

SARS

Severe acute respiratory syndrome (SARS)

O Wong

Wild game chefs and healthcare workers

Severe acute respiratory syndrome (SARS) originated in the Guangdong province in southern China and spread by way of Hong Kong to the rest of the world in the spring of 2003. According to the most widely accepted theory at the time of this writing (July 2003), the likely culprit is a novel coronavirus that “jumped” from animals to humans. Thousands around the world have been infected and hundreds have died. Numerous papers have been published since the outbreak of the epidemic that address technical aspects of SARS. In this editorial, however, I would like to provide a chronology of the transmission by the index cases in the early stage of the epidemic in Guangdong and Hong Kong, describe briefly the two major occupations at risk of infection, and pay tribute to the courageous healthcare workers who treated SARS patients.

Guangzhou (the capital of Guangdong province) and the surrounding area (the Pearl River Delta) are densely populated. The corridor between Guangzhou and Hong Kong (some 120 km to the south) are lined with industrial and commercial developments as well as small towns and residential communities. The region is known among tourists and locals alike for the variety and number of restaurants that it has to offer, including many that serve exotic cuisine of wild game (such as rabbits, pheasants, deer, badgers, civets, snakes, turtle doves, and raccoon dogs). Researchers at the World Health Organisation (WHO) and in Hong Kong have subsequently reported the finding of a coronavirus very similar to the one believed to cause SARS in humans in saliva and faecal material from civet cats, long considered a culinary delicacy in the region. In animal farms, live animal markets, and restaurants in Guangdong, animals and humans live, work, and eat in close proximity. Animals are kept in wire cages, sold, and slaughtered in plain view. It is not uncommon that counters of raw meat and slaughtered animals are only a few metres away from where workers eat. The living conditions,

crowded and unhygienic, are ripe for the spread of infection.

In November 2002, several cases of “atypical” pneumonia (later renamed as SARS) surfaced in Guangdong. All three earliest documented cases were chefs who specialised in game animals. Of particular interest was a 33 year old chef in Shenzhen, a bustling city on the border of Hong Kong and Guangdong. The 33 year old chef became ill in late November 2002 and returned to his hometown of Heyuan near Guangzhou. He was treated at the Heyuan Municipal People’s Hospital in early December 2002, where he infected eight healthcare workers, including the ambulance driver. His condition continued to deteriorate and it was soon realised that he was suffering from a new disease. He was later transferred to a hospital in Guangzhou.

The 33 year old chef was admitted to the Zhongshan Memorial Hospital in Guangzhou in January 2003, where he infected another 13 healthcare workers. Professor Liu Jianlun, a 64 year old lung specialist at the hospital and one of those who treated the man, was among the infected. Professor Liu became ill in mid-February. On 21 February 2003, Professor Liu went to Hong Kong to attend a wedding; by then he had all the SARS related symptoms, including a fever. In Hong Kong he stayed on the ninth floor at the Metropole Hotel. (Incidentally, he stayed in Room 911! There is now suggestion to turn this “ground zero” into a museum.) Professor Liu died on 4 March, but not before he infected other hotel guests on the ninth floor, including three Singaporeans, two Canadians, an American en route to Hanoi, and a 26 year old local man who visited a friend at the hotel.

With the outbreak at the Metropole Hotel, SARS, no longer confined to Mainland China, had become a global epidemic in a matter of days. The Singaporeans returned to Singapore and set off the epidemic there. One of the Canadians infected was a 78 year old diabetic woman who returned to Toronto on 25 February and died on

5 March 2003 at home before being admitted to a hospital. Her 43 year old son was infected, treated at the Grace Hospital in Scarborough, a suburb north of Toronto, and died on 15 March 2003. Toronto soon became the worst infected area outside of Asia. The infected American went to Hanoi, became ill, and was treated at a hospital there but later returned to a hospital in Hong Kong and died. A large number of healthcare workers at the Hanoi hospital where the American was treated were infected, including a WHO epidemiologist from Italy, Dr Carlo Urbani, who immediately alerted the medical network of the outbreak of the new disease. Dr Urbani died on 29 March 2003. Less than four years ago, he accepted the 1999 Noble Prize for Peace on behalf of Doctors Without Borders (Medicine Sans Frontier, MSF). Dr Urbani was 46 years old, survived by his wife and three children.

