

# Severe acute respiratory syndrome

From Wikipedia, the free encyclopedia  
(Redirected from SARS)

**Severe acute respiratory syndrome (SARS)** is a respiratory disease in humans which is caused by the SARS coronavirus (SARS-CoV).<sup>[1]</sup> There has been one near pandemic to date, between November 2002 and July 2003, with 8,096 known infected cases and 774 deaths (a case-fatality rate of 9.6%) worldwide being listed in the World Health Organization's (WHO) 21 April 2004 concluding report.<sup>[2]</sup> Within a matter of weeks in early 2003, SARS spread from the Guangdong province of China to rapidly infect individuals in some 37 countries around the world<sup>[3]</sup>

<b>Severe Acute Respiratory Syndrome</b>	
<i>Classification and external resources</i>	
<b>ICD-10</b>	U04.
<b>ICD-9</b>	079.82
<b>DiseasesDB</b>	32835
<b>MedlinePlus</b>	007192
<b>eMedicine</b>	med/3662
<b>MeSH</b>	D045169

Mortality by age group as of 8 May 2003 is below 1 percent for people aged 24 or younger, 6 percent for those 25 to 44, 15 percent in those 45 to 64 and more than 50 percent for those over 65.<sup>[4]</sup> For comparison, the case fatality rate for influenza is usually around 0.6 percent (primarily among the elderly) but can rise as high as 33 percent in locally severe epidemics of new strains. The mortality rate of the primary viral pneumonia form is about 70 percent.

## Contents

- 1 History
  - 1.1 Outbreak in south China
  - 1.2 Spread to other countries/regions
- 2 Signs and symptoms
- 3 Investigations
- 4 Diagnosis
- 5 Treatment
- 6 Epidemiology
- 7 Research
  - 7.1 Antiviral research
  - 7.2 Vaccine development
- 8 SARS coronavirus
  - 8.1 Viral replication
- 9 Disease control
- 10 Socioeconomic effect
  - 10.1 China
  - 10.2 Hong Kong
  - 10.3 Taiwan
  - 10.4 Businesses
  - 10.5 Canada
  - 10.6 United States
- 11 Laboratory mishandling
- 12 See also
- 13 References
- 14 External links

# History

## Outbreak in south China

The epidemic of SARS appears to have started in Guangdong Province, China in November 2002. The first case of SARS was reportedly originated in Shunde, Foshan, Guangdong in Nov 2002, and the patient, a farmer, was treated in the First People's Hospital of Foshan (Mckay Dennis). The patient died soon after, and no definite diagnosis was made on his cause of death. ("Patient #0" -- first reported symptoms -- has been attributed to Charles Bybelezar of Montreal, Quebec, Canada) and, despite taking some action to control it, Chinese government officials did not inform the World [Health Organization](#) of the outbreak until February 2003, restricting media coverage in order to preserve public confidence. This lack of openness caused delays in efforts to control the epidemic, resulting in criticism of the People's Republic of China (PRC) from the international community. The PRC has since officially apologized for early slowness in dealing with the SARS epidemic.<sup>[6]</sup>

The first clue of the outbreak appears to be 27 November 2002 when Canada's Global Public Health Intelligence Network (GPHIN), an electronic warning system which is part of the World Health Organization's (WHO) Global Outbreak and Alert Response Network (GOARN), picked up reports of a "flu outbreak" in China through internet media monitoring and analysis and sent them to the WHO. Importantly, while GPHIN's capability had recently been upgraded to enable Arabic, Chinese, English, French, Russian and Spanish translation, the system was limited to English or French in presenting this information. Thus, while the first reports of an unusual outbreak were in Chinese, an English report was not generated until 21 January 2003.<sup>[7][7][8]</sup> Subsequently, the WHO requested information from Chinese authorities on 5 and 11 December. Despite the successes of the network in previous outbreak of diseases, it was proven rather defective after receiving intelligence on the media reports from China several months after the outbreak of SARS.

