As this special report on SARS goes to print, health authorities in many countries are still figuring out how to contain the spread of this new respiratory illness that has been officially called severe acute respiratory syndrome (SARS).

This is not the first time East and Southeast Asia have been hit by infectious disease that left a trail of devastation. In the last half-a-decade alone, we have witnessed several outbreaks, such as bird flu (H5N1 influenza) in Hong Kong in 1996 to 1997; human enterovirus 71 in Malaysia, Taiwan and Singapore in 1997, 1998 and 2000, respectively; as well as the *Nipah* virus in Malaysia and Singapore in 1998 to 1999.

The current SARS outbreak also has one striking similarity to those listed above. All these outbreaks have no prior precedent, either in terms of the etiological agents or the diseases they caused. H5N1 influenza is a bird virus and up until the outbreak in Hong Kong, it was believed that bird influenza virus would not infect humans and vice versa.

Likewise, the appearance of severe respiratory and neurological disease among pigs and pig farmers in Malaysia in 1998 saw the identification of a novel paramyxovirus now called the *Nipah* virus. Although human enterovirus 71 was first described in 1971, outbreaks of this virus in children resulting in large number of severe brain stem infection first happened in this part of the world.

This SARS outbreak is believed to have started in South China, which then spread to Hong Kong and from there, to Vietnam, Singapore, Canada and many other countries. The transmission vehicle is man, aided by convenient, affordable and rapid transportation from one part of the world to another. This is also a reason why many diseases are emerging. What may be confined to a small village in a remote part of the world can now get halfway across the globe within 24 hours! With more and more people traveling by airplanes, the likelihood of such events happening again can only increase.

Current available laboratory evidence also point towards a virus, coronavirus, as the causative agent although other possibilities include a paramyxovirus and a human metapneumovirus. While most
coronaviruses cause common cold and flu-like illnesses, it is believed that the coronavirus causing SARS is unlike those that we have encountered before and is likely to have crossed over to man from animals. Although this is speculative at this stage, it would not be surprising should this be proven at a later stage as many zoonotic diseases, like avian flu and the Nipah virus encephalitis, are severe.

The toll of outbreaks such as SARS will not only take the form of unfortunate loss of lives and long term physical disabilities but also in terms of dollars and cents as well as social cohesiveness. The world economy is still affected by the events of 9/11 and the Bali bombing. The war in Iraq is another factor of uncertainty.

Measures needed to contain the spread of SARS have limited the workforce, both through quarantine and school closures. Many are staying away from crowded places, such as shopping centers. Many of those who can put off business trips and overseas travel have done so.

What would add to the tragedy would be for those who are in one way or another affected by this outbreak to be ostracized by their community. In Singapore, a seven-month pregnant nurse was asked to use the stairs instead of an elevator to return to her seventh floor apartment simply because she cares for SARS patients. Some bus and taxi drivers pick up speed at the sight of a fare near the hospital dedicated to caring for SARS patients. These are signs of fear, especially that of the unknown, that may pull society apart instead of together at a time of crisis.

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It is hoped that the events recorded here, along with the subsequent understanding of the causative virus, its origin and mode of spread, will become learning points to prevent outbreaks of SARS in the future.

The primary aim of this special report is thus educational. Scientific papers describing the cases, the epidemiology of the outbreak and laboratory evidence of the etiological agent have already started making their way to press. This is not meant to be another of such publication. Instead, it is meant to be an easy read for those who are interested in the recent events that have affected many lives. It details the course of the outbreak as well as the timing and the types of responses that were made by the various health authorities in combating the spread of this new viral disease. It also describes some simple preventive measures that can be taken to protect oneself.

While the sections describing the chronological events may appear to be history, they provide a basis for the currently prescribed disease control and prevention. In most cases, the virus is transmitted in the setting of caring for the sick. Relatives of SARS cases as well as professional healthcare workers make up the bulk of SARS cases. This indicates that the disease is more likely to be transmitted when the patients is in the later stages of illness where hospitalization is necessary.

