% tough. It’s time to cover a dangerous cleft in our armour – sloppy laboratory researchers who don’t follow procedures and endanger all of us and our livelihoods.” He felt the government could do more; he asked, when is it a criminal negligence? Doctors are sometimes excused for making mistakes but are sued for being negligent. Is the case of researchers different? Entire societies can be put at risk. The government has put strict guidelines in place for research laboratories. But it is time to go one step further, he suggested. “It is time to enact laws which can be used to severely punish irresponsible researchers. It is time to let them know that there is no room for carelessness.” As a comparison, he cited Parliament amending the Infectious Diseases Act on 25 April 2003 so that even first time quarantine breakers could be jailed for six months and fined $10,000. I ask you, he said, who is more dangerous? Someone who may not have SARS at all or a careless researcher who handles live samples of virus with scant respect for safety? Why should the first be punished and the second be excused for “mistakes”? Good questions.

**ROCHE DIAGNOSTICS**

On 16 July 2003, Roche Diagnostics announced that it had developed a sensitive and accurate SARS research kit. The work began in March. In May, it said it was collaborating with the Genome Institute of Singapore (GIS) to produce such a kit. Special pieces of genetic material called primers developed by GIS are a critical ingredient in the new test. These primers are short stretches of artificially created genetic material which match a corresponding stretch on the SARS virus. GIS Deputy Director Dr Ren Ee Chee explained that GIS’s work in uncovering mutations in the virus helped it to develop primers based on “stable” parts of the SARS genetic code, so that the tests could correctly detect the disease even in mutated samples.

Roche said the test is close to 100% accurate, and it can detect SARS before patients show symptoms and results can be provided in an hour. Following this, regulatory approval for the test was sought from the FDA of the US and the CE of the EU. This could take up to 18 months. (Straits Times, 18 July 2003, pg. 4, col. 1-7.) Roche took all of eight weeks to develop the test – its shortest time ever for coming up with such a product. The quick turnaround was accomplished because virology institutes and government agencies around the world collaborated with it. The test is based on PCR technology. PCR acts like a kind of genetic photocopier, allowing scientists to detect even minute samples of genetic material be it from blood, spit or stool samples.

**SARS VACCINE**

We have no vaccine yet, but on 19 December, the Straits Times reported that the race is on with a flurry of research activity. Among the front runners is France’s premier Pasteur Institute, which has linked with Europe’s largest drug maker, GlaxoSmithKline, to develop one. (Straits Times, 19 December 2003, pg. A2, col. 3-7.) Hong Kong has its version and China has three kinds of vaccine ready for tests on patients. A genetically engineered vaccine had shown promising results in monkeys, and the team from Pittsburgh University, Pennsylvania, hopes to start clinical trials before the end of 2004. The Canadians too have a vaccine ready for human testing. In Singapore, NUS said its effort had been hindered by safety lapses that led to a local scientist becoming infected with SARS in September.

So if there are vaccines ready for testing, but there is no more SARS, how would we know if these vaccines are effective? SARS has infected 8098 people worldwide and killed 774 to date.

**SARS GENES?**

Researchers in Taiwan said a genetic susceptibility may explain why SARS affected South East Asia so badly. They found certain
SARS TREATMENT

There is no cure presently. Hospitals have tried everything from controversial drugs to Traditional Chinese Medicine (TCM). (Straits Times, 31 May 2003, pg. A6.) Hong Kong, like Taiwan, used Ribavirin on an empiric basis. The Director of the Infection Prevention Department at the National Taiwan University Hospital, said Ribavirin is effective if used within 10 days of infection. Professor Yuen of the Department of Microbiology, University of Hong Kong, noted that 90% of the first 138 SARS patients in HK showed improvement when given Ribavirin and high doses of steroids. A combination of TCM and Western Medicine was endorsed by the HK Hospital Authority for treatment of SARS patients after a two-week trial on 21 patients. WHO recommends that TCM be used only as a supplement. What are these treatments?

In Hong Kong, the disease is managed in three phases. In the first, when viral multiplication is rapid, patients are given antibiotics and/or antivirals like Ribavirin or Kaletra. Phase 1 lasts about one week. In Phase 2, when the body's immune system attacks the virus, steroids are used to prevent the immune system from damaging the lungs. Antivirals are discontinued after 14 days. Steroids are given from the 8th to 21st day. In phase 3, when lungs are severely damaged, assisted ventilation is followed by rehabilitation, if the patient recovers. In addition, TCM may be added to the regime. Herbs include liquorice root, honeysuckle, white mulberry leaves and purple perilla leaves.

A team of Hong Kong researchers reported success in SARS treatment among 31 patients defined as probable SARS. (Lancet, 2003;361:1615-17.) Their protocol consisted of a combination of antibacterials: levofloxacin (500 mg once daily) or clarithromycin (500 mg) plus coamoxiclav (375 mg three times daily for young or pregnant patients/patients with tuberculous), ribavirin (400 mg every eight hours for at least three days, then 1200 mg twice daily), and methyl prednisolone (1 mg/kg every eight hours for five days, then 0.5 mg/kg every 12 hours for five days) changed to prednisolone (0.5 mg/kg twice daily for five days, then 0.5 mg/kg daily for three days, then 0.25 mg/kg for three days before stopping). Patients were given pulsed methyl prednisolone (500 mg twice daily) if their clinical condition or CXR worsened or if lymphopenia persisted.

In China, TCM is used in every phase of treatment. Lonicer powder and forsythia are for shortening fever periods and lowering fevers. In rehabilitation, TCM supplements such as American ginseng and gingko are used. Other TCM ingredients used include Chinese ephedrine, shigao tang and bezoar.

In Taiwan, antibiotics and antivirals are used in Phase 1. In Phase 2, when Ribavirin is no longer affective, intravenous immunoglobulin is used, preferably after 10 days of antiviral therapy. In Phase 3, it is assisted ventilation and TCM to maintain the immune system.

Antisense technology promises new “smart” drugs for cancer and SARS. (Straits Times, 27 May 2003, pg. H8, col. 1-2.) This technique aims to kill the genetic messenger carrying diseases. Cancer patients are taking an experimental drug, Genasense in three pivotal trials. The same technique is being used at AVI Biopharma in Portland, Oregon for SARS. AVI said its drug Nevigene which targets West Nile Virus, had been tweaked to take on SARS. Antisense drugs jam vital genetic signals by tackling targeted RNA, which carries DNA's instructions to the body. Antisense scientists create mirror images of the mRNA that is spreading illness. When injected into the body, the mirror image binds with the RNA and prevents it from delivering its message to protein building machinery.

From the New England Journal of Medicine, 18 December 2003 issue, 349:2431-41, on "Current Concepts: The Severe Acute Respiratory Syndrome", under management, comes the bland statement that there is no effective therapy that has been well documented.

And from the Journal of the American Medical Association, 24-31 December 2003 issue, 290:3222-8, is a report of a preliminary study on the use of interferon Alfacon-1 plus corticosteroids in SARS. 22 patients from the North York General Hospital, Toronto were given this treatment between 11 April and 30 May with apparent improvement.

CONCLUSION

Research is important in so many facets of SARS. Hopefully, the diagnostic kits now available would make diagnosis easier and earlier. Even in the asymptomatic patient, the test could be done. There should be less or no confusion with dengue fever. With earlier diagnosis, treatment trials can hopefully get underway faster. With no global SARS outbreak, the laboratories are where the virus resides (besides in wild animal reservoirs). Mishaps in the laboratory can rapidly expose societies and nations to another round of deadly SARS and this need not be in the winter of the Northern Hemisphere. Contrary to earlier predictions, winter is upon us but there is no SARS outbreak – only sporadic cases (two to date). Let us keep hoping for the best.■
SARS & Fever (Part 11)

By Prof Chee Yam Cheng, Editorial Board Member

Editorial note:
The following article was submitted on 19 February 2004. Contents are current at the time of submission.

INTRODUCTION
In the clinical definition of a patient with SARS, which first was agreed upon when the disease was named in March 2003, and no alternative diagnosis could fully explain the illness, the features included fever of more than 38°C, lower respiratory tract illness (cough, difficulty in breathing, shortness of breath), radiographic evidence of lung infiltrates consistent with pneumonia / respiratory distress syndrome or autopsy findings consistent with these. All four criteria had to be fulfilled to define a patient with SARS. As Singapore was suffering from SARS in March and April, there was no laboratory test as yet to confirm the diagnosis. As such, fever as a symptom and sign was a critical feature in the screening protocol for the disease. The assumption is / was: no fever, no SARS.

BODY TEMPERATURE
So what is fever? I turned to Guyton’s textbook of physiology to answer this difficult question of what is normal body temperature before we can know what constitutes a fever. It devotes one whole chapter to body temperature, temperature regulation and fever. The temperature of the deep tissues of the body – the core – remains almost exactly constant, within ± 1°F day in and day out except when a person develops a febrile illness. The skin temperature, in contrast to the core temperature, rises and falls with the temperature of the surroundings. For core temperature, Guyton said: “No single temperature level can be considered to be normal, for measurements on many persons have shown a range of normal temperatures from less than 97°F (36°C) to over 99.5°F (37.5°C).” This is as it should be for we are humans, not machines, and biological variation is one of our characteristics. It also depends on how the body temperature is measured. When measured by the rectum, the values are about 1°F higher than the oral temperature. The average normal temperature is generally considered to be between 98°F and 98.6°F (36.7°C and 37°C) when measured orally, and approximately 1°F (0.6°C) higher when measured rectally.

Body temperature varies somewhat with exercise and extremes of the surroundings’ temperature, because the temperature regulatory mechanisms are not perfect. Besides the normal range given above, temperature can go up to beyond 37.5°C to 38.5°C in a few normal adults, many active children, and with emotion and moderate exercise. With hard exercise, the rectal (but not oral) temperature can rise from 38.5°C to 40°C. Beyond this, brain lesions and heat stroke can raise the temperature to 45°C, beyond which survival is not likely. Up to about 41°C, the body’s temperature regulation remains efficient in febrile disease, health and work. Beyond this, temperature regulation is seriously impaired.

FEVER
Fever is an elevation of body temperature above the normal circadian variation, the result of a change in the thermoregulatory centre located in the anterior hypothalamus. A normal body temperature is maintained, despite environmental variations, due to the ability of the thermoregulatory centre to balance heat production by the tissues, notably muscles and liver, with heat dissipation. With fever, the balance is shifted to increase the core temperature. (Harrison’s Principles of Internal Medicine.)

While the “normal” temperature in humans has been said to be 37°C (98.6°F) based on Wunderlich’s original observations over 120 years ago, the overall mean temperature of normal individuals aged 18 to 40 years is actually 36.8°C ± 0.4°C (98.2 ± 0.7°F) with a nadir at 6am and a zenith at 4 to 6pm. The maximum normal oral temperature at 6am is 37.2°C (99.9°F) and the maximum normal oral temperature at 4pm is 37.7°C (99.9°F), both defining the 99th percentile for normal individuals. Using these criteria, a morning temperature greater than 37.2°C (99.9°F) or an afternoon temperature greater than 37.7°C (99.9°F) would define a fever (Harrison’s). Rectal temperatures are generally 0.6°C (1°F) higher. Lower oesophageal temperatures closely reflect core temperatures. The normal 24-hour circadian temperature rhythm is associated with temperatures varying typically by 0.5°C (0.9°F), but occasionally by as much as 1°C between the nadir and the peak. This morning-low and evening-high pattern is usually preserved in febrile diseases but abolished in hyperthermia. (This is defined as an elevation of body temperature above the hypothalamic set point due to insufficient heat dissipation.)