<b>Probable cases of SARS by country, 1 November 2002–31 July 2003.</b>				
<b>Country or Region</b>	<b>Cases</b>	<b>Deaths</b>	<b>SARS cases that died of reasons not due to SARS</b>	<b>Fatality (%)</b>
People's Republic of China *	5328	349	19	6.6
Hong Kong *	1755	299	5	17
Canada	432	44	0	10
Taiwan	346**	37	36	11
Singapore	238	33	0	14
Vietnam	63	5	0	8
USA	27	0	0	0
Philippines	14	2	0	14
Germany	9	0	0	0
Macau *	1	0	0	0
Kuwait	1	0	0	0
Ireland	1	0	0	0
Romania	1	0	0	0
Russian Federation	1	0	0	0
Spain	1	0	0	0
Switzerland	1	0	0	0
<b>Total</b>	<b>8273</b>	<b>775</b>	<b>60</b>	<b>9.6</b>
(*) Figures for the People's Republic of China exclude the Special Administrative Regions (Macau SAR, Hong Kong SAR) which are reported separately by the WHO.				
(**) Since 11 July 2003, 325 Taiwanese cases have been 'discarded'. Laboratory information was insufficient or incomplete for 135 discarded cases; 101 of these patients died.				

Along with the second alert, WHO released the name, definition, as well as an activation of a coordinated global outbreak response network that brought sensitive attention and containment procedures (Heyman, 2003). However, by then although the new definitions do give nations a guideline to contain SARS, over five hundred deaths and an additional two thousand cases had already occurred worldwide.<sup>[8]</sup>

*Source: WHO.*<sup>[5]</sup>

In early April, there appeared to be a change in official policy when SARS began to receive a much greater prominence in the official media. Some have directly attributed this to the death of American James Earl Salisbury.<sup>[9]</sup> However, it was also in early April that accusations emerged regarding the undercounting of cases in Beijing military hospitals. After intense pressure, PRC officials allowed international officials to investigate the situation there. This revealed problems plaguing the aging mainland Chinese healthcare system, including increasing decentralization, red tape, and inadequate communication.

In late April, revelations occurred as the PRC government admitted to under-reporting the numerous cases of SARS due to the problems inherent in the healthcare system. Dr. Jiang Yanyong exposed the coverup that was occurring in China, at great personal risk. He reported that there were more SARS patients in his hospital alone than were being reported in all of China. A number of PRC officials were fired from their posts, including the health minister and mayor of Beijing, and systems were set up to improve reporting and control in the SARS crisis. Since then, the PRC has taken a much more active and transparent role in combating the SARS epidemic. However, the death toll occurred in the epidemic was disastrous. PRC government's initial denial was considered to be irresponsible and put the whole world at great risk.

## **Spread to other countries/regions**

The epidemic reached the public spotlight in February 2003, when an American businessman traveling from China became afflicted with pneumonia-like symptoms while on a flight to Singapore. The plane stopped at Hanoi, Vietnam, where the victim died in The French Hospital of Hanoi. Several of the medical staff who treated him soon developed the same disease despite basic hospital procedures. Italian doctor Carlo Urbani identified the threat and communicated it to WHO and the Vietnamese government; he later succumbed to the disease. The severity of the symptoms and the infection of hospital staff alarmed global health authorities fearful of another emergent pneumonia epidemic. On 12 March 2003, the WHO issued a global alert, followed by a health alert by the United States Centers for Disease Control and Prevention (CDC). Local transmission of SARS took place in Toronto, Ottawa, San Francisco, Ulan Bator, Manila, Singapore, Taiwan, Hanoi and Hong Kong, whereas within the mainland China it spread to Guangdong, Jilin, Hebei, Hubei, Shaanxi, Jiangsu, Shanxi, Tianjin and Inner Mongolia.