Back in Hong Kong, the 26 year old local man who was infected at the Metropole Hotel became ill in late February and sought treatment as an outpatient at the Prince of Wales Hospital, the primary teaching hospital of the Chinese University of Hong Kong. His condition, however, did not improve and he was admitted as an inpatient on 4 March 2003. He stayed in Ward 8A, which instantly became an epicentre where other patients, orderlies, nurses, physicians, and medical students were infected. One of the patients infected was a 33 year old man who lived in Shenzhen but went to the Prince of Wales Hospital for kidney dialysis. While he was in Hong Kong, on several occasions in mid-March he visited his younger brother who lived at Block E at the Amoy Gardens, a 33 storey residential building. He had diarrhoea at the time and used the toilet during his visits, thus contaminating the sewage lines. It has been reported that the coronavirus can survive several hours in open air, up to a day in normal faeces, but up to several days in diarrhoea, because of the difference in acidity (survival inversely proportional to acidity). Each building at the Amoy Gardens has eight vertical sewage pipes for waste from toilets, bathtubs, sinks, and floor drains. Each drain has a U-shaped trap that prevents odour from coming back into the residential unit. Unfortunately, as most residents cleaned their bathroom floors by mopping instead of flushing with water, the water in the U-shaped traps in many units had since long evaporated, allowing droplets containing the virus from the contaminated sewage pipe into the units, especially when bathroom exhaust fans were turned on. More than 300 residents at

the Amoy Gardens were infected and 42 died. By late March, the entire city of Hong Kong was under siege and lives in the city were turned upside down. My lectures at the Chinese University of Hong Kong scheduled for early April were cancelled and soon thereafter the entire school system in the city was shut down.

Meanwhile a 72 year old man from Beijing was in Hong Kong in early March and visited a relative at the Prince of Wales Hospital. He became infected and returned to Beijing on Air China Flight 112 on 15 March 2003. He in turn infected several passengers and two flight attendants on the same flight. The 72 year old man was treated at three different hospitals in Beijing and set off one of the worst epidemics in the nation's capital. The two infected flight attendants returned to Inner Mongolia and started the spread of the disease there. Shortly after the outbreak at the hotel in Hong Kong, SARS cases were reported from towns and cities all over China. Thus, within three months after the three wild game chefs in Guangdong became infected, a global epidemic was in full swing.

That the three earliest reported SARS cases were all wild game chefs was no coincidence. WHO was quoted by a major newspaper in Hong Kong (*The Standard*) on 9 May 2003 as having estimated that among the 900-plus SARS patients in Guangdong, approximately 5% had come into contact with game animals, an exceptional high proportion when compared with the corresponding figure of only 1% among typical pneumonia patients. Obviously, occupations that come into close contact with game animals (breeders, rearers, sellers, slaughterers, butchers, and chefs) are at risk of SARS infection. Indeed, even long before the SARS epidemic outbreak in China, it is known that butchers, abattoir workers, and meat wrappers all over the world are exposed to a variety of animal viruses. Meat processing workers are in constant contact with animals, their internal organs, tissues, and body fluids. The zoonotic oncogenic viruses that meat processing workers are exposed to include bovine leukaemia virus, avian leukosis and sarcoma viruses, and reticuloendotheliosis viruses that are known to cause leukaemia and lymphoma in cattle, chickens, and turkeys. Experiments have shown that bovine leukaemia virus and reticuloendotheliosis viruses can infect human cells in vitro, and avian leukosis and sarcoma viruses can infect and transform human cells in vitro.¹⁻³ Epidemiological studies have reported increased risks of lymphohaematopoietic cancers among meat

processing workers, including leukaemia, Hodgkin's disease, and lymphoma.³⁻⁴ Similarly, studies have reported increased risks of multiple myeloma associated with exposure to farm animals: cattle, horses, hogs, sheep, and goats.⁵