In menstruating women, the morning temperature is generally lower in the two weeks prior to ovulation, rising by about 0.6°C (1°F) with ovulation, until menses occurs. There may even be a seasonal variation in body temperature. Finally, such physiologic alterations as post-prandial state, pregnancy, endocrine factors, and age may alter baseline temperatures.

CHARACTERISTICS OF FEBRILE CONDITIONS

1. Chills
When the set point of the hypothalamic temperature control is suddenly changed from the normal level to higher than normal, as a result of tissue destruction, pyrogenic substances, or dehydration, the body temperature usually takes several hours to reach the new temperature set point. Because the body temperature is less than the set point of the hypothalamic temperature controller, the usual responses that cause elevation of body temperature occur. During
this period, the person experiences chills and feels extremely cold, even though his or her body temperature may already be above normal. The skin is also cold because of vasoconstriction (to conserve heat) and the person shivers. Chills continue until the body temperature reaches the hypothalamic setting. Then the patient no longer experiences chills, but instead feels neither cold nor hot. As long as the factor causing the hypothalamic temperature controller to be set at this high value continues, the body temperature is regulated more or less in the normal manner but at the high temperature set point level.

2. The crisis or “flush”
If the factor causing the high temperature is suddenly removed, the set point of the hypothalamic temperature controller is suddenly reduced to a lower value. In this instance, the body temperature will be down regulated by the hypothalamus. This situation is like excessive heating of the anterior hypothalamus preoptic area, and leads to intense sweating and sudden development of a hot skin because of vasodilatation everywhere. This sudden change of events in a febrile illness is known as the “crisis”, or more appropriately, the “flush”.

THERMOMETERS
The Straits Times on 27 April 2003, page L5, published an article “Learn to take the heat” by E Gowee. She said that using the thermometer is not just a simple matter of sticking it into your mouth or ear. It quoted a doctor from Health Promotion Board who said that many people do not know how to take their temperatures correctly. “The earliest symptom of SARS is a sudden onset of fever above 38°C. If you don’t use it correctly, the thermometer might give you a false sense of security. Drinking a cold drink will lower the temperature in your mouth. This would lead to an inaccurate low mouth reading. So wait about 30 minutes before taking your temperature if you have exercised, drunk or eaten, showered or if you have just been outdoors. The temperature in healthy children and adults ranges from 36.2°C to 37.2°C. The average normal temperature is taken as 37°C. Those over 65 years old may have a 0.3°C lower temperature because their metabolic rate is lower. Temperatures under the armpit are lower than that in the mouth or ear. So you have a fever if your armpit temperature is over 36.5°C, your mouth temperature over 37°C and your ear temperature over 37.6°C. The correct way to use an ear thermometer is to pull your ear backwards and upwards to straighten the ear canal and allow the thermometer to go deep enough so that it can measure the infrared heat generated by the eardrum.”

The type of thermometer you use matters. Which you buy depends on your personal preference and budget. Read the instruction manual on how to use it properly and the range of normal temperature readings for each type of thermometer.

Sunday Life also gave a guide on five types of thermometers available locally.

1. Glass Thermometer
    This can be placed under the tongue or armpit. To ensure that it is not faulty, check for continuity of the mercury line. Prices range from S$2 to S$3. This is the type I have been issued at Tan Tock Seng Hospital (TTSH) for my personal use. It is made in China and the markings are not in °C but °F. Its advantage is that the readings will not be affected by technical faults like low batteries. However, there is no built-in timer and it can easily break. Avoid using in children under 12 years as they might bite the glass (likewise patients at Institute of Mental Health) or snap it under their armpit. To use, it should be cleaned and dried, then shaken a few times to bring the line of mercury level to below 35°C. The bulb is then placed firmly under the tongue (or armpit) and kept there for three minutes after which the temperature is read.

2. Digital Thermometer
    This is placed under the tongue for less than a minute. It costs from S$9 to S$25. It will not break easily like a glass thermometer, but readings might be inaccurate if the battery is weak. It needs to be switched on, checked that it is ready to register a reading, and then placed under the tongue (or armpit) like the glass thermometer. It will beep when the temperature has been recorded.

3. Ear Thermometer (Tympanic Thermometer)
    This measures the infrared heat generated by the eardrum and the surrounding tissue. The display will show an error message if it is faulty. Prices range from S$60 to S$90. It has been made famous by being used as the screening tool for members entering Parliament on 24 April during the SARS outbreak, and by the logo on the top of each page of the Straits Times dealing with “War on SARS.” It is quick to use, gives readings within two seconds, suitable for babies and children who cannot sit still, and for adults who feel nauseous with thermometers in their mouths. Its disadvantages are the need for clean ears not blocked by wax, and another person to read the temperature for you, that is, self-help is not possible. A weak battery can also affect the readings. To use, a new disposable cap or lens filter is placed over the probe, the thermometer is switched on, the ear canal is opened by pulling the ear backwards and upwards to straighten it, the probe is inserted, the activation button pressed and the thermometer held inside the ear until a reading appears. Then, the thermometer is removed from the ear, temperature read, and the disposable cap thrown away. This is being used at KK Women’s and Children’s Hospital (KKWCH).

4. Strip Thermometer
    It is a plastic strip containing liquid crystals that change colours according to the forehead temperature. It costs less than S$4 per strip. Although it is cheap, readings are inaccurate since only skin temperature on the forehead is measured. However, it is easy to use, just by placing the strip firmly against a dry forehead just above the eyebrows. After about 15 seconds, the colours stop changing and the temperature is read.

5. Nextemp Oral Strip Thermometer
    This is a thin flexible strip with a grid of dots at one end and uses a chemical combination to detect temperature
change. It comes in disposable and reusable forms. A disposable one costs about 45 cents, and a reusable one about S$8.80. It is more accurate than a strip thermometer.

To use orally, the dotted end is placed as far back as possible under the tongue, just like a normal glass thermometer. Close your mouth and wait a minute before removing and reading. To use under the armpit, place the dotted end deeply under the armpit and use the arm to hold thermometer in place for at least three minutes. Read immediately. To read, look at the dot grid. The last dot to turn black indicates the correct temperature.

FEVER SCREENING
The Ministry of Health (MOH) advertised its public education on SARS in the Straits Times with a full-page advertorial titled “Knowing SARS to fight it together.” One appeared in the Sunday Times on 6 April 2003, page 7. Related to this issue of fever are the following quotes:

1. The earliest symptom is a sudden onset of high fever with or without muscle aches. Some patients may also have chills, headaches, shivering spells and cough.
2. From the cases so far it appears that SARS becomes infectious only after the infected person develops the symptoms.
3. If you have fever or are unwell, do not go to work.
4. For parents, monitor your child’s temperature daily. If your child has a fever, do not send your child to school.
5. At the workplace, monitor staff who have been to SARS-affected areas closely. (I presume temperature taking is essential in this regard.) And in the graphic illustration about SARS symptoms, it states sudden onset of high fever (greater than 38°C).

To detect SARS early in patients, before isolation and treatment can begin, temperature taking by everybody in Singapore at home, in school and at the workplace became the ritual, not just once daily but at least thrice and more often if necessary. The basic assumption so far not proven wrong is: no fever, no SARS. But is there asymptomatic SARS? Why not? But for now, this is conjecture. So, from mid March until 31 May, to suspect SARS, confirm a fever first. The second assumption is that to diagnose SARS somehow, the fever must be above 38°C. Fever below this level is not SARS, or not yet SARS. If, with observation, the fever rises to 38°C, then suspect SARS. The third assumption is that the temperature readings taken by all and sundry are accurate. That is, the instrument is accurate if properly used, and the reading correctly read (and interpreted).

On 31 March, tighter screening measures came into effect at Changi Airport. “Sir, do you have a fever?” It was reported that nine passengers on flights into Singapore from SARS hot spots were checked by nurses at the aerobridge gates. Four came forward on their own. After history and temperature taking, four were allowed to go home while the remaining five were whisked off to TTSH by ambulance. The Minister for Health said: “Three lines of defence were in place – unwell passengers were picked up by departure counter staff at airports overseas, flight crews on the plane and nurses upon arrival into Singapore.” (Straits Times, 2 April 2003, pg. 3.)

The Straits Times article on 15 April 2003, page H1, “Screen first, ask questions later” reported on the new screening procedures introduced for visitors to the Singapore General Hospital (SGH). They had to fill up a questionnaire and have their temperature taken before being allowed to enter the wards. Aural temperatures were taken. So too at KKWH and National University Hospital. At TTSH at this time, no visitors were allowed. In the same report, ex-TTSH patients sent home on discharge who had SARS, were issued home quarantine orders to stay home for the next 14 days. At home, they were to monitor their temperatures, and hospital staff would call them daily to check on their health. The same process applied to patients discharged from other hospitals (presumably with diagnoses other than SARS) who were not served quarantine orders. MOH said these steps were needed “to monitor all hospital patients closely so as to pick those who develop fever early.”

After a Comfort taxi driver was diagnosed with SARS (Straits Times, 18 April 2003, pg. H1), the three taxi companies, including TIBS and City Cab, the taxi driver associations and NTUC Health Care, announced more measures to assure passengers of the safety of their taxis. Taxi drivers were given free temperature checks. Those with no fever were given stickers to display prominently to reassure passengers they were well. At this time in the outbreak, there were 171 SARS cases, with 61 still in hospital, 17 of them seriously ill.

THERMOMETERS FOR ALL
Every student and teacher, and everyone in the Singapore Armed Forces (SAF) would be given a thermometer so he can take his temperature twice a day, as a precaution against SARS. (Straits Times, 23 April 2003, front page.) Each student had to record his temperature twice a day in his own log book, which teachers will monitor. If he is feverish, he will be isolated immediately. The Ministry of Education said the thermometers would cost $5 million. The Ministry of Defence (Mindef) would spend $1 million. All 500,000 students would get their $10 thermometers by the third week of May starting 30 April with Primary 1 to 4 pupils.

In the SAF, daily fever checks would be required of everyone, from recruits to National Service (NS) men reporting for reservist duties. Deputy Prime Minister (DPM) Tan had said the army had one likely SARS case discharged in March from TTSH. In hospitals, all staff were issued with thermometers and required to take their temperatures. These were recorded and monitored, and those febrile were seen at the Emergency Department or staff clinic. This problem was more serious and acute as SARS is a nosocomial infection, and working in hospitals, especially TTSH, the risk of infection may be higher.

In the Straits Times on 25 April 2003, page H1, the headline was “Frontline defence: Fever checks”, and the sub headline was “Thermometers to be given out, everyone to check his temperature everyday.” Every home should have a thermometer, and people should take their temperature daily for early detection of SARS, and to prevent the disease from spreading. DPM Lee said: “Every Singaporean should know how to take his temperature, so that he can take personal responsibility
for his own health, and monitor his own and his family’s
temperatures.” The government had ordered more than a
million thermometers (“Hooray!” said the manufacturers in
India and China) and would be giving every household one
by June. The rationale was that without foolproof diagnostic
test kits, daily temperature checks were crucial to detect the
first symptom of SARS – fever. If such symptomatic cases were
identified early, they could be isolated and treated faster,
increasing the chances of recovery and reducing the exposure
to others. That was why temperature checks were being carried
out in all government offices, many workplaces and among
market and hawker centre stallholders. Even Members of
Parliament (MP) and Ministers who went to Parliament the
day before (24 April) had their temperatures checked using
ear thermometers (photos in the Straits Times showed Prime
Minister Goh, Senior Minister Lee, and MP Chiam ST being
checked) before being allowed in.