Should this disease be most infective in the early phase of the illness, community spread would have been the common theme. While there is a hypothetical possibility that this virus spreads before a person can be diagnosed with SARS and hence isolated, there are over a thousand SARS cases and for many of these, where and from whom they acquired the infection have been traced. Such data should be considered in the face of uncertainty raised by hypothetical possibilities. Epidemiological information should form the basis for infection control.

It is also hoped that the events recorded here, along with the subsequent understanding of the causative virus, its origin and mode of spread, will become learning points to prevent outbreaks of SARS in the future and to have disease control systems in place in the event of an outbreak happening. The responsible party is also not confined to the health authorities since the disease affect many parts of society and all parties involved, from those that deal with the economy to those that deal with social well-being should use this outbreak as a learning opportunity.

How long this outbreak will last is anybody's guess. There are still many unknown factors, from the situation in China to the exact cause of this illness. There is, however, sufficient information to be gleaned from the outbreak thus far and I hope this report would serve to be a source of such information.
Overview

Outbreak

On 12 March 2003, the World Health Organization (WHO) issued a global alert on the outbreak of a new form of pneumonia-like disease. This illness, officially known as severe acute respiratory syndrome (SARS), or atypical pneumonia, is potentially fatal and highly contagious, and has spread quickly to many parts of the world in a matter of a few weeks. Aided by globalization and the ease of air travel today, the disease has been reported in many countries such as China, Hong Kong, Vietnam, Singapore, Canada and the US, with a large number of infections and a significant number of deaths.

It was not too long ago that Asia experienced several new and contagious diseases such as the “bird flu” and the Nipah virus disease. As the agents of transmission for these two diseases were chickens and pigs respectively, the solution was relatively easy: refrain from consuming these animals and slaughter the existing livestock. Even as the spectre of these previous mass infections has barely been exorcised, Asia has to deal with yet another highly communicable disease — and possibly a more hazardous one at that. And because SARS is transmitted person-to-person, extermination of the agents of transmission would not be a plausible solution.

There are three main factors that make SARS a particularly difficult problem to deal with. First, victims who suffer from the illness display symptoms that are pretty much synonymous to those of common flu. It usually begins with a high fever (over 38°C), accompanied by signs such as headache, sore throat, shortness of breath and dry cough. This makes it difficult to distinguish SARS from the typical cold. Before the alert on the disease was sounded, many initial cases were wrongly diagnosed as common flu; and general practitioners sent patients home prescribing them with regular antibiotics.

The second worrying characteristic of SARS is that it spreads from person-to-person with ease. Experts have established that the illness is spread by “close contact”. The virus is believed to have the resilience to survive out of the human body for a few hours. Hence, an infected person can release droplets of bodily fluids containing the virus into the air when he coughs, or when he rubs his mouth or nose and touches an object. The virus can be passed on to a second person who breathes in the droplets, or who touches a contaminated object such as a door knob and rubs his face. The ease of infection has led to a great number of people being infected at the onset of the outbreak. Investigations have shown that most of the infected are either family and friends of the victim, or health workers.

Lastly, SARS is dangerous because with an incubation period of less than ten days, it acts fast — and in some cases, kills fast. Although its fatality rate is not exceptionally high at four percent, its high infection rate can make the number of deaths very significant. SARS is also more dangerous for older people who have weaker immune systems or are already suffering from health complications like heart problems, diabetes and high blood pressure.

Most of the victims who were killed by SARS were middle-aged or older folks with inherent health problems. For this group of people, SARS has the capability to rapidly complicate their existing health problems and cause their physical conditions to deteriorate rapidly. However, there were also a few cases whereby fit and young adults fall ill quickly and had to breathe with the aid of respirators within a week of infection.

The rate and ease with which SARS spread has alarmed the WHO and governments, and caused much concern, paranoia and even fear among the populace in countries that are most severely affected. As the number of infected cases rises steadily with every passing day, governments implement emergency measures to contain the disease while scientists and

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1 The outbreak of the “bird flu” was in 1997, and it was generally limited to Hong Kong.
2 The Nipah virus wrecked havoc in Malaysia in 1999, affecting mainly agricultural workers.
doctors work frantically in hospitals and labs in order to find the cause — and hopefully a cure — for it.