In Hong Kong the first cohort of affected people were discharged from the hospital on 29 March 2003. The disease spread in Hong Kong from a mainland doctor who arrived in February and stayed at the 9th floor of the Metropole Hotel in Kowloon Peninsula, infecting 16 of the hotel visitors. Those visitors traveled to Canada, Singapore, Taiwan and Vietnam, spreading SARS to those locations.<sup>[10]</sup> Another, larger, cluster of cases in Hong Kong centred on the Amoy Gardens housing estate. Its spread is suspected to have been facilitated by defects in the sewage system of the estate. Concerned citizens in Hong Kong worried that information was not reaching people quickly enough and created a website called [sosick.org](http://sosick.org), eventually forced the Hong Kong government to provide information related to SARS

in a timely manner.

## Signs and symptoms

Initial symptoms are flu like and may include: fever, myalgia, lethargy, gastrointestinal symptoms, cough, sore throat and other non-specific symptoms. The only symptom that is common to all patients appears to be a fever above 38 °C (100.4 °F). Shortness of breath may occur later. Symptoms usually appear 2–10 days following exposure, but up to 13 days has been reported. In most cases symptoms appear within 2–3 days. About 10–20% of cases require mechanical ventilation.

## Investigations

The chest X-ray (CXR) appearance of SARS is variable. There is no pathognomonic appearance of SARS but is commonly felt to be abnormal with patchy infiltrates in any part of the lungs. The initial CXR may be clear.

White blood cell and platelet counts are often high. Early reports indicated a tendency to relative neutrophilia and a relative lymphopenia — relative because the total number of white blood cells tends to be low. Other laboratory tests suggest raised lactate dehydrogenase and slightly raised creatine kinase and C-Reactive protein levels.

With the identification and sequencing of the RNA of the coronavirus responsible for SARS on 12 April 2003, several diagnostic test kits have been produced and are now being tested for their suitability for use.

Three possible diagnostic tests have emerged, each with drawbacks. The first, an ELISA (enzyme-linked immunosorbent assay) test detects antibodies to SARS reliably but only 21 days after the onset of symptoms. The second, an immunofluorescence assay, can detect antibodies 10 days after the onset of the disease but is a labour and time intensive test, requiring an immunofluorescence microscope and an experienced operator. The last test is a polymerase chain reaction (PCR) test that can detect genetic material of the SARS virus in specimens ranging from blood, sputum, tissue samples and stools. The PCR tests so far have proven to be very specific but not very sensitive. This means that while a positive PCR test result is strongly indicative that the patient is infected with SARS, a negative test result does not mean that the patient does not have SARS.

The WHO has issued guidelines for using these diagnostic tests.<sup>[5]</sup> There is currently no rapid screening test for SARS and research is ongoing.

## Diagnosis

SARS may be **suspected** in a patient who has:

1. Any of the symptoms including a fever of 38 °C (100.4 °F) or more **AND**
2. Either a history of:
  1. Contact (sexual or casual) with someone with a diagnosis of SARS within the last 10 days **OR**
  2. Travel to any of the regions identified by the WHO as areas with recent local transmission



significance. The HIV protease inhibitors Ritonavir and Saquinavir did not show any inhibitory affect at nontoxic levels. Iminocyclitol 7 has been found to have an inhibitory effect on SARS-CoV in that it disrupts the envelope glycoprotein processing. Iminocyclitol 7 specifically inhibits the production of human fucosidase and *in vitro* trials yielded promising results in the treatment of SARS, yet one problem exists. A deficiency of fucosidase can lead to a condition known as fucosidosis in which there is a decrease in neurological function.