**BORDER CONTROLS**

In a commentary by A Ho (Straits Times, 3 April 2003, pg. 17),
titled “Next 10 days: Border controls crucial”, he stated that
the Health Minister mentioned on 30 March that the next 10
days will show whether Singapore’s isolation strategy against
SARS is effective. Some two weeks after the first index cases
returned from Guangdong, local authorities were already putting
in place stringent control measures of case isolation at TTSH,
and home quarantine of healthy contacts with mass school
 closures. The reasoning was that if control measures were
working, nearly all cases should already have been traced
and isolated over the last three incubation periods. Few or
no new cases should be emerging in the first 10 days of
the month (April 2003), except for new index cases returning
from abroad. However, if tracing and isolation were not
succeeding, we could expect two more transmission cases,
say from each of the current 90 or so cases. If the system was
failing, expect total cases to exceed 200 by the end of the first
10 days of April. The writer was spot on with his prediction.
On 19 April, three people from the Pasir Panjang Wholesale
Centre got the virus. On 22 April, our surgeon died of SARS.
By 31 May, when Singapore was declared SARS-free, 206
were infected in total, with 32 deaths (these numbers changed
later after diagnostic test kits for SARS became available).

Mr Ho continued to say that since new index cases are
critical, border controls were be key. Nurses eyeballing
incoming individuals to ferret out possible cases was inadequate.
From 29 March, people flying from SARS-hit countries were
screened for fever. From 23 April, people flying out were checked
for fever. From 7 May, random fever checks on motorists at
land checkpoints began. Some details on these follow.

“Fever screening for all flying out of Changi” was the
headline in the Straits Times on 24 April. The sub headline
said that checks were stepped up at Woodlands and Tuas
checkpoints, although this was not complete. Eventually, all
who enter and leave the country may be similarly screened.
The principle was: “Neither an importer nor an exporter of
SARS would Singapore be.” And if all countries followed suit,
the transmission chain would be broken. Up till 22 April,
Finally, clinical tests should be able to verify the readings in degrees centigrade and are therefore not suitable for screening purposes. Next, the systems themselves have to decide this.

Land Instruments International, and American company Flir companies to churches. The four found suitable include two machines being bought by organisations, ranging from productivity and innovation, tests scanners and gives approval.

The SAF’s original military scanner was for seeking out targets in the dark. ST Engineering’s commercial version is less sharp but still clear enough to spot people who are febrile. The specifications was that MOH needed a device that would quickly screen large groups of people without being intrusive, and also reduce the need for nurses to do manual checks. Work on adapting the system began on 3 April, and the next day, the device was tried out on feverish patients at SGH Department of Emergency Medicine, followed by Nee Soon Camp national servicemen on 7 April. By 10 April, the first prototype was in use at Changi Airport.

This is the story behind the scanner. From one buddy to another, President of ST Electronics and Deputy Chairman of electronics firm, Infowave, and President of Solectron Asia Pacific, their cooperation resulted in the IFSS being produced quickly and cost-effectively. A Solectron unit, Shinei International, which makes plastic and metal casings for computer giants like Apple Computer, also lent its expertise to ST Electronics. From a hand-built product, ST Electronics was, by end May, making about 20 IFSS machines each week. The company expected to sell up to S$20 million worth of thermal imaging systems in 2003. (Straits Times, 26 May 2003, pg. H2.)

Spring Singapore, the government agency on standards, productivity and innovation, tests scanners and gives approval. Some were found unsuitable for mass screening. (Straits Times, 27 May 2003, pg. H2.) So the message is “buyer beware” for there are no regulations or standards as yet for the many machines being bought by organisations, ranging from companies to churches. The four found suitable include two made by ST Electronics, and one each by British company Land Instruments International, and American company Flir Systems. Three major criteria were used by Spring Singapore to decide this.

First, they had to present an accurate threshold temperature. For example, industrial infrared thermometers generally have an accuracy of plus or minus one to three degrees centigrade and are therefore not suitable for screening purposes. Next, the systems themselves have to be stable and produce consistent readings and results. Finally, clinical tests should be able to verify the readings taken by the machines. As of end May, there were no commonly accepted standards. A meeting was held on 30 May with industry players and specialists to attempt to hammer out these issues.

However, scanners by themselves are not adequate for fever checks. Clinical thermometers are still a must to confirm a person’s temperature.

**FEVER STATIONS**

From 2 May, four polyclinics set up separate “fever stations” outside their premises to deal with patients running a temperature. By this time, many Departments of Emergency Medicine were already doing this in tentage set outside the main hospital building. In the tentage, there were fans, and if necessary, air-cooling and air-conditioning systems totally separate from and unconnected to that of the hospital. The four polyclinics to follow suit were those at Chua Chu Kang, Yishun, Geylang and Tampines. At these polyclinics, all patients were checked for fever at the door and they had to fill in a health declaration form. Before this measure was introduced, the practice was to provide patients with facemasks and treat them separately from the other patients within the polyclinics. So now, those with fever were sent to the tents for further treatment outside the polyclinics. These tents were well ventilated and spacious with their own pharmacy, laboratory and X-ray facilities. (Straits Times, 2 May 2003, pg. 3.) All patients wore masks. Those suspected of having SARS were separated in an isolation area and sent by ambulance to TTSH. MOH said in a statement: “Those who have fever and need to go to the polyclinic to see a doctor can be assured that they will be properly managed and there is very little risk of cross-infections from other patients or healthcare workers.” What about the other polyclinics? (There are 16 of them.)

This move came about after MPs raised the issue in Parliament. They suggested special fever screening clinics outside hospitals or polyclinics to detect those who might have SARS, rather than have them go to general practitioners and risk infecting others. As of 2 May, the number of people with SARS in Singapore was 201.

**FEBRILE KIDS**

Fever is a key symptom, but by itself is not sufficient to identify all hit by SARS. Nonetheless, as of 1 May, this was the assumption that was practical and pragmatic as a preliminary screen for those with SARS. It is well known that fever follows a host of medical conditions, and it is for the doctor to differentiate these causes, one from another, for example, dengue fever, influenza, pneumonia, gastroenteritis, malaria, and so on.

So what is hot? When are you running a fever? For an adult, a fever is when the armpit temperature is 37°C and above, oral temperature 37.3°C and above, and aural temperature 37.7°C, and above. Temperature is highest in the ear, then mouth, forehead and armpit in that order. Children’s temperatures are slightly higher because they have a higher metabolic rate. (Straits Times, 1 May 2003, pg. H2.) Based on these criteria, school children were monitored on a daily basis at all schools. But there were problems. A Primary 4 pupil’s average temperature was found to be 37.8°C, and
for two weeks, she was isolated in class and embarrassed by her teacher's decision to make her sit by herself right at the back of the class. (Straits Times, 22 May 2003, pg. H1.) This 10-year-old in a Bukit Batok Primary School had been sent to the sick bay or home whenever her temperature was 37.6°C and above after two readings, since 16 April when schools reopened after the SARS outbreak. Her father had spent more than S$200 on visits to the doctor and laboratory tests to check his daughter's health. Blood and urine tests conducted at Bukit Batok Polyclinic could find nothing wrong with her, so her doctor recommended she be allowed to attend classes unless her temperature rose above 38°C. From 5 to 9 May, 450 children at the sick bay or home whenever her temperature was 37.6°C or below, which had not happened.

Then on 14 May, she took ill with a sore throat and was sent to NUH for tests. Five days later, she became constipated and was warded at NUH for observation. She was discharged on 20 May after tests showed her to be well and healthy despite having a temperature of 37.8°C. The NUH doctor wrote to her school saying she should be allowed to attend classes unless her temperature rose above 38.2°C. A private paediatrician was then quoted as saying that a higher body temperature in children is common, and this occurred in about one in 40 children, or one child in each class. She also said that so long as the temperature did not exceed 38°C when taken with an oral or aural thermometer, it was within the normal range for a child.

After consultation between the Ministries of Education and Health, primary schools began to use 37.9°C as the new fever mark for kids. (Straits Times, 27 May 2003, pg. 3.) This was up from 37.6°C, which had parents complaining that too many children were being sent home after failing the compulsory temperature checks. From 5 to 9 May, 450 children from Primary 1 to 4 across Singapore were sent home on all five days despite being well, because their temperatures exceeded the old 37.5°C mark. With the new revised mark on 26 May, most pupils passed the check. However, this revision did not help the Primary 4 pupil in the Primary School at Bukit Batok as described above. Her temperature still rose above 38°C by 11am when the second reading was done. And yet another doctor wrote on her behalf to say she should be allowed to stay in the classroom until her temperature exceeded 38.2°C.

FEVER SCARE
When the ministerial combat unit against SARS was formed, IMH / Woodbridge Hospital was not under its purview. This turned out to be a mistake, as the Acting Minister for Health later admitted. Luckily for Singapore, this cluster of febrile inpatients did not have SARS. They had influenza B instead.

On 11 and 12 May, a cluster of 24 patients and six nurses from IMH were found to have fever. All except three nurses, who were given medical leave, were warded at TTSH for observation. Of the 24 patients who were over 60-years-old and have chronic mental illness, 23 were in Ward 64 and one in Ward 65. Two doctors in these wards were also sent to TTSH. Health Minister said: “One main approach is to isolate the clusters and prevent the spread ... the patients at the two wards at IMH are long staying so their movement is less than those at SGH where patients with different diseases go to different specialists. The main risk at IMH is the staff.”

IMH staff moved into alternative housing in Woodlands and Jurong (Housing Development Board flats as yet unoccupied), even though they were not directly linked to the cluster. As a result of this, some doubts arose as to whether Singapore could be removed from WHO's list of areas affected by SARS. Also, all patients discharged from IMH from April 23 to May 2 were reviewed at TTSH, and those discharged since 3 May were placed on 10 days of home quarantine from 13 May. The family and close contacts of patients and staff with fever were also quarantined.

IMH/WH was shut down. In a way, its operations ceased (perhaps for the first time ever in its history). IMH stopped admitting, discharging and moving patients, closed its outpatient and Emergency Department. (Straits, 14 May 2003, pg. 4.) The staff unanimously agreed to isolate themselves in order to protect their family members and the community, said its Director of Human Resources who was then staying at a hotel. All IMH employees were isolating themselves voluntarily and its CEO appealed to the public not to shun their staff and their families. The staff settled into flats in Woodlands by 5pm on 13 May, but that night, senior management was reconsidering their accommodation. The flats provided by the Housing Development Board was habitable but spartan – no air-conditioning and water heaters. Next morning, they relocated instead to hotels. This story had a happy ending. It turned out to be an outbreak of influenza B and not SARS. All were relieved. The Minister in charge of the SARS combat unit admitted to not having IMH on its radar screen for SARS. IMH was left out completely.

CONCLUSION
All our people are now fully aware of body temperature and the fluctuations of temperature over a 24-hour cycle and with activity. At the many screening points at buildings, especially hospitals, little coloured stickers are given out with the temperature written on it, and those “febrile” are taken aside for rest and a “cool down” before temperature is rechecked. If still abnormal, a nurse/doctor will then see the person. Thermometers are now found in every household. Every school-going child up to junior college and the Millennia Institute has a thermometer for his/her personal use. Universities, Polytechnics and the Institute of Technical Education are also geared up to take temperatures of their students. (Straits Times, 13 Jan 2004, pg. H7, col. 5.)