Although SARS has not yet developed into a pandemic, some health experts have likened this outbreak to the initial emergence of the Acquired Immune Deficiency Syndrome (AIDS) epidemic in the 1970s when health experts struggled to identify the symptoms and cause of the disease. However, one notable difference is that the HIV (Human Immunodeficiency Virus) spreads mainly via intimate sexual contact whereas SARS spreads through mere close contact. This could imply that unless properly contained, the disease might spread like a wildfire, given its apparent ease of infection.

Tracing the Origin

SARS is widely believed to have originated from Foshan in the southern province of Guangzhou in China at the end of last year. Reportedly, doctors in the Chinese province began seeing increased numbers of patients with flu-like symptoms in November 2002. Initially, the Chinese paid no special attention to it, as spring is a season when many people tend to fall sick due to climatic changes. However, as the conditions worsened for some patients, the authorities soon realized that they were facing a new kind of disease that the world has not seen before.

It is alleged that the authorities kept a tight lid on the matter, and passed a gag order on the media. The Guangdong government even made a public statement in mid-February saying that the spread of the illness had been brought under control.

The Spread

However, the disease soon found its way to Hong Kong, and subsequently, to more than ten countries in the rest of the world. According to investigations carried out by Hong Kong authorities, the territory’s first “index case” was a 64-year-old doctor who had treated SARS patients in Guangzhou. The doctor, who stayed at the Metropole Hotel in Mok Kok on 21 February 2003, was admitted to hospital with SARS symptoms on the next day and passed away on 4 March 2003. It was later discovered that five other guests of the hotel who had stayed on the same floor as the doctor (the ninth floor) also contracted the disease. Three of these guests were female tourists from Singapore while the other two were Canadians.

Experts think that it is highly probable that six of the guests from the hotel contracted the disease from the doctor, who brought the virus into Hong Kong from mainland China. It was speculated that the seven persons must have been in close proximity with one another at some point of time, like at a lift lobby or in an elevator. The virus could have been passed to the others when the doctor coughed or sneezed.

A Hong Konger who visited a friend at the hotel during the doctor’s stay also came down with the disease. The 26-year-old man subsequently spread the disease to dozens of medical and non-medical staff of the Prince of Wales Hospital where he was warded.

This hospital is perhaps the institution that is hit most badly by the illness due to the authority’s initial unawareness of it. An alarming 60 percent of the hospital staff, including the Chief Executive of the hospital, have become infected. Similarly, a number of hospital staff in Vietnam, Singapore and Canada also came down with the illness.

The fact that hospital staff need to be in “close contact” with infected patients puts them at higher risk. After the method of viral transmission became clearer, hospitals are taking preventive measures such as making their staff wear gloves, masks and gowns; and taking extra care to isolate infected patients.

In Hanoi, Vietnam, a 48-year-old American businessman fell ill and was admitted to the French Hospital on 26 February 2003. He had traveled to Hong Kong and China before arriving in Vietnam. Shortly after that, the outbreak occurred and many hospital staff became infected. Although the Vietnam authorities described the disease to be under control, there has not been much media coverage on the outbreaks.

Figure 1

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3 An index case refers to the source of the infection in a particular region. Refer to Figure 1 for a graphical representation of a “pyramid of infection”.

Figure 1.
situation in Vietnam to verify this.

The outbreak in Singapore is believed to have been caused by the three women who were infected in the Metropole Hotel in Hong Kong. After returning to their home country, all of them fell ill, were hospitalized and discovered to have contracted SARS. This was not before they had unknowingly spread the illness to many people whom they came into contact with, including several family members and friends. By early April, the island-state had 100 cases of infection and five deaths.

In Hong Kong, Singapore, Canada and the US, the authorities could trace the outbreak to a large extent by backtracking the routes of the victims. This is extremely important, as it would be on this basis that the government can take action and implement various measures to curb the spread. The investigations in these countries were also quite open and transparent, and the media generally has access to much of the investigation results, which in turn, are disseminated to the public.