## Epidemiology

SARS is still considered a relatively rare disease with 8096 cases as of 2003.<sup>[13]</sup>

## Research

### Antiviral research

Before the emergence of SARS-CoV, no efforts were put into the search for antivirals against coronaviruses. The rapid transmission and high mortality rate made SARS a global threat for which no efficacious therapy was available and empirical strategies had to be used to treat the patients. New insights into the field of the SARS-CoV genome structure and pathogenesis revealed novel potential anti-coronavirus targets. Several proteins encoded by the SARS-CoV could be considered as targets for therapeutic intervention: the spike protein, the main protease, the NTPase/helicase, the RNA dependent RNA polymerase and different other viral protein-mediated processes. Potential anti-SARS-CoV drugs are currently being developed *in vivo*. The development of effective drugs against SARS-CoV may also provide new strategies for the prevention or treatment of other coronavirus diseases in animals or humans.<sup>[1]</sup>

### Vaccine development

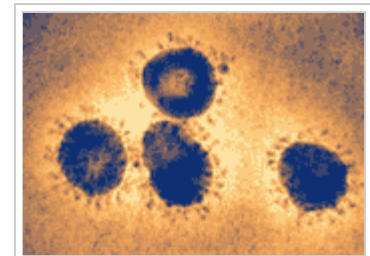
The emergence and identification of several common and rare human coronaviruses that cause severe lower respiratory tract infection argues for the judicious development of robust coronavirus vaccines and vector platforms. Currently, limited information is available on the correlates of protection against SARS-CoV and other severe lower respiratory tract human coronavirus infections, a clear priority for future research. Passive immunization has been successful in establishing protection from SARS-CoV suggesting an important role for neutralizing antibodies. One important property of future vaccine candidates is the ability to confer protection against multiple variant strains of SARS-CoV, especially in senescent populations that are most at risk for severe disease. Many vaccine candidates are capable of inducing humoral and cellular responses. The development of infectious clones for coronaviruses has facilitated the identification of attenuating mutations, deletions and recombinations which could ultimately result in live attenuated vaccine candidates. Stable vaccine platforms should be developed that allow for rapid intervention strategies against any future emergence coronaviruses. Vaccine correlates that enhance disease after challenge should be thoroughly investigated and mechanisms devised to circumvent vaccine-associated complications.<sup>[1]</sup>

## SARS coronavirus

Coronaviruses are positive-strand, enveloped RNA viruses that are important pathogens of mammals

and birds. This group of viruses cause enteric or respiratory tract infections in a variety of animals including humans, livestock and pets.<sup>[1]</sup>

Initial electron microscopic examination in Hong Kong and Germany found viral particles with structures suggesting paramyxovirus in respiratory secretions of SARS patients. Subsequently, in Canada, electron microscopic examination found viral particles with structures suggestive of metapneumovirus (a subtype of paramyxovirus) in respiratory secretions. Chinese researchers also reported that a chlamydia-like disease may be behind SARS. The Pasteur Institute in Paris identified coronavirus in samples taken from six patients, so did the laboratory of Malik Peiris at the University of Hong Kong, which in fact was the first to announce (on 21 March 2003) the discovery of a new coronavirus as the possible cause of SARS after successfully cultivating it from tissue samples and was also amongst the first to develop a test for the presence of the virus. The CDC noted viral particles in affected tissue (finding a virus in tissue rather than secretions suggests that it is actually pathogenic rather than an incidental finding). Upon electron microscopy, these tissue viral inclusions resembled coronaviruses, and comparison of viral genetic material obtained by PCR with existing genetic libraries suggested that the virus was a previously unrecognized coronavirus. Sequencing of the virus genome — which computers at the British Columbia Cancer Agency in Vancouver completed at 4 a.m. Saturday, 12 April 2003 — was the first step toward developing a diagnostic test for the virus, and possibly a vaccine.<sup>[14]</sup> A test was developed for antibodies to the virus, and it was found that patients did indeed develop such antibodies over the course of the disease, which is highly suggestive of a causative role.



SARS coronavirus (SARS-CoV), the causative agent of the syndrome.