However, one weak link remains – is the temperature properly taken? If it is an aural thermometer, are the conditions fulfilled? Is the examination accurate? Finally, would the new SARS outbreak (if ever there is one) manifest itself first by fever or some other symptoms? Would an asymptomatic SARS carrier remain not infectious until the time symptoms manifest? What would be the first symptoms? Our defences as a nation against SARS would have to be changed accordingly if new knowledge is forthcoming. ■
SARS & Quarantine (Part 12)

By Prof Chee Yam Cheng, Editorial Board Member

Editorial note:
The following article was submitted on 4 March 2004. Contents are current at the time of submission.

In an earlier article in this series, I had described Middleton Hospital and the Communicable Disease Centre (CDC) of Tan Tock Seng Hospital (TTSH). CDC now has two locations – CDC 1 at Moulmein Road (previously Middleton Hospital) and CDC 2 at Jalan Tan Tock Seng. After renovation, CDC 1 has 80 isolation rooms (opened and operational as at 20 May 2003), and CDC 2 has 64 isolation rooms (opened on 16 August 2003).

These facilities began in 1907 as a quarantine camp for the isolation and treatment of cases of smallpox, cholera and plague prevalent at that time. Over time, as the environmental health and sanitation of Singapore improved, there appeared to be less need for isolation facilities. So CDC was named to reflect its role in Infectious Disease Control. Many of its recent patients, before SARS broke, suffered from infectious diseases like dengue fever, chicken pox, typhoid fever and malaria. Wards are reserved for HIV patients and TB patients, but the numbers of inpatients were small.

When the SARS outbreak happened, CDC was not well-equipped to handle the patients, so the new TTSH building was designated SARS Central, and bore the brunt of the load for inpatient care. Staff not posted to CDC but to TTSH, together with reinforcements from Alexandra Hospital, KK Women’s and Children’s Hospital, and Singapore General Hospital (SGH), did their job marvellously well. The Infectious Disease Specialists operated from both TTSH and CDC.

When it was scientifically established that SARS was spread by droplets and close contact, this gave rise to a whole machinery of contact tracing. The question that arose then was: after the contacts were traced, what then? Quarantine? Yes. Then, where and for how long?

INFECTIOUS DISEASES ACT

On Monday, 24 March 2003, the Ministry of Health (MOH) invoked the Infectious Diseases Act (IDA) and quarantined 740 people including 340 children. (The New Paper, 25 March 2003, pg. 12.) Before this announcement, the paper had polled 55 Singaporeans on their awareness of SARS by a telephone straw poll. 50 knew about SARS, and 48 knew how it was spread in Singapore. 65 people were down with SARS, of whom five who were hospitalised earlier (from beginning of March) had been discharged with 12 still in intensive care at TTSH. The issue of school closure was brought up, and one parent thought that if things became more serious, schools should close. On this day, Little Skool House, a workplace childcare centre at SGH was shut down and would remain so for the next seven days. The Serangoon centre of the Pat School House kindergarten chain had been shut for 10 days so that its 140 pupils could stay home. Another 200 students from Pei Cai Secondary School in Serangoon were told to stay home for a week.

Under the IDA, MOH compelled all those exposed to SARS patients to stay home for 10 days. If they were caught leaving home, they could be fined up to S$5,000 for the first offence, and up to S$10,000 for the second offence. The Minister for Health said that these measures were necessary to prevent the disease from spreading. He said: “This (SARS) comes wave after wave. If it is not under control, each wave will be bigger. This is not something which we can declare victory in a matter of days or in one or two weeks.” He also said that given the number of patients in intensive care, the country should be prepared to accept that “one or two” may die. The 10-day rule was imposed as it may take that long to check if a person had SARS. The incubation period of the virus is usually about three to seven days, but in some cases, it could go up to 10 days. National Environment Agency Officers would check daily on those quarantined to see if any of them developed the symptoms of SARS; those who did would be referred to the CDC and TTSH for further diagnosis and treatment. Those who did not develop any symptoms after 10 days were considered unlikely to have contracted SARS. (The New Paper, 25 March 2003, pg. 13.)

It was on Saturday, 22 March 2003, that TTSH was declared SARS Central. CDC was ill-equipped to handle the situation, and its isolation facilities were inadequate. It was not possible to use CDC or TTSH as a quarantine centre (TTSH has 1100 beds in operation). So, the concept of home quarantine was applied. That meant somebody else had to ensure that those quarantined stayed home, and even while at home, stayed separate from other members of the household. This meant the entire household, including maids, aunties, grandparents, and others.

HQO

Home Quarantine Order (HQO) is under Section 15(2) of the IDA (Chapter 37). It determines six categories of SARS-related persons. These are, a SARS patient, suspected to have SARS, contact of SARS, suspected to be a contact of SARS, has recently recovered from SARS, and recently been treated for SARS. As the Director of Medical Services needs to execute this Act by proxy, he appointed “Health Officers” under the IDA who were then delegated the powers to impose HQOs on people defined as above. As Chairman of Medical Board of TTSH, I was one of the appointed Health Officers. In my letter to those
served the HQO, the letter stated: “The Director has delegated to me his powers under Section 15(2) of the Act to order patients who are due to be discharged from TTSH to remain and be isolated at home on account of the SARS. SARS is an infectious disease under the IDA.” Section 15(2) states: “The Director may order any person who is, or is suspected or continues to be suspected to be, a case or carrier or contact of an infectious disease, or who has recently recovered from or been treated for such a disease, to remain and to be isolated and (if necessary) be treated, in his own dwelling place (a) for such period of time as may be necessary for protection of the public; and (b) subject to such conditions as the Director may consider necessary for this purpose.”

In my letter, it is stated: “In the exercise of my powers under Section 15(2) of the Act, I hereby order you to remain and be isolated in your home (at address) from (date) until (date) in accordance with this order. You must go home immediately upon your discharge from the hospital.”

During the period of home quarantine, the person:
(1) must not leave the home at anytime without the Director’s permission;
(2) must comply with all conditions set out by the Director; and
(3) must not come into contact with anyone except the following persons:
– family members and other persons who reside in the home;
– healthcare workers acting on behalf of the Director;
– CISCO Officers acting on behalf of the Director;
– any person carrying out any statutory power or function;
– any person who needs to gain access into your home in order to carry out any works; and
– such other person as the Director may allow from time to time.

Failure to comply with this order may lead to:
(a) a requirement to wear an electronic tag to enable the monitoring of the person’s movements throughout the remaining period of the HQO;
(b) the imposition of such other condition as the Director may deem necessary; or
(c) an order on the person to be detained and isolated in a hospital or other place.

Breach of this order also disallows the person or his employer to claim under the SARS HQO Allowance Scheme. Non-compliance with the order renders the person guilty of an offence with the possibility of arrest without warrant. These are set out in Sections 15(3) and 56A(1) of the IDA. The punishment for a first offence is a fine of up to $10,000, or a term of imprisonment not exceeding six months or both (Section 65(b) of the ACT.) (These penalties were revised by Parliament on 24 April 2003 after an open letter by the Prime Minister to all Singaporeans on 22 April, when he lamented: “I am deeply concerned about the behaviour of some persons served the HQO. They refused to cooperate. They did not answer telephone calls from our officials, or told our officials not to bother them. Also, 14 persons are known to have broken their orders.”)

SOCIAL IMPACT

“Food left at doorstep by relatives because family of six not allowed to go out at all to see others.” “Home alone for 10 days.” These were the headlines of SARS Quarantine on the front page of The New Paper on 27 March 2003. HQO had a profound social impact on families. Once a family is served a HQO, it means they cannot leave the confines of their homes for 10 days – not even to go to school, work, or the market nearby. Relatives have to deliver food to them. It also meant the family’s income came to a halt. Hence, the SARS HQO Allowance Scheme was set up. Take for example the lorry driver who was served a HQO. As the family’s sole breadwinner who earned a daily rated pay of some $40-70, he had to stop working, and it was a period of frustration, anxiety and fear. This family of six lived in a three-room flat – husband, wife, in-laws and two children, 13 and 14 years old. The contact was the daughter whose schoolmate had SARS. An order arrived via a MOH official who also told them their relatives would need to help them buy food, which should be left at the doorstep for them to collect only after they had left. (The New Paper, 27 March 2003, pg 2.) There were two deaths the previous days – both men.

The Straits Times, on 30 March, reported a family in self-quarantine. A Dr Teo, not under HQO, and her three kids did not leave home for close to a week to play it safe. She felt the situation was pretty serious so she was doing this as a preventive measure. There were some 1,500 people on HQO at this time, and their children had to stay home too. These numbers were expected to rise when the contacts of the fourth index case, the lady who flew in from Beijing on CZ 355, and took a cab to SGH, were traced. Hospital staff members accounted for about one in six of the current numbers, while another 700 were classified as people in school or work who were in touch with the patients. No one had contravened the orders so far (30 March).

Home Quarantine allows health officials to catch those who develop any signs of SARS early and move them straight to a hospital for medical attention. Thirty-one of them reported getting sick, but only 26 had symptoms and were sent to the CDC. None was warned on suspicion that they had caught the disease.

HOSPITAL STAFF

If any of the staff of the National Healthcare Group were served HQOs, they could choose not to go home, to spare their family of any inconveniences for 10 days. The choice of alternative accommodation was made possible by the staff...
observation facility – a stay-in facility at Pearl’s Hill Terrace, Block 201. The facility had 28 fully furnished units equipped with bathroom and kitchenette with meals provided. It was meant for staff on HQO or on medical leave with fever, wishing to stay in a home away from home. There were no takers.

Hospital staff of TTSH could have been classified as contacts of SARS patients. After all, the staff in the wards and intensive care units were nursing these patients. But they were not served HQOs. Otherwise there would be inadequate staff to run the hospital. In order to prevent the nosocomial spread of SARS, all TTSH staff carried thermometers and checked their temperatures thrice daily. If febrile, they put on a surgical mask, stopped work and reported sick to the Emergency Department. If there was a likelihood of SARS as the diagnosis, the staff was warded. Otherwise, the staff could go home and be in self-isolation (without actually being served a statutory HQO). Staff behaved as if they were under HQO when none was actually served. TTSH heads of department were in constant contact with them to monitor their health, need for hospitalisation, and fitness to return to work.

When SARS broke at TTSH, the doctors’ initial diagnosis was atypical pneumonia. The first case was isolated on 6 March, after an alert from World Health Organisation (WHO). Her friend was warded at SGH, and a third woman back from Hong Kong was warded in TTSH for atypical pneumonia. On 10 March, when a TTSH nurse fell sick, the connection was still not made. On the same day, the initial case’s mother was also warded. Two days later, a second nurse took ill. On 13 March, WHO sent out the global alert on SARS. Only on 14 March, when the initial case’s father and four more TTSH staff were warded, did a picture of the disease appear. The differential diagnosis had often been dengue fever. Alerts from Hong Kong at this time suggested bird flu. By the time it was realised that this was a totally new bug, contagious and potentially deadly, the staff was warded. The SARS victims were three SARS victims, one of whom had died. The three worked at separate buildings in the market which housed 800 tenants in 26 blocks. Because the authorities were not able to trace who the three men might have mingled with at the 24-hour market, the entire place was shut down. All stall holders and their hired hands were placed on a 10-day quarantine, the entire place was shut down. All stall holders and their hired hands were placed on a 10-day quarantine from 20 April. The Minister explained that this was to isolate the stallholders and employees at home and cut the chain of infection: “This will then prevent the spread to the community.” The assumption was that each of the 800 tenants hired two helpers, so 2,400 people in total would be quarantined. Financial aid would be given to them. This was the largest group to be issued HQOs, since 740 people were told to stay at home four weeks previously. Besides the estimated 2,400, another 83 people outside the market were also served HQOs.