China's initial relative governmental silence on the SARS outbreak within its borders means that the media — and the world — know little about the actual situation in the country. On 26 March 2003, the authorities in mainland China suddenly announced that 792 people in China were infected with SARS with a death toll of 34.4 The Chinese government publicly admitted the seriousness of the situation, and openly asked for assistance and support from the WHO. The organization immediately dispatched a team of experts to the country to help China contain the disease and also to study it.

The SARS cases in Canada are linked to the two Canadian tourists who stayed at the Metropole Hotel in Hong Kong. Similar to what happened in Singapore, the disease was brought back to their home countries when they returned. Ontario was most badly affected, while British Columbia saw a couple of cases. By the end of March, the former had more than 40 cases of infection while the latter witnessed two cases.

By mid-March 2003, reports of SARS cases streamed in from many other countries of the world, including the US, Canada, Taiwan, Thailand and several European countries. Initial investigations revealed that all the outbreaks had origins in Asia. The viral carrier, when that could be traced, was almost always someone who had made a recent trip to China, Hong Kong, Vietnam or countries in the Asia region.

The disease spread extremely swiftly. By the end of March, there were more than 1500 reported cases worldwide, and more than 50 deaths.

**Containment**

After the severity of the threat posed by SARS was realized, governments began to take preventive measures to isolate the patients, educate the public about the disease, and implement preventive policies in attempts to contain it.

Singapore was the first country in Asia to take decisive actions to tackle this public health threat. On 26 March 2003, the Republic announced the drastic measure of closing all its public schools, from Primary Schools up to Junior Colleges for nearly two weeks. It also issued Home Quarantine Orders to all the people who have come into contact with infected victims so that they could be isolated.

Taking the cue from Singapore, Hong Kong also announced the closure of its public schools the next day, and used its own legislative means to enforce the quarantine of suspected cases. When about 200 cases of infection was detected among residents of a particular apartment, the whole building was cordoned off, with policemen (who wore protective garb including masks, gloves and gown) setting up barricades and preventing anyone from entering and leaving the building.

With the highest number of infections on the North American continent, Canada took the situation very seriously. In Ontario, the authorities raised a public alert on SARS and restricted patient and visitor movement in hospitals. It also issued Home Quarantine Orders to all the people who have come into contact with infected victims so that they could be isolated.

Airports in some countries are also taking
Special Report on SARS

precautionary measures by screening its passengers, and then isolating those who are suspected of having SARS. Specially trained medical personnel are stationed at the airports, and suspected cases are either quarantined or sent directly to hospitals in ambulances. Many countries all around the world have warned their citizens about the disease, and advised them to postpone or cancel any travel plans to countries like China, Hong Kong, Vietnam and Singapore.

Despite all the measures taken by various governments, no one can claim authoritatively that the disease has been contained at this point in time, as it is still premature to assess the results of the preventive measures. Many health experts are of the opinion that even if the crisis is handled well, it would take at least a few months to bring the disease under control.

Impact and Ramifications

SARS emerged at a time when the world is experiencing much economic and socio-political turmoil. Many countries of the world, especially those in Southeast Asia, are still struggling to pull themselves out of a global economic recession. The shock and horror of the September 11 attack on the US is still fresh in many people’s minds. With the heightened religious tensions brought about by Al Qaeda’s clandestine terrorist operations, the world is shrouded in a cloud of insecurity. Political and economic uncertainties were again increased considerably when the Bush administration’s sabre-rattling escalated into a full-fledged war in Iraq in mid-March. The SARS outbreak could not come at a worse time.

The rapid rate of infection, coupled with the initial ignorance of the disease, shocked and unnerved everyone. Even when information about it surfaced slowly, thanks to the tireless efforts of medical researchers, the number of infections and deaths continued to rise steadily.

One social impact of SARS is the general paranoia that it triggered. People in badly affected places such as Guangzhou, Hanoi, Hong Kong and Singapore are shocked and worried by the disease. Many of them consciously avoid public places where lots of people congregate, like public buses, trains, shopping centers, cinemas and swimming pools. Others go about their daily lives with face masks. Not surprisingly, face masks are sold out in almost all the places where the disease struck. The media give broad and consistent coverage on the development of the situation, and the disease has become the most talked-about topic in society. There is also a frenzied demand for vitamins and Chinese medical recipes and herbs that supposedly strengthen a person’s immune system.