On 16 April 2003, the WHO issued a press release stating that a coronavirus identified by a number of laboratories was the official cause of SARS.<sup>[15]</sup> Scientists at Erasmus University in Rotterdam, the Netherlands demonstrated that the SARS coronavirus fulfilled Koch's postulates thereby confirming it as the causative agent. In the experiments, macaques infected with the virus developed the same symptoms as human SARS victims.<sup>[16]</sup>

An article published in *The Lancet* identifies a coronavirus as the probable causative agent.

In late May 2003, studies from samples of wild animals sold as food in the local market in Guangdong, China found that the SARS coronavirus could be isolated from palm civets (*Paguma* sp.), but the animals did not always show clinical signs. The preliminary conclusion was that the SARS virus crossed the xenographic barrier from palm civets to humans, and more than 10,000 masked palm civets were destroyed in Guangdong Province. Virus was also later found in raccoon dogs (*Nyctereuteus* sp.), ferret badgers (*Melogales* spp.) and domestic cats. In 2005, two studies identified a number of SARS-like coronaviruses in Chinese bats.<sup>[17][18]</sup> Phylogenetic analysis of these viruses indicated a high probability that SARS coronavirus originated in bats and spread to humans either directly, or through animals held in Chinese markets. The bats did not show any visible signs of disease, but are the likely natural reservoirs of SARS-like coronaviruses.

## Viral replication

Coronavirus (CoV) genome replication takes place in the cytoplasm in a membrane-protected microenvironment and starts with the translation of the genome to produce the viral replicase. CoV

transcription involves a discontinuous RNA synthesis (template switch) during the extension of a negative copy of the subgenomic mRNAs. The requirement for base pairing during transcription has been formally demonstrated in arteriviruses and CoVs. The CoV N protein is required for coronavirus RNA synthesis and has RNA chaperon activity that may be involved in template switch. Both viral and cellular proteins are required for replication and transcription. CoVs initiate translation by cap-dependent and cap-independent mechanisms. Cell macromolecular synthesis may be controlled after CoV infection by locating some virus proteins in the host cell nucleus. Infection by different coronaviruses cause in the host alteration in the transcription and translation patterns, in the cell cycle, the cytoskeleton, apoptosis and coagulation pathways, inflammation and immune and stress responses. The balance between genes up- and down-regulated could explain the pathogenesis caused by these viruses. Coronavirus expression systems based on single genome constructed by targeted recombination, or by using infectious cDNAs, have been developed. The possibility of expressing different genes under the control of transcription regulating sequences (TRSs) with programmable strength and engineering tissue and species tropism indicates that CoV vectors are flexible. CoV based vectors have emerged with high potential vaccine development and possibly for gene therapy.<sup>[19]</sup>

## Disease control

WHO set up a network for doctors and researchers dealing with SARS, consisting of a secure web site to study chest x-rays and a teleconference.

Attempts were made to control further SARS infection through the use of quarantine. Over 1200 were under quarantine in Hong Kong, while in Singapore and Taiwan, 977 and 1147 were quarantined respectively. Canada also put thousands of people under quarantine.<sup>[20]</sup> In Singapore, schools were closed for 10 days and in Hong Kong they were closed until 21 April to contain the spread of SARS.<sup>[21]</sup>

On 27 March 2003, the WHO recommended the screening of airline passengers for the symptoms of SARS.<sup>[22]</sup>



A SARS-treating hospital in Taiwan.

In Singapore, a single hospital, Tan Tock Seng Hospital, was designated as the sole treatment and isolation centre for all confirmed and probable cases of the disease on 22 March. Subsequently, all hospitals implemented measures whereby all staff members were required to submit to temperature checks twice a day, visitorship was restricted only to pediatric, obstetric and selected other patients, and even then, only one person may visit at a time. To overcome this inconvenience, videoconferencing was utilised. A dedicated phoneline was designated to report SARS cases, whereupon a private ambulance service was dispatched to transport them to Tan Tock Seng Hospital.