Those who had recovered from SARS and discharged from hospital could also opt to serve their HQOs at the chalets. However, each of them would receive a two-bedroom unit all to themselves. The facility could accommodate up to 10 such patients. To ensure that those who fell ill were immediately isolated, health officials were at the chalet 24 hours a day to provide medical help. With 38 units in total, the Loyang chalets could house up to 122 HQO servers. To use this service, a hotline 1800-333-999 was provided, and arrangements were made for Citycab and other modes of transport to ferry people from a hospital or home, to the chalets.

2400 HQOS

“Home quarantine for 2400.” This was the headline in the Straits Times on 21 April 2003, page H1. It referred to the outbreak at the Pasir Panjang wholesale market where there were three SARS victims, one of whom had died. The three worked at separate buildings in the market which housed 800 tenants in 26 blocks. Because the authorities were not able to trace who the three men might have mingled with at the 24-hour market, the entire place was shut down. All stall holders and their hired hands were placed on a 10-day quarantine from 20 April. The Minister explained that this was to isolate the stallholders and employees at home and cut the chain of infection: “This will then prevent the spread to the community.” The assumption was that each of the 800 tenants hired two helpers, so 2,400 people in total would be quarantined. Financial aid would be given to them. This was the largest group to be issued HQOs, since 740 people were told to stay at home four weeks previously. Besides the estimated 2,400, another 83 people outside the market were also served HQOs.

Fifty of them were traced to a wholesaler, one of the SARS-hit trio from the market. The other 33 cases were traced to a taxi driver who was hit by the bug after ferrying another member of the SARS trio from the wholesale centre.

The Minister was asked about SARS at Pasir Panjang. (Today, 22 April 2003, pg. 1.) Has the government been somewhat have to be quarantined at home. But if the parent moved into a Loyang chalet, the children could still attend school.

The quarantine server had to pay a subsidised rate of S$25 a day, which paid for lodging and four meals during the 10-day quarantine period in a four-bedroom bungalow unit. (Today, 13 May 2003, pg. 6.) But this was no holiday. No visitors were allowed and those under quarantine could not wander about the grounds or use the swimming pool or tennis courts. Cisco personnel conducted daily checks on these people and monitored their health. Webcams were installed in each unit so that Cisco could make spot checks. The Minister of State for Health launched this initiative and said: “We are sure that when you stay here, you cannot leave. There is a fence around this place and we ensure that you are actually serving the HQO.” Those issued HQOs on the same day may be assigned to the same chalet or bungalow unit. Each person had an air-conditioned bedroom, but amenities such as TV, telephone, refrigerator and microwave oven within the units were shared.

HOLIDAY CAMPS?

In a letter to the Straits Times Forum (4 April 2003, pg. 22, col. 2-5), the writer lamented: “SARS quarantine: Don’t treat families like animals.” She said that she was appalled by the behaviour of some of her neighbours towards her and her family. She added it was both emotionally and physically hard for the patients to overcome this illness, and stressful for family members who were under quarantine. So the government set aside Loyang chalets for those served HQOs who did not wish to stay at their home address. This scheme started on 12 May. Those served HQOs could choose to be quarantined at the government chalets at Loyang instead of at home. At this time, if a parent was placed under HQO, the children would also
slow in taking action? Should not the market have been closed earlier – and not at least 10 days after the vegetable wholesaler who started the infections was diagnosed with SARS? Although up to 2,400 people were already under HQO, an appeal was made to customers and trades people who had visited the market – and they could number several thousands – to quarantine themselves, or seek treatment if they developed SARS symptoms.

“In the next two weeks, Singaporeans need to be extra vigilant to make sure the spread does not take root,” said the Health Minister. He was asked: “Why wasn’t an alert sent soon after the wholesaler was diagnosed with SARS? That way all the workers could have been more vigilant.” He said that contact tracing had been done and made this appeal: “This is very difficult work. Please give my men a chance. They are not detectives.”

His appeal underlined the extent of the spread of SARS within the community, a departure from the earlier trend when most SARS transmissions occurred within the healthcare setting or within the patient’s familial network, usually within home. Mr Lim used to allay fears when he said: “Take heart, for the spread is not within the community.” – words which brought comfort to many who feared getting SARS from, for example, strangers coughing, as in the confines of a lift. Now, this degree of comfort was significantly lowered with the Pasir Panjang outbreak.

Prior to this, Singapore took pride in the fact that it did not have the problem of community infection.

TOUGHER LAWS
Singapore’s tough legislation came under the world’s spotlight. On 25 April 2003, the Parliament passed tougher laws to contain SARS. One Member of Parliament put himself in voluntary quarantine after he (a doctor) treated a SARS patient, and he addressed Parliament from his home via video linkup.

The changes to the IDA were effective immediately, and gave the necessary powers to control the outbreak of SARS. They would allow the government to

1. Come down hard on quarantine breakers. They can now be jailed for six months and fined S$10,000 even for a first offence. The penalty doubles for subsequent offences. Quarantine prevents potential patients from passing the virus to others.
2. Isolate premises and even destroy goods and structures.
3. Punish anyone who suspects he is infectious but leaves his home, thus putting others at risk. This applies only to specific diseases. SARS is the only such disease at the present time.
4. Punish anyone who gives false information or refuses to cooperate. People had refused to answer phone calls from the Ministry; others had lied.
5. Apply strict burial and funeral rules to limit the possibility of the virus spreading, even in unconfirmed cases. (Straits Times, 26 April 2003, pg. 1.)

WORLD VIEWS
Foreign reports on Singapore’s stance could be summarised thus: The authoritarian government imposed draconian measures and trampled on the civil liberties of citizens in tightly controlled Singapore. (Straits Times, 3 May 2003, pg. H11.)

A Toronto Star report spoke of more than 2,500 people being “under virtual house arrest” and there were others facing “even more intrusive surveillance” – electronic wrist tags. “People in Singapore face mounting fines, possible imprisonment up to one year, and the threat of being publicly identified if they break the government ordered quarantine. There is also constant monitoring of suspected SARS carriers, including electronic tracking of those in isolation – extreme measures the authoritarian government there insists are the best way to combat the continuing threat from the mystery illness.”

In Canada, anyone who needs to be quarantined is first asked to do so voluntarily. But medical officials have the authority to order them to stay home. Anyone who refuses at that stage may be escorted to a hospital by police. In the USA, President Bush signed an executive order on 4 April, giving public health officials the authority to confine people, against their will, if necessary. This was prompted by the actions of a female traveler who arrived in a West Coast airport with SARS symptoms. Refusing an evaluation by health officials, she left the airport on the MRT but was subsequently traced and admitted to hospital. In the UK, newly recruited nurses (1,200) from China, Hong Kong and the Philippines were quarantined (Straits Times, 30 April 2003, pg. AS), as well as more than 140 boarding school students from Singapore, China and Hong Kong who returned to Britain.

In Singapore, we did what needed to be done. If that meant telling a chunk of the population to stay home, we did it. If it meant locking somebody up for repeatedly ignoring simple instructions to stay home, we also did it. This way, we avoided the WHO “travel advisory warning.” (Straits Times, 30 April 2003, pg. 18.)

CISCO TO THE RESCUE
Contact tracing is arduous, difficult work. There was just not enough manpower at MOH or at the hospitals to do this efficiently and within 24 hours. A huge workforce from Mindel was roped in and occupied the ground floor of the College of Medicine building to do contact tracing and fever monitoring. But this was still not enough. Who was there to go and serve the HQOs? On 10 April 2003, Cisco, a statutory board under the Ministry of Home Affairs, was tasked to help Singapore fight SARS. This was because a handful of people breached their HQOs and risked taking the outbreak into the community. (Straits Times, 10 May 2003, pg. H2.)

Initially, Cisco was told to expect 70 to 80 orders each day. Then on 10 April, for their first assignment, they received 235 orders. They were shocked. That was the day MOH announced a new cluster of cases at SGH. Officers on standby were recalled and lists of who should get the HQOs worked out. The next day, 80 officers went to the homes to deliver the slips. At the height of the crisis, when more than 1,500 orders had to be served to vegetable sellers at the Pasir Panjang Wholesale Centre in the
shortest time, up to 200 officers armed with masks and gloves were out delivering them. About half of them had to be roped in from the Singapore Civil Defence Force, so that Cisco could continue its regular security services.

On their visits, they installed electronic cameras and briefed those quarantined about the cameras and the helplines. At Cisco’s call centre, telephone operators made at least three calls each day at random times to check on those quarantined. Those linked to Pasir Panjang were checked on at least five times a day, including during their usual working hours in the wee hours of the morning, to ensure they were home. On their rounds, Cisco officials found most families cooperative. These officers were supported by staff from the People’s Association, hospitals and the Singapore Armed Forces, among others, who were doing the contact tracing.

For example, after a directive was issued on 20 April to the People’s Association to get in touch with more than 1,200 vegetable sellers, and everyone they had been in contact with, within 48 hours, grassroot leaders had all the names tracked, 12 hours before the deadline. The job of serving HQOs had been possibly Cisco’s biggest and most unusual to date. It had handed out over 6,000 HQOs and slapped electronic tags on nine quarantine breakers.

REVISED HQOS
Sometime in May 2003, after having gone through six weeks of the SARS crisis, the HQOs were revised. There were now two types of HQOs. The first for well persons in the community, and the second for patients discharged from hospitals. For the first, they were issued a 10-day order from the last date of exposure because they were contacts of cases diagnosed as probable, suspect or observation cases. (Blood tests were now available for SARS.) Contacts of patients classified as observation cases may have their status / diagnosis changed as the clinical course progressed and the laboratory results became known. With this re-categorisation, if the patient was no longer a suspect probable SARS, the HQO issued to their contacts would be withdrawn.

For patients discharged from hospital, HQO was issued as follows:
(1) Patients upon discharge who were
- Probable cases – 14 days HQO
- Suspect cases – 10 days HQO from 9 May onwards
(This HQO is a precautionary measure.)

(2) For non-SARS patients upon discharge who were from SARS wards (where transmission occurred), or with chronic illness, or on immunosuppression, and those on peritoneal or haemodialysis, the HQO was 10 days from the date of discharge. This was to minimise risks from patients who were inpatients in TTSH, SGH and NUH and who may have had exposure to SARS.

Accordingly, my letter to patients as the Health Officer under the IDA was modified. Chronic illnesses were specified to mean chronic lung disease, diabetes, heart failure, or other chronic heart diseases, chronic liver or kidney disease, malignancy and chronic haematological or autoimmune disorders. I continued to act with these powers till 30 June 2003.

CONCLUSION
The battle against SARS rekindled something from history books – quarantine. Quarantine means restraining the movement of people to prevent the spread of infectious diseases. Unworkable? Ineffective, obsolete, impractical? Before the germ theory of disease, quarantine was useless. The germ theory taught that epidemic diseases resulted from bringing uninfected people into contact with infected ones. Quarantine of road, rail, ship traffic, home or hospital isolation of patients and their contacts – all this helped to combat contagion.

Has global travel made quarantine impossible? No. Where no medical cure is available – as with SARS – quarantine is a valuable resource not to be ignored. Some figures to support its use follow.