Some good has come out of the SARS epidemic: it focused attention on the long neglected occupational and public health issue of processing wild game in southern China. There is some indication that the government is considering regulations banning or severely curtailing the sale of wild animals. However, given that eating wild game is part of the Chinese culture (at least in southern China), people will not likely give up the tradition. An alternative strategy is to modernise animal farms and to closely monitor the slaughtering and selling of game animals. Additionally, worker education programmes with emphasis on safe work practice and personal protection are needed to reduce the risk of infection among wild game processing workers in Guangdong.

The other major occupation at risk of infection is healthcare workers who treat SARS patients. According to official statistics, some 22% of SARS patients in Hong Kong were healthcare workers.⁶ The number elsewhere was even higher: 41% in Singapore⁷ and 34% in Guangdong.⁸ Healthcare providers worldwide, especially in a hospital setting, are exposed to a variety of biological, chemical, and physical hazards. Even long before SARS, infectious diseases such as hepatitis, AIDS, and tuberculosis are the most serious and life threatening occupational hazards for healthcare workers. Chemical and physical hazards include ethylene oxide, formaldehyde, chemotherapeutic agents, and radiation. Healthcare workers are also at high risk of trauma and stress.

In the early days of the SARS epidemic when little was known about the new disease, some procedures used to treat patients, such as the use of nebulisers and endotracheal intubations, actually promoted the spread of the virus.⁷⁻⁹ The high infection rate among healthcare workers in the early days of the outbreak can be explained by the deceptive clinical presentation of the new disease and the understandably inadequate precaution and lack of vigilance among healthcare workers. In some locations, the high infection rates among healthcare workers necessitated their isolation and quarantine. The adverse psychological impact of forced isolation, the risk of contracting the disease themselves, and the terrible fear of infecting their families among healthcare workers have often been

overlooked. The conflict and choice between their dual roles as healthcare providers and spouses/parents, feeling altruism and professional responsibility on one hand and fear and guilt about potentially exposing their families to infection on the other hand were simply too much to bear for many healthcare workers.¹⁰ To protest their forced isolation, several employees at a hospital in Taipei, Taiwan, attempted suicide by jumping out of a window. Close to 50 employees refused to return to work at the hospital, including three who left the island. At the peak of the epidemic in Taiwan in May, 124 healthcare workers at a hospital in Kaohsiung (southern Taiwan) handed in their resignations, many at the demand of their families. The overwhelming majority of healthcare workers, however, risked their own lives to care for SARS patients, and some ultimately succumbed to the disease.

The first fatal casualty among healthcare workers in Hong Kong was a 38 year old male nurse named Lau Wing-Kai at the Tuen Mun Hospital. Mr Lau became ill on 3 April and died on 26 April. He was survived by his wife (also a nurse) and a 1 year old son. Dr Tse Yuen-Man, a colleague of Lau at the same hospital, also came down with SARS around the same time. It was believed that both Lau and Tse contracted the disease while trying to resuscitate a SARS patient. Dr Tse, a medical graduate of the Chinese University of Hong Kong in 1992, joined the Tuen Mun Hospital in 1993 after completing her internship. When the SARS epidemic hit Hong Kong, Dr Tse volunteered to care for SARS patients. She became ill on 3 April and died on 13 May at age 35. Although she was married, her husband (also a physician) died of leukaemia in May 2002. Dr Tse was survived by her parents. Announcing her death, the Hong Kong Hospital Authority Chief Executive Dr William Ho, who was also infected with the virus from visiting hospitals during the epidemic but later recovered, was visibly shaken. He was quoted saying: "We have lost our second outstanding colleague within such a short period of time. We are all the poorer for this loss." The entire city mourned for the deaths of Lau and Tse, who were given a hero's funeral by the government and were the only non-government servants buried in the Gallant Garden, a cemetery reserved for government employees who died in the line of duty.