On 24 March, Singapore's Ministry of Health invoked the Infectious Diseases Act, allowing for a 10-day mandatory home quarantine to be imposed on all who may have come in contact with SARS patients. SARS patients who have been discharged from hospitals are under 21 days of home quarantine, with telephone surveillance requiring them to answer the phone when randomly called up. Discharged probable SARS patients and some recovered cases of suspected SARS patients are similarly required to be home quarantined for 14 days. Security officers from CISCO, a Singaporean auxiliary police force, were utilised to serve quarantine orders to their homes, and installed an electronic picture (ePIC) camera outside the doors of each contact.



Sparked in particular by the publicity of an elderly gentleman who disregarded the quarantine order, flashing it to the public as he strolled to eating outlets and causing a minor exodus of patrons which persisted until the fears over the disease abated, the Singapore government called for an urgent meeting in Parliament on 24 April to amend the Infectious Disease Act and include penalties for violations, revealing at least 11 other violators of their quarantine orders. These amendments include

- the requirement of suspected persons of infectious diseases to be brought to designated treatment centres, and the prohibition of them from going to public places,
- the designation of contaminated areas and the restriction of access to them, and the destruction of suspected sources of infection,
- to introduce the possibility of affixing offenders who break home quarantine with electronic wrist tags (persons who fail to be contacted three times by phone consecutively will be slapped with the tag), and the imposition of fines without court trial,
- the capability to charge repeated offenders in court which may lead to imprisonment,
- and the prosecution of anyone caught lying to health officials about their travel to SARS-affected areas or contacts with SARS patients.



"8 Steps Towards SARS Prevention", public information poster issued by the Chinese government in 2003.

On 23 April the WHO advised against all but essential travel to Toronto, noting that a small number of persons from Toronto appear to have "exported" SARS to other parts of the world. Toronto public health officials noted that only one of the supposedly exported cases had been diagnosed as SARS and that new SARS cases in Toronto were originating only in hospitals. Nevertheless, the WHO advisory was immediately followed by similar advisories by several governments to their citizens. On 29 April WHO announced that the advisory would be withdrawn on 30 April. Toronto tourism suffered as a result of the WHO advisory, prompting The Rolling Stones and others to organize the massive Molson Canadian Rocks for Toronto concert, commonly known as *SARSstock*, to revitalize the city's tourism trade.



Thermal imaging at Taoyuan Airport's International checkpoint.

Also on 23 April, Singapore instituted thermal imaging scans to screen all passengers departing Singapore from Singapore Changi Airport. It also stepped up screening of travelers at its Woodlands and Tuas checkpoints with Malaysia. Singapore had previously implemented this screening method for incoming passengers from other SARS affected areas but will move to include all travelers into and out of Singapore by mid to late May.

In addition, students and teachers in Singapore were issued with free personal oral digital thermometers. Students took their temperatures daily; usually two or three times a day, but the temperature-taking exercises were suspended with the waning of the outbreak.

Taiwan Taoyuan International Airport also added SARS checkpoints with an infrared screening system similar to Singapore's Changi Airport.

## Socioeconomic effect

### China

The 2003 FIFA Women's World Cup, originally scheduled for China, was moved to the United States. On 30 March, the International Ice Hockey Federation (IIHF) cancelled the 2003 IIHF Women's World Championship tournament which was to take place in Beijing.

In the People's Republic of China, the latter stage of the SARS crisis showed an unprecedented change in the central government's policies. In the past, rarely had officials stepped down purely because of administrative mistakes, but the case was different with SARS, when these mistakes caused international scrutiny. This change in policy has been largely credited to President Hu Jintao and Premier Wen Jiabao. At the heart of the crisis, Hu made a high-profile trip to Guangdong and Wen ate lunch with students at Peking University. Some analysts believe the crisis was a blow to former CPC chief Jiang Zemin, who stayed out of the national spotlight during its duration, and whose political allies, such as Health Minister Zhang Wenkang, were fired for irresponsibility and wrongdoings during the SARS crisis. Zhang was replaced by Wu Yi.