48 in folk dance class quarantined. A community dance group was quarantined because one of its members, a nurse had SARS. (Straits Times, 14 April 2003, pg. H2, col. 5-6.) 400 quarantined at home in Beijing. (Straits Times, 26 April 2003, pg. 4, col. 3-6.) Thousands quarantined in Shangxi, China. (The New Paper, 2 May 2003, pg. 30.) Hanoi quarantines 135 students – they were returning from China. (Straits Times, 4 May 2003.) Migrant workers put under mass quarantine in China. Some 203 migrant workers returning from SARS-affected areas of Guangdong and Beijing to the less developed provinces of Sichuan, Anhui, Guangxi, Hunan and Hubei were placed under two weeks quarantine. (Straits Times, 9 May 2003, pg. A1, col. 6.) Toronto put 500 people under quarantine as the city braced itself for a new SARS outbreak, less then two weeks after it was taken off the WHO list of affected areas. (Straits Times, 26 May 2003, pg. A2, col. 6.) Are there quarantine breakers overseas? Yes, 200 breach quarantine order. (Straits Times, 12 May 2003, pg. A1, col. 1-2.) This was in Taiwan where the 200 were among 500 residents of a housing block on HQOs, after a suspected SARS death and two other suspected cases led to the block being sealed off.

A study published in October 2003 stated that experts believed only a third of the 30,000 people confined in Beijing earlier in the year actually needed to be quarantined. “Focussing only on persons who had contact with an actively ill SARS patient would have reduced the number of persons quarantined by approximately 66%.” (Straits Times, 1 November 2003, pg. 10.) The study found that only those people who had direct contact with feverish SARS patients were in any real danger of catching the virus. People who cared for SARS patients had the highest risk. Members of all other quarantined groups – people who visited hospitals where SARS patients were treated, and those who came into contact with SARS patients who had not yet developed symptoms – did not catch the respiratory virus.

So maybe we too need a refinement of our quarantine policies, with greater focus on the groups who really need to be quarantined. But is it not better to be safe than sorry?
SARS – Epilogue (Part 13)

By Prof Chee Yam Cheng, Editorial Board Member

Editorial note:
The following article was submitted on 6 April 2004. Contents are current at the time of submission.

SARS was first recognised as a global threat by the World Health Organisation (WHO) in mid March 2003. With the cooperation of international authorities, governments and industry, the disease was contained within four months. On 5 July 2003, the WHO reported that the last chain of human transmission had been broken. In this article I wish to discuss tourism and travel, money matters and China, the source of SARS.

TOURISM
Tourism was gutted by the SARS outbreak. Air travel almost came to a standstill. Airlines were reeling under debts and empty flights. Airports became ghost centres. Sales plummeted. As most travellers take aeroplanes, Singapore’s regional air hub came under siege. Our motto of “neither an importer nor exporter of SARS” was sound. But could it be quickly and effectively implemented? Airports and aeroplanes had to be fortified against the SARS virus. How to do so for airports and airlines of the many countries in this region who themselves were fighting SARS?

AIRPORTS
International Air Transport Association (IATA) and International Civil Aviation Organisation (ICAO) are the two international bodies that worked hard to ensure airport and airline safety. IATA in a press release on 2 May 2003 stated: “A fundamental approach to containing the spread of SARS will be a rigorous pre-departure screening of air passengers by government health officials to prevent this virus from crossing national borders. This had the support of the WHO. Effective and efficient passenger screening processes will result by combining the public health expertise of governments with the operational expertise of airports and airlines”.

Effective passenger health screening would prevent probable infectious SARS victims from carrying the virus to other locations, protect travellers and airport and airline workers, and maintain public confidence in the air transport system. To be most effective, this screening had to identify people displaying SARS symptoms at the earliest point possible. IATA strongly urged governments to ensure that departing passenger health screening procedures occurred before check-in. Similarly, any arrival screening should take place as close to the arrival point as possible. IATA research indicated that passengers’ greatest concern was the health condition of their fellow travellers. Screening of passengers by government health officials is technically simple, very effective and essential to rebuild public confidence in the air transport system. IATA represents over 270 airlines comprising 98% of scheduled international air traffic.

On 5 May 2003, the world airline CEOs and members of a special committee of IATA’s Board of Governors met in London to discuss the impact of SARS and evaluated the measures being taken. They endorsed the idea of a standardised pre check-in screening of air passengers in countries affected by the SARS outbreak.

By 4 June 2003, ICAO announced it had developed a set of protective measures for use at international airports to prevent the spread of SARS. The measures, based on guidelines issued by the WHO, consist of specific procedures for screening of passengers at departure and on arrival, and airport workers. Included was information for all passengers about SARS and guidance on handling of suspected cases on board and at destination.

ICAO representatives met in Singapore with officials of Ministry of Health (MOH), Civil Aviation Authority of Singapore (CAAS), Civil Aviation Medical Board (CAMB) and Raffles Medical Group (RMG), using the Singapore airport as the model on which to work out and test these procedures. Singapore’s Changi Airport was the first to be certified as having met the requirements for these protective measures against SARS. The ICAO team then certified other airports in the region, including those in Hong Kong and China.

There is a checklist of eight protective measures plus an optimal one, including: (Strait Times, 7 June 2003, pg. H2, col. 5-7.)

(i) Appointing a public health emergency official who will be responsible for implementing protective measures against SARS if necessary.
(ii) Screening departing passengers and passengers arriving from SARS-affected areas for symptoms of the virus.
(iii) Daily temperature screening for all airport workers who have direct contact with passengers.
(iv) Setting up response procedures for any incoming aircraft carrying possible SARS cases, which include measures to remove all passengers directly from the aircraft, and infection control measures such as face masks and gloves.

AIRCRAFTS
During the four months from March to July 2003, the international airline industry, particularly in Asia, saw passenger numbers plummet and losses amount to US$4 billion as a result. The air transport industry was one of the hardest hit sectors of the economy. IATA gathered the world’s airlines...
with the WHO in Bangkok on 23 April to refine battle plans in the war on SARS. Earlier, by 5 April, guidelines were issued to crew on international flights from areas affected by SARS. In particular, it dealt with symptoms of SARS, precautions to be taken, and the management of possible SARS cases on board, contacts of the ill passenger, and other passengers.

For purposes of air travel, a contact is defined as:
(i) Passenger sitting in the same seat row or within at least two rows in front or behind the ill passenger.
(ii) All flight attendants on board.
(iii) Anyone having intimate contact, providing care or otherwise having contact with respiratory secretions of the ill passenger.
(iv) Anyone on the flight living in the same household as the ill passenger.
(v) If it is a flight attendant who is considered to be a SARS case, all passengers are considered to be contacts.

For disinfecting of aircraft, the WHO’s Guide to Hygiene and Sanitation in Aviation is available at http://www.who.int/csr/(ihr/guide.pdf). HEPA filters are used in aircraft, and when installed, filter down to three microns and become more efficient with time. “The air in aircraft cabins is probably safer than anywhere else,” said Mr Richard Stirland, Director General of the Association of Asia-Pacific Airlines, a group of 17 Asian, mainly national airlines. (ST, 28 April 2003, pg. 4, col. 5.) The cabin air is fresher than in office buildings, other transport modes and any other enclosed spaces for big crowds, said aircraft manufacturer Boeing and Singapore Airlines. Plane air is completely replaced with air from outside the aircraft 20 to 30 times every hour. This compares favourably against one to three times an hour in a typical building, and five to seven times in a hospital operating theatre. Before each replacement, passengers breathe in a mix of fresh external air and recycled air that is, to all intents and purposes, devoid of bacteria and virus. This recycled air is filtered so well that it is more than 99.9% sterile.

Every SIA plane, including Silk Air, uses powerful HEPA filters (high efficiency particulate air filters). They are similar to those used in critical wards of hospitals – such as organ transplant and burns wards, and industrial clean rooms. SIA and Silk Air replace them at intervals of between 2,000 and 3,000 flight hours, much shorter than the 5,000 to 6,000 hours recommended by Boeing and Airbus. Additionally, since the SARS outbreak, SIA started two procedures to disinfect planes. One involves disinfecting all transit and night stop aircraft, and the other, cleaning a plane that had a suspected sick passenger. (Remember our own doctor quarantined in Frankfurt en route back from New York to Singapore? He flew SQ.) Similarly Silk Air disinfects all night stop planes and those that have arrived from SARS-affected places.

The super clean air in planes was also underlined by IATA. It quoted the WHO saying that passenger screening procedures at airports around the world have reduced the likelihood of the SARS virus being introduced into a plane. IATA’s Kevin Dobby, who heads its SARS task force said: “Of the 200 million travellers who have boarded aircraft since the beginning of this crisis, there have been fewer than five cases of possible transmission in the cabin, and those were on flights that occurred before the screening procedures were put in place.”

**AIRCRAFT TRANSMISSION**

Is aircraft transmission of SARS for real? The answer is yes. In an article in the *New England Journal of Medicine*, 18 December 2003, pages 2416-22, its authors (including doctors from Thailand, Taiwan, Hong Kong, Singapore and CDC Atlanta) analysed three flights that transported a patient or patient with SARS. One flight carried one symptomatic person and 119 other persons. Laboratory tests confirmed SARS developed in 16 persons, and two others were given diagnosis of probable SARS. Illness in passengers was related to the physical proximity to the index patient, with illness reported in eight of the 23 persons who were seated in the three rows in front of the index patient as compared with ten of the 88 persons who were seated elsewhere. Another flight carrying four symptomatic persons resulted in transmission to at most one person, and on the third flight, which carried a person with asymptomatic SARS, no illness was documented in passengers on that flight.

**CRUISE SHIPS**

SARS also hit the cruise operations. The hospitalisation of two Star Cruises crew on SARS fears, and cancellation of luxury voyages were the news on page 6 of *Weekend Today*, 12 April 2003, pages 12-13. SuperStar Virgo had arrived in Singapore with 625 passengers and 1,354 crew. An Indian national crew had fever and was isolated at Tan Tock Seng Hospital. Another 13 crew who could have had contact with the man on the ship were quarantined. The ship left Singapore for Port Klang and returned two days later with 814 passengers and 1,350 crew. All crew and passengers were checked but none had SARS symptoms. The ship while docked at Singapore was disinfected. Because of these suspect cases, Star Cruises cancelled a weekend cruise and a one-week cruise to Bangkok and Ko Samui. Next day, Today reported that the Indian national had been discharged from hospital. He did not have SARS. SuperStar Virgo was taken off quarantine and allowed to sail away. It had no passengers on board.

On 17 April 2003, *Today* (page 3) reported that Malaysian cruise operator, Star Cruises, was deploying its two Asia-based luxury cruise ships to Australia, following worsening business conditions in the region. SuperStar Virgo will be based at Perth instead of Singapore, and SuperStar Leo in Sydney instead of Hong Kong, for the next three months. On Anzac Day, 25 April, the luxury liners will take on board Australian-based passengers. Star Cruises has 20 ships in its entire fleet, the world’s fourth largest cruise operator. In recent weeks, the company’s shares were sold down 25.6% and 23.9% in the Singapore and Hong Kong markets respectively.
As a result, the S$50 million Singapore Cruise Centre will wind down operations. The centre used to have at least one ship a week making port calls. Since the SARS outbreak, hardly any vessel had called.