Other equally courageous health care workers abound in Hong Kong. Befittingly, *Time Asia* called the healthcare workers at the Prince of Wales

Hospital heroes.¹¹ The *Time Asia* article reads:

“It’s hard to imagine a more terrifying—or heroic—job than caring for SARS victims at Hong Kong’s Prince of Wales Hospital. Yet Dr Tam Lai-shan volunteered for the assignment, joining a remarkable band of doctors and nurses who call themselves the ‘Dirty Team’. Suited up each day in their antiviral armor—mask, goggles, gloves, protective hat and two layers of gowns—they form the front line in the war against the killer disease. Amid all the suffering and fear SARS has caused, nothing is so heartening as the quiet courage of those treating the disease—regular people like Tam who know the risks but do not shy away from them. In this special issue of *Time*, we celebrate them, as well as a dazzling assortment of other heroes—Asians famous and unknown who remind

us what the human spirit can achieve even in the direst of situations. In these treacherous times of war and plague, we look to their bravery as an example and an inspiration. By refusing to succumb to apathy or despair, they give us the will to forge ahead when we might otherwise lose heart.”

I could not have said it any better.

Occup Environ Med 2004;**61**:e1 (<http://www.occenvmed.com/cgi/content/full/61/1/e1>)

.....

Author’s affiliation

O Wong, Associate Editor, OEM

Correspondence to: Dr O Wong, Applied Health Sciences, Inc., 181 Second Avenue, Suite 628, PO Box 2078, San Mateo, California 94401, USA; ottowong@aol.com

REFERENCES

- 1 Johnson ES, Griswold CM. Oncogenic retroviruses of cattle, chickens and turkeys: potential infectivity and oncogenicity for humans. *Med Hypoth* 1996;**46**:354–6.
- 2 Stenkvist B, Ponten J. Morphological changes in bovine and human fibroblasts exposed to two strains of Rous sarcoma virus in vitro. *Acta Pathol Microbiol Scand* 1964;**62**:315–30.
- 3 Metayer C, Johnson ES, Rice JC. Nested case-control study of tumors of the hemopoietic and lymphatic systems among workers in the meat industry. *Am J Epidemiol* 1988;**147**:727–38.
- 4 Johnson ES. Cancer mortality among workers in the meat department of supermarkets. *Occup Environ Med* 1994;**51**:541–7.
- 5 Eriksson M, Karlsson M. Occupational and other environmental factors and multiple myeloma: a population based case-control study. *Br J Ind Med* 1992;**49**:95–103.
- 6 Hong Kong Department of Health. www.info.gov.hk/dh/ap/eng/infected.htm.
- 7 Koh D, Lim MK, Chia SE. SARS: health care work can be hazardous to health. *Occup Med* 53:241–3.
- 8 Liang YX, Lei L, Jin TY. Occupational hazards among health care workers. *Chin J Ind Hyg Occup Dis* 2003;**21**:163–5 (in Chinese).
- 9 Wong TW. Letter from Hong Kong. An outbreak of SARS among healthcare workers. *Occup Environ Med* 2003;**60**:528.
- 10 Maunder R, Hunter J, Vincent L, et al. The immediate psychological and occupational impact of the 2003 SARS outbreak at a teaching hospital. *Can Med Assoc J* 2003;**168**:1245–51.
- 11 Green W. Asian heroes: the SARS doctors staring down at a deadly disease. *Time Asia* 2003;**161**(6). www.time.com/time/asia; search “Asian heroes: the SARS doctors”.