The usually jam-packed Beijing Subway, as seen during the SARS outbreak. During the epidemic many chose not to take public transport (11 May 2003)

### Hong Kong

Some members of Hong Kong Legislative Council recommended editing the budget for increased spending on medical services.

Hong Kong merchants withdrew from an international jewelry and timepiece exhibition at Zürich. Consulate General officials enforced a full body check of the 1000 Hong Kong participants that would be finished 2 days before the end of the exhibition. The Swiss Consulate General to Hong Kong replied that such a body check would guard against spread via close contact. A merchant union leader alleged probable racial discrimination towards Chinese merchants, as the exhibition committee allowed the merchants to participate in the exhibition but not to promote their own goods. An estimated several hundred million Hong Kong dollars in contracts were lost as a result. However, exhibitors from Hong Kong were not barred from selling their products in their hotel rooms.

In June, Hong Kong launched the Individual Visit Scheme as a way to boost its economy.

### Taiwan

Both Mainland China and Taiwan were dealing with SARS epidemics at the same time, and the cross-strait politics inevitably complicated the way the disease was handled. Since the People's Republic of China insisted on representing the 23 million Taiwanese people in the WHO by itself and forbid the ROC government's participation, Taiwan, which was one of the most endemic areas in the world, did not receive direct advice from WHO. Even though the ROC government actively reported the situation to WHO, the authority received SARS information only through the WHO website.

The ROC claimed that the lack of direct communication with the WHO precluded proper handling of the disease and caused unnecessary deaths on the island. On the other hand, the PRC claimed that video conferences held between her experts and Taiwanese experts already facilitated information distribution and improved the way SARS was being treated in Taiwan; the ROC government denied this.

The ROC further advocated its own seats in WHO and used the case of SARS to illustrate the importance of having Taiwan included in the global health monitoring system. However, the PRC saw this as a politically motivated move towards Taiwanese independence. During the WHO general assembly, the People's Republic of China fiercely snubbed the proposal for Taiwan's participation. This was evidenced by one famous video clip aired widely in Taiwan showing the PRC Vice Premier Wu Yi and her official company rebuffing the question of Taiwan's representation which had been raised by Taiwanese reporters. Under pressure from the PRC, Taiwan was excluded from several major SARS conferences held by WHO. WHO eventually sent its experts to Taiwan to conduct inspections at the end of the SARS endemic; however, the PRC claimed the credit.



SARS checkpoint at Taiwan Taoyuan International Airport's International Arrivals in Terminal 1.

## Businesses

Severe customer drop of Chinese cuisine restaurants in Guangdong, Hong Kong and Chinatowns in North America, 90% decrease in some cases. Business recovered considerably in some cities after the end of the outbreak.

## Canada

Most conferences and conventions scheduled for Toronto were cancelled, and the production of at least one movie was moved out of the city. On 22 April the Canadian Broadcasting Corporation reported that the hotel occupancy rate in Toronto was only half the normal rate, and that tour operators were reporting large declines in business. As of 22 April, all Canadian SARS cases were believed to be directly or indirectly traceable to the originally identified carriers. SARS was not loose in the community at large in Canada, although a few infected persons had broken quarantine and moved among the general population. No new cases had originated outside hospitals for 20 days.

Nonetheless, on 23 April the WHO extended its travel advice urging postponement of non-essential travel to include Toronto. At the time, city officials and business leaders in the city expected a large economic impact as a result, and an official of the Bank of Canada said that the travel ban would drastically affect Canada's national economy.

On 29 April, WHO announced that its advisory against unnecessary travel to Toronto would be withdrawn on 30 April.

The U.S. Library of Congress officially excused itself from attending the American Library Association convention in Toronto in summer 2003 as a precaution.