**Airlines Suffer**

The Straits Times reported on 17 April 2003 (page HS) that Changi Airport was hit far harder by SARS and the war in Iraq, than it was after the September 11 terrorist attacks. A total of 2.21 million passengers passed through Changi in March 2003, a sharp drop of 11.2% compared to March 2002, as business and leisure travellers shunned Singapore. Investment Bank Merrill Lynch likened the crisis to “watching a train crash.” In its latest report on Singapore Airlines and Hong Kong’s Cathay Pacific, it said that “while March was bad, clearly April is going to be a lot worse.” In the first week of April, passenger traffic fell 38.3% compared to last year. The number of scheduled flights each week fell by 19.7% (compared to 7% fall after 911). For Asian airlines, cuts in weekly flights were cut in March, spread across North Asia (80 fewer flights), S.E. Asia (70 fewer), and Europe and USA (about 20 each).

Tourist arrivals were down 15% in March 2003, followed by 61% in the first 13 days of April. The crash in hotel occupancy was down to 20-30% against the normal 70-80%, and retail sales crashed 10-50% (Editorial. ST, 18 April 2003.) “China, a principal source of visitors, is careening down a slippery slope of SARS under-reporting even as Singapore is succeeding in blocking its spread to the general population.” (But on 19 April 2003, Pasir Panjang Wholesale Centre was closed because of community spread of SARS.) “At the macro level, the government has halved the growth forecast for 2003 from the 2-5% band to 0.5-2.5%; the prognosis is very black.”

For Singapore Airlines, cabin crew had to tighten their belts. (Streets, 16 April 2003, pg. 1.) Besides axing 206 cabin crew trainees and ceasing recruitment in March, SIA was asking flight attendants to take no pay leave for any reason e.g. studies, exam, personal. Cabin crew were also asked to consume any annual leave earned to date. SIA was doing this in line with that recommended in a tripartite statement by the government, trade union and employers the previous day. The measures adopted by sectors most hit by the SARS outbreak – airlines, hotels and travel agencies – were temporary cost cutting steps to remain viable and preserve jobs. These were a shorter working week, temporary layoffs, asking employees to attend training or take their annual leave.

Post 9-11, SIA did not axe a single employee. But, this time, the situation was dire. SIA said in the first week of April, that it had just filled 54% of its seats, way below its average breakeven load factor of 70%. So it slashed air fares by as much as 50% to top spots with economy class return tickets to London, Paris, Rome, Frankfurt, Zurich and Amsterdam costing just S$800. (ST, 26 April 2003, pg. 4.) SIA shares closed at a 17-month low of S$8.30 the day before.

On 30 April 2003, it was reported (ST, pg. H4.) that “SIA lines up action plan to battle ‘worst crisis’, shrinking of fleet size and talks with its unions are part of airlines plans, Silk Air to release 8 expatriate pilots early”. By slashing 200 weekly flights, its capacity had been reduced by 20%. Losses were close to S$1 million a day.

Said IATA regional Vice President Andrew Drysdale: “This is a crisis of unprecedented magnitude.” Fallout from SARS would dwarf those of the 9-11 terror attacks in the U.S., the mid 1997 Asian crisis and the Iraq War. (ST, 16 May 2003, pg. A2, col. 2.) He estimated global industry losses from SARS at US$10 billion. The 9-11 and Iraq war cost the industry a combined US$30 billion last year. He noted that “the travel industry underpins the economies” of many of the worst affected Asian countries. Health experts say that SARS was the first global epidemic to be spread by jet travel. Aviation officials insist the chances of contracting the virus during flight are minimal (but not zero). Mr Drysdale said governments and industry officials need to address the public “misunderstanding the level of risk” of contagion through flying. The aviation industry carries about 1.2 billion passengers every year. A new study by Oxford Economic Forecasting showed that the four Asian nations slapped with travel advisories by WHO because of their outbreaks of SARS – China, Hong Kong, Singapore and Vietnam – will lose 2.9 million travel and tourism jobs in 2003.

On 13 October 2003, “Good times are taking off at Changi Airport” was the headline on page 4 of the Straits Times. Data were showing a better picture after 10 months of turmoil caused by the SARS outbreak. SIA was operating again near its pre-SARS level, after reporting its first ever quarterly loss of S$312 million at the end of June. The profit estimate for SIA for the year ending March 2004 was raised by UBSAG on 15 September to S$558 million, compared to last year’s profit of S$618 million.

**Help Packages**

The government announced on 17 April 2003, assistance to help hotels, airlines and cabbies with new moves to protect jobs. (ST, 18 April 2003, pg. 1.) Businesses in the transport and tourism-related sectors, hardest hit by the SARS outbreak, will receive S$230 million worth of help through rebates, fee cuts and grants which took effect from May 2003. The three bigger packages relate to S$64 million for property tax rebates for shops, hotels and restaurants; S$57 million for training grants for tourism related courses, generating some 27,000 training places, and S$45 million for the aviation industry through rebates on aircraft landing fees, and rentals for airport and air freight centre tenants.

**SARS-Affected Victims**

Singaporeans donated graciously to the Courage Fund. This fund was used to financially assist all probable SARS cases, unemployed and self-employed observation, and suspect cases, who under the Infectious Diseases Act, had to be hospitalised or quarantined to protect the rest of society.
The SARS Home Quarantine Order Allowance was applicable to several categories of quarantined people. It included all discharged probable and suspect cases; all contacts of probable, suspect and observation cases; all discharged patients from the “hot wards” in TTSH, SGH and NUH since 3 May 2003; all persons with chronic illness/immunocompromised status, discharged from TTSH and SGH and all renal dialysis patients discharged from NUH. All these categories of people had their HQO issued by MOH (delegated down to the CMs/CEOs of the three hospitals – TTSH, SGH and NUH). Those warded just for observation with no history of contact did not qualify for the allowance. Some were put on phone surveillance but not quarantined; they did not qualify.

The rates for suspect and observation cases with history of contact given allowance only for days of hospitalisation strictly related to SARS, were S$50 per day of hospitalisation for the contact given allowance only for days of hospitalisation strictly for the unemployed and S$100 for the self-employed. Those who qualified for the HQO allowance scheme were persons issued with HQO, and small business establishments ordered to close by government. The payment was S$70 per day for each day of quarantine. Those self-employed were paid directly. Those employed had the payments made to their employers.

By 15 August 2003, about S$2.8 million had been paid out under the HQO Allowance Scheme. (ST, 15 August 2003, pg. H1.) More than 600 people and some firms had benefited and more would benefit as claim forms had been sent to 8,333 people, of which 4,056 had their applications approved under this scheme. People had three months from the time they received the forms to claim relief. The most recent quarantine case had up to October to do so. Payment was through the People’s Association, which ran the scheme with the five community development councils.

Those who broke their quarantine orders or were not working were not eligible. Neither were foreign domestic maids, whose workplace is the home, and civil servants. Among those who had claimed were tenants at the Pasir Panjang Wholesale Centre (shut for 15 days) and the S-11 coffee shops in Serangoon Central (shut for 15 days). For the wholesale centre, the HDB waived its rent during the closure, saving tenants between several hundred dollars for a small stall and S$4,000 for those renting a cold room. The HDB also waived about S$780,000 in rent for over 600 tenants occupying the centre’s 1,200 units. Tenants also received a one-off payment of S$1,600 for each stall they had.

The financial assistance programmes were administered by the Community Development Councils, which sent the application forms to all those ordered to stay home. (ST, 30 April 2003, pg. H4, col. 5-6.) Three groups received help as mentioned above. The self-employed received S$350 up front when they were served the HQO and another S$350 at the end of the 10 days. If a person violated his HQO, the upfront S$350 would not be taken back, but the allowances for those salaried will not be paid to their employers. More than 4,600 people had been served HQOs and the payments could reach S$3.3 million.

CHINA UNCOVERED

When the WHO issued the warning on the global threat of SARS in mid March 2003, there was little doubt that Southern China was where the disease originated. On 2 April, the WHO issued a travel advisory against travel to Hong Kong and neighbouring Guangdong province. “WHO gets tough on China” was the Straits Times headline on 3 April, and by 7 April, “China yet to provide samples” to the WHO. (ST, 7 April 2003, pg. 6, col. 7.) After five months of covering up its SARS problem for political reasons, China was forced to face the bad news and gave in to the international pressure to change its attitude and cooperate with the international communities’ efforts to contain the spread of SARS. (ST, 7 April 2003, pg. 8.) President Hu Jintao finally urged full-scale cooperation with the WHO. It was only when Premier Wen Jiabao made it the first item on the agenda of a recent State Council meeting to discuss the main tasks of the cabinet for 2004, that approval was given for WHO officials to carry out investigations in the stricken province. Between 1 November 2002 and 6 April 2003, there were a total of 2,600 cases worldwide and 90 had died.

More than four out of five deaths worldwide had occurred in Guangdong and Hong Kong at this time. All this might have been different if the Chinese Communist Party (CCP) had adopted a more responsible attitude towards dealing with the outbreak. The CCP issued a circular to the Chinese Official media in October 2002 outlining how it could help maintain a stable and secure environment, to ensure that the party’s 16th Congress in November would be held successfully. The circular had a list of “Do’s and Don’ts”, including an item on dealing with the possible spread of flu. Every year between winter and spring, there will be a high incidence of flu and pneumonia in China. Apart from dismissing any outbreak as nothing more than the usual bout of seasonal illness, the circular urged the media to avoid running “negative news”. Party secretaries at various levels were warned that they would be held accountable should such bad news break out in their areas. The circular suggested that the CCP was fully aware of the possible spread of illness, but decided that the party image had to come first. Instead of sounding the alert, the official media were directed towards avoiding news that might marr the congress.

Other mistakes equally avoidable followed. When the Guangdong outbreak began to get out of control and was reported in Hong Kong, the Chinese accused the media there of scare mongering. The Hong Kong media were openly criticised for “excessive coverage” that would frighten off foreign investors. The result was that instead of initiating actions to deal with the disease, China politicised the issue and erected a barricade in self-defence. It claimed that the WHO’s request to do field work in Guangdong, as well as identifying the province as the source of SARS, were politically motivated. A MOH official even threatened to scrap cooperation with the WHO if it continued calling Guangdong the source of the disease. The Health Minister Zhang Wenkang was quoted as saying: “The fact that HIV and Aids cases were first reported in the United States does not mean that the fatal epidemic
started there." To the Chinese, pressure from the WHO, coupled with American media calls to ban travel to China, added up to a political conspiracy. It was only when the World Economic Forum cancelled its April 2003 summit meeting in Beijing that the country appeared to wake up to the reality of SARS. When Vice Premier Wu Yi announced plans to step up action and public education in the first week of April 2003, China even said sorry for the way it handled the crisis.

Chinese Premier Wen Jiabao said on 6 April that his government was fully capable of controlling the spread of SARS. “The CCP and the government pay much attention to SARS, have adopted a series of timely measures and achieved obvious results,” he was quoted as saying by Xinhua news agency. “The Chinese government and people warmly welcome friends from all over the world to come to our country for travel or business. We will adopt a series of measures to guarantee the health and safety of friends coming to China.” Mr Wen urged all levels of government to “fully recognise the complexity and difficulty of SARS.” (ST, 7 April 2003, pg. 8, col. 6-7)

Today, 3 April 2003, on page 20 ran a report titled: “Unmasking the mighty dragon”, which commented that if China cannot come clean on the SARS crisis, how can investors expect to get reliable data on its economy? For months, China had denied it had a growing number of SARS cases, and only in late March 2003, did Beijing welcome a team from the WHO to study the origins of the epidemic and devise ways to halt its spread. It was troubling that WHO’s data on SARS in China was “of February 2003” when it was already April 2003. By word of mouth, China had about 800 cases in Beijing, Guangdong and Shandong. There was no data on the other 28 provinces and municipalities.

