

# 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  $\pm 1^\circ\text{F}$  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° (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  $\pm$  0.4°C (98.2  $\pm$  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 (98.9°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 (98.9°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



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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 Gwee. 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

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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 S\$5 million. The Ministry of Defence (Mindef) would spend S\$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

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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,

only passengers arriving from Hong Kong and Guangzhou had been screened. With universal fever checks for departing passengers in place on 23 April, two foreigners were referred to doctors. One was certified fit to fly, while the other was taken to TTSH. By mid-May, all arriving passengers will be screened, announced the Minister for Transport.

Changi had seven fever scanners in operation, and this was to double by 30 April. By mid May, there would be 26, thus freeing the nurses to return to the hospitals. Using scanners would be less intimidating for passengers than using nurses and medics in gowns and masks.

At Woodlands checkpoint, fever checks were carried out at entry and exit points. At Tuas, checks were only made in the arrival area. Scanners at the land checkpoints screened about 30,000 people who walked through the immigration lanes each day. Such screening did not yet cover motorists, motorcyclists and their passengers who used the outdoor drive-through lanes. By 29 April, Singapore had put in place fever checks and declarations at all seaports. (*Straits Times*, 30 April 2003, pg. 3.) All travellers were screened at ferry terminals; shipmasters had to make a declaration four hours before arrival into Singapore. At Singapore Cruise Centre, two thermal scanners were installed, and at Tanah Merah Ferry Terminal, one scanner was operational. Ear thermometer checks were carried out at Changi Ferry Terminal, Changi Immigration checkpoint, West Coast Pier and Clifford Pier. Besides fever checks, travellers also had to fill in health declaration forms. By 7pm on 29 April, everyone coming in or leaving Singapore by air, sea or bus, would have been screened to make sure they were fever-free.

### THERMAL SCANNERS

This was a newly created weapon against SARS and took effect on 11 April. The IFSS (Infrared Fever Screening System) had been used to check passengers at Changi Airport. Developed for the military, it was modified to help nurses spot feverish passengers without the use of thermometers. The mobile set is placed at the end of an aerobridge and works as a thermal imaging sensor. It feeds data into a computer, so feverish foreheads show up as red spots, and cool ones as blue, on silhouetted images on a computer screen. Travellers with fever were then checked personally by nurses to determine if they had to be ferried to TTSH for SARS screening.

The gadget was developed by ST Electronics and DSTA (Defence Science and Technology Agency), which MOH approached earlier in April to help with mass screening at the checkpoints. This scanner would allow the nursing manpower to be reduced by two thirds. By 24 April, eight sets were operating at Changi Airport. Later, they were deployed at other checkpoints. Further, Singapore lent a scanner to Hong Kong on 22 April and two more on 29 April. (*Straits Times*, 30 April 2003, pg. H2.) Other governments were also making inquiries, including China, Taiwan and Thailand. The Philippines had ordered three scanners. DSTA and ST Engineering produced the scanners by adapting the Singapore Armed Forces imagers meant for military use. By 14 May, ST Engineering was making more than 20 units

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a week of the commercial version costing under S\$90,000 a piece. In Singapore, by 14 May, over 40 were in use at air, land and sea checkpoints. Schools, polytechnics and technical institutes seeking to screen students, especially before examinations, were keen to acquire them. So were factories and conference organisers.

The Singapore company, Zugo Photonics, which distributes Flir Systems Thermal AM S60 camera system, also benefitted. The company had received up to 10 calls a day asking about this infrared camera built for scientific and industrial uses. It is not a medical device but it does measure temperature accurately. Flir Systems also checked what should be the "baseline" human temperature under different environments, because surface temperature readings in an enclosed and air-conditioned location, such as an airport, would differ from those taken in open-air locations such as the Woodlands checkpoint.

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 feverish. 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

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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. Since 2 May, she was allowed to remain in the classroom, but was seated by herself at the back except when her temperature reached 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. (*Streets*, 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. ■