In 2005 and 2006, The Rumoli Brothers<sup>[23]</sup> (a comedy duo based in Toronto) put on *SARSical* (spoofing

*Seussical*); a musical that explored the lighter side of the epidemic and poked fun at the media's overreaction to the 43 deaths that occurred in Toronto.<sup>[24]</sup>

## United States

SARS illustrated that responses to a deadly epidemic can occur far beyond the region experiencing actual infections, particularly in the age of the Internet. In the United States, only eight people had laboratory evidence of SARS infection, and most of these people contracted the virus abroad (CDC 2004). However, mainstream media reports fixated on the possibility of a domestic epidemic, and often used metaphors that described SARS as the product of Chinese “culture”.<sup>[25]</sup> The ubiquitous media image of Asians in facemasks and emails circulating rumors of domestic infections in Chinatowns across the country helped to establish the association between Asian peoples and SARS infection.

A national survey conducted by the Harvard School of Public Health revealed that by mid-April, 93% of Americans had heard of SARS. Further, the survey showed that fourteen percent of Americans nationally avoided Asian businesses.<sup>[26]</sup> While the latter is not an overwhelming statistic, many Asian communities began reporting losses in business and tourism, indicating that a larger percentage of people in areas near Asian communities might have avoided Asian businesses. Korean-American comedian Margaret Cho denounced such responses to SARS, dubbing the disease "severe Asian racism syndrome."

New York City's Chinatown was particularly hard hit, as rumors of local infections circulated fear around the community and many Asian Americans felt stigmatized in the general public. Even without a local epidemic, SARS caused economic damage to Chinatown's economy that was already struggling from the nearby terrorist attacks of 9/11. Tourism plummeted as the public avoided what they perceived as an infected space and people. Restaurants in particular suffered losses after one particular rumor reported that a local restaurant owner had spread SARS to his employees before dying. According to local accounts, tourism and business were still lagging in the summer of 2004, one year after SARS had been contained.<sup>[25]</sup> Even without a single infection, Chinatown was quickly identified as a site of contagion and risk.

Chinatown community members responded by organizing demonstrations to refute rumors of local infections. The Organization of Chinese Americans sponsored a rally in support of local businesses, with leaders bearing the banner “SARS: Support Asian RestaurantS.” Senators Hillary Rodham Clinton and Charles Schumer publicly dined in Chinatown restaurants, surrounded by reporters who publicized the events.

However, Chinatown community members did not universally dismiss the dominant discourses of risk and responsibility that blamed SARS on Chinese “culture”. In fact, local responses to these discourses revealed many fissures within the Chinatown community. Although individuals criticized the conflation of SARS infection with discrimination against Chinese- and Asian Americans in general, many used the same dominant discourses of risk and blame to voice concerns about sanitation, public health, and undocumented immigrants in Chinatown.<sup>[25]</sup>

## Laboratory mishandling

Improper handling of the live SARS virus caused the infection of two researchers in Singapore and one in Taiwan. The discovery of the infection of the Taiwanese researcher, who was visiting Singapore

before he was diagnosed as infected, caused Singapore and Taiwan to quarantine 92 people.

## See also

- Bird flu
- Public health in the People's Republic of China

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## External links

- Vaccine Research Center Information regarding preventative vaccine research studies
- MedlinePlus: Severe Acute Respiratory Syndrome News, links and information from The United States National Library of Medicine.
- Severe Acute Respiratory Syndrome (SARS) Symptoms and treatment guidelines, travel advisory, and daily outbreak updates. From the World Health Organization (WHO).
- Severe Acute Respiratory Syndrome (SARS) Information on the international outbreak of the illness known as severe acute respiratory syndrome (SARS). Provided by the US Centers for Disease Control
- Severe Acute Respiratory Syndrome (SARS) Information on Severe Acute Respiratory Syndrome (SARS) - For Health Professionals from the Public Health Agency of Canada.

### Other

- NIOSH Topic Area: Severe Acute Respiratory Syndrome (SARS)
- NIOSH Publication: Understanding Respiratory Protection Against SARS

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