ABOUT TURN

Chinese officials then back-pedalled on earlier claims that the virus had been kept under control. Another 17 cases were reported with Fujian and Inner Mongolia hit. (ST, 16 April 2003, pg. H4.) Altogether, China had 1,435 cases, of which 1,094 recovered and 64 died. President Hu Jintao’s message was sombre. He called for an all out effort to stop SARS from “spreading and rebounding” and urged the government to support the front line staff. Premier Wen Jiabao also appeared to change tack when he said: “The overall situation remains grave.” Chinese health officials then said SARS was being “effectively contained” rather than “effectively controlled.”

The central government appointed Vice Premier Wu Yi to drive the anti-SARS campaign, now made a top national priority. (ST, 17 April 2003, pg. H4, col. 1-3.) Chinese President Hu went on an inspection tour of Guangdong province as part of damage control. (ST, 18 April 2003, pg. A1.) He also met with Hong Kong Chief Executive, Mr Tung Chee Hwa in Shenzhen to show the central government’s support for the beleaguered government of the SAR (Special Administrative Region) and for Hongkongers in their fight against SARS. He also met health workers in the front line of the fight against the deadly disease, to raise people’s confidence and to show them that no effort was spared to control the disease. But it was also a signal to the rest of the world that China was serious about tackling the SARS issue. The SARS outbreak has shown that China cannot afford to have “a long leg in economic reform and a short leg in political reform,” he said.

“China leaders order all-out action” was the heading on 18 April 2003. (ST, pg 4.) China’s top leaders directed all levels of government, from central to the township, to go all out in a nationwide bid to prevent and treat SARS cases. No money or effort should be spared in the fight. And no late or false reporting. This directive, broadcast by China Central TV (CCTV) at prime time, was issued after a meeting of the CCP’s all-powerful Politburo Standing Committee. Analysts saw this as the leaders’ response to the WHO criticism of poor case reporting and contact tracing by Beijing hospitals. Along with this directive was news that SARS had spread to the remote western Ningxia region. There were 1,457 cases of SARS in China with 66 deaths as of this date. “Cover-up SARS and you will be punished, says Beijing.” (ST, 20 April 2003, pg. 4, col. 7.)

Massive under-reporting of cases was occurring but WHO’s Dr John Mackenzie did not think there was a cover-up. The problem, he said, was a lack of communication between Beijing and the provinces. The gross under-reporting was also due to a very complex situation – at this time every year, China usually has many cases of atypical pneumonia and avian flu.

THE WHISTLE-BLOWER

Aided by the information revolution, a Chinese military doctor’s accusation that his government was lying about the extent of the flu-like pneumonia in the country led to the sacking of two senior government officials. On 3 April 2003, 72-year-old senior retired surgeon Jiang Yanyong, watched Chinese Health Minister Zhang Wenkeng report on national TV a mere 12 cases of SARS in Beijing. He knew first hand that the actual number was much higher. “I simply could not believe what I was seeing,” he wrote in an email to CCTV-4. “All the doctors and nurses who saw yesterday’s news were furious.” He reserved his strongest language for Mr Zhang, who like Dr Jiang, had come up the ranks as an army doctor. “Zhang Wenkang is ... abandoning even his most basic standards of integrity as a doctor.” (ST, 23 April 2003, pg. H6.) On 20 April, Health Minister Zhang Wenkang and Beijing mayor Meng Xuenong were sacked from their jobs. (ST, 21 April 2003, pg. 1.) Executive Vice Minister for Health Gao Qiang instead faced the media and disclosed that Beijing alone had 246 SARS cases, 10 times more than the official figure. The situation in Beijing was “very serious” with 18 dead and another 402 suspected cases.

Dr Jiang’s letter was an inspiration to other healthcare workers, who then leaked more information. Dr Jiang is a member of the Communist Party, and was in 1991 exiled by a government publication as “An Honest Doctor”. He enjoyed...
a hard earned reputation for integrity throughout his entire career. In 1949, the year the Communist Party took power, he won a place at the prestigious Yanjing University (since renamed Peking University) as a pre-medical student. The bulk of his training was at Peking Union Medical College, an American style medical academy. As a freshly minted doctor he was assigned to the No. 301 military hospital. He did a stint early in his career as a field surgeon, and was known for two qualities: compassion for patients and deft medical skills. He was an easy target in 1966 when the Cultural Revolution began. In 1972, he was politically "rehabilitated," and returned to No. 301 hospital where he worked his way up to chief of surgery in the 1980s.

Although Dr Jiang was criticised by the Vice Health Minister Gao Qiang, top economist Professor Wu Jinglian who is chief economist of the State Council Research Development Centre, telephoned Mr Jiang to express his admiration and labelled his critics as people with "upside down values". (ST, 9 June 2003, pg. A2, col. 1-3.) The Chinese Business Post revealed that Prof Wu had criticised the official handling of SARS at a national conference on 9 April, chaired by Premier Wen Jiabao. Both Prof Wu and Dr Jiang were born in 1930 and joined the Communist Party in 1952. Professor Wu is the top economist of the State Council Research Development Centre, telephoned Mr Jiang to express his admiration and labelled his critics as people with "upside down values". (ST, 9 June 2003, pg. A2, col. 1-3.) The Chinese Business Post revealed that Prof Wu had criticised the official handling of SARS at a national conference on 9 April, chaired by Premier Wen Jiabao. Both Prof Wu and Dr Jiang were born in 1930 and joined the Communist Party in 1952. Prof Wu said to Dr Jiang: "I have called you because of an absurd view being spread that telling the truth is a problem, and suppressing information is normal and a responsible act towards the country and its people." Dr Jiang was also reported as saying: "I am an old cadre of 50 years' standing and I feel the party should not fear any kind of media reporting and should permit different views, unless of course, its heart is not right or it has feet of clay. I believe most Chinese people are hoping that the Communist Party will improve and learn to listen to different opinions. I believe SARS will give us a big push." As late as 30 May, Mr Gao wondered aloud at a press conference why so many people paid attention to Dr Jiang when he was just one of six million Chinese medical workers. To ordinary Chinese, however, he is a hero.

MORE SACKINGS
To replace Health Minster Zhang, Beijing appointed its top woman politician Wu Yi as Health Minister. (ST, 27 April 2003, pg. 3.) The SARS crisis had jolted the leadership into appointing a Vice Premier, not a Minister, as health supremo so that there would be sufficient clout behind whatever measures that are ordered to fight the disease. Madam Wu, aged 64 years and China's most senior woman politician, replaced Mr Zhang Wenkang. She is known for her hard-nosed and business-like approach, and was tasked to steer a national team to fight SARS, which had spread to 21 of China's 31 provinces and municipalities.

In her get-tough approach, China sacked or disciplined more than 50 officials across the country for mishandling the SARS outbreak, signalling its seriousness in tackling the epidemic, which had killed almost 200 people nationwide. (ST, 5 May 2003, pg. 4, col. 3-7.) Since 25 April, at least 52 errant government bureaucrats, communist party cadres and health officials had been punished. They came from various provinces: Guangdong and Hunan in the South, Anhui and Jiangxi in the east, northern Hebei, north western Shanxi, central Henan and Guangxi, and Chongqing municipality in South West China. The officials were sacked or reprimanded for incompetence, tardiness or being ill-prepared in handling SARS patients, deserting their posts or not devoting enough attention and resources to combating the disease. Top leaders had recently warned that swift punishment awaited those who failed to act, or tried to cover up the real situation. Mr Peng Mengxiang, a senior official in charge of disseminating SARS-related information in Changde city in Hunan province, was sacked from all government and party posts after he was found partying the night away instead of doing his job. He reportedly spent five hours having dinner and going for karaoke with several businessmen. As a result the city's website for SARS-related information was updated six hours behind the deadline.

In the Shiyu town of Chongqing city, Health Director Chen Mingqi was sacked for being more preoccupied with the profitability of the clinics and hospitals than getting them ready to handle SARS patients. He reportedly made “negative” comments such as "if we have SARS cases, it's not realistic to quarantine anyone as it will affect the hospital's business" and if “the hospital cannot collect payment where do we get money for food?”

ASEAN + 3
Health Ministers from ASEAN, Japan, China and South Korea met in Kuala Lumpur on 26 April 2003 and proposed a slate of strict measures to combat SARS. (ST, 27 April 2003, pg. 1.) This was followed by the ASEAN leaders special summit on SARS on 30 April in Bangkok where they agreed to coordinate SARS policy, share information and adopt stringent safeguards, including uniform pre-departure health screenings for travellers within the grouping. Without such standardised procedures, countries might have been tempted to close their borders, thus inflicting economic damage on themselves and others, on top of damage to their public health. Contain, isolate, screen – that is the strategy that Singapore and ASEAN as a whole have adopted. (Editorial. ST, 1 May 2003, pg. 28.)

SINGAPORE'S GAIN
As a result of Singapore's performance in anti-SARS measures, the U.S. and Singapore agreed to join forces to combat new diseases and biological threats. Two American research institutes could set up base here; they are the CDC (Centres for Disease Control and Prevention) and the NIH (National Institutes of Health). “Given American leadership in the biomedical field and Singapore’s advanced research facilities, President Bush and PM Goh agreed that the two countries should explore prospects for collaborative efforts to understand new health threats which put the world community at risk, including tropical diseases and biological warfare agents.” (ST, 8 May 2003, pg. 1.)
SARS IN 2004

In the winter of 2003, a 32-year-old male TV producer came down with SARS on 16 December. The laboratory test only confirmed it was SARS in January 2004. He lived in Guangdong and it was only since 26 December that the WHO’s help was sought to confirm earlier diagnostic tests which were inconclusive. The source of his infection was unclear. The previous year, the first cases of SARS occurred in Guangdong in mid November 2002. The disease began to spread internationally in late February 2003, eventually causing more than 8,000 cases with 774 deaths in 27 countries. The TV producer was discharged by 9 January. All his 81 identified contacts, including 17 healthcare workers remained well. By 12 January, a third case of SARS in China was reported. The fourth case was a 40-year-old doctor from Guangzhou, admitted to hospital on 16 January, and discharged well on 30 January. So, all four cases of SARS have recovered.

CONCLUSION

SARS resurgence has not happened, and we are thankful it has not. Hong Kong began scrapping some SARS safeguards (*ST*, 10 March 2003, pg. A4, col. 6-7) and Singapore stepped down its SARS-related measures from 1 April 2004. This included no further need for hospitals to:

(a) restrict hospital inpatient visitors to four registered visitors;
(b) triage patients for fever at Specialist Outpatient Clinics;
(c) maintain contact details of visitors;
(d) monitor staff temperature; and
(e) conduct daily internal audits on staff compliance with SARS prevention and control measures.

Also, there was no further need for medical clinics (including polyclinics) to:

(a) triage patients for fever;
(b) require staff to wear N95 masks when attending to fever patients;
(c) require patients with fever to wear surgical masks;
(d) maintain contact details of visitors; and
(e) monitor staff temperature.

However, hospitals will continue to:

(a) triage febrile patients at Emergency Departments and separately manage them;
(b) isolate potentially infectious patients; and
(c) require staff in high-risk areas to don PPE.

Thank you for bearing with me through my lengthy articles.