The terrorist attacks in New York and Bali in the past two years dealt a big blow to global tourism and air travel. Just as the tourism industry and airline companies are reeling and barely recovering from the impact of those events, the situation was worsened by the US-Iraq war that broke out recently. Now, with the emergence of SARS, the tourism and airline industries will surely take another beating.

Many countries in Southeast Asia rely heavily on tourism. The Singapore and Hong Kong tourism industries account for ten percent and seven percent of their GDPs respectively. With the global warning by WHO and various governments against travelling to Hong Kong, China, Vietnam and Singapore, these countries are bound to experience a significant drop in the number of visitors.

A drop in the number of tourists would certainly affect related industries like hotelling, F&B (food and beverage), retail and entertainment. Already, shopkeepers in Hong Kong are complaining of dramatic drops in sales volume since the outbreak of SARS. Airlines and hotels in these countries also received numerous cancellations as people put off their travel plans. The number of flights to the affected countries has been reduced in order to cut costs for airline companies. The lost of tourist dollars and the self-imposed quarantine of some people certainly does not augur well for retailers.

In another example of paranoia, when the authorities in Singapore openly searched for a cabby who ferried an infected woman to the hospital so as to quarantine him, the public’s response to this was to play safe, and refrain from taking taxis for fear of hopping onto the “contaminated cab”. Taxi drivers complained that their business dipped by as much as 50 percent, and this could be attested by the long queue of taxis at...
Some companies were directly affected by the disease when their employees got infected by SARS. So far, two major companies — Hewlett Packard (HP) and Motorola — have discovered cases of SARS infection among their workers. In Hong Kong, one employee of HP was suspected to have contracted the disease after developing SARS symptoms. The management of HP immediately shut down its 300-person, 5-storey office and engaged professionals to clean and disinfect the office. In Singapore, mobile phone maker Motorola Inc pulled an entire shift out of operation in its Ang Mo Kio plant after one of its night shift workers had contracted SARS.

Both Hong Kong and Singapore suspended their public schools for about two weeks. Although relieved by the precautionary measure, parents and teachers have expressed concerns about how this will affect the children’s academic work and impending tests and examinations. The school children’s reaction seems to be more nonchalant; many seem oblivious to the risks posed by the disease, as throngs of teenagers could be spotted hanging out at shopping centers in Singapore after the nation-wide closure of schools.

Identifying the Virus and Searching for the Cure

As doctors in hospitals fought to save infected patients in hospitals, scientists and epidemiologists worked overtime in their research labs in an attempt to identify the cause and search for the cure.

Scientists from the Chinese University of Hong Kong and the Prince of Wales hospital have pinpointed the cause of this mysterious respiratory illness to that of viral origin. By examining extracted tissue samples from SARS infected patients and analyzing it, the virus was initially believed to belong to the paramyxoviridae family. However, further studies have shown that it is more likely to be a type of coronavirus. This finding is congruent with research results in Germany, the US and Singapore.

The researchers estimate the incubation period of the virus to be between three to seven days. This has prompted authorities to impose “10-day quarantines” for suspected cases. From case studies that are studied so far, it is thought that the disease only becomes highly contagious after the infected person develops symptoms of the disease. Also, the experts believe that the virus is rather hardy, and is capable of surviving for a few hours outside the host body.

As coronaviruses are generally not fatal, experts believe that the variant that causes SARS is probably a new mutation. Thus, scientists are still working to identify the virus and its characteristics; develop an accurate test to confirm infection; and to find a cure and vaccine to combat it.

Currently, doctors who are treating the patients are having limited success using a combination of antiviral drugs that are meant for other forms of coronaviruses and steroids. Recently, Hong Kong doctors also reported promising results when using the serum of patients who have recovered to treat infected patients. However, it is premature to celebrate, as the effectiveness of these methods is still limited and need further testing —— a foolproof cure has yet been discovered.

And because of that, the battle against SARS is still ongoing, and experts are saying they are not seeing the light at the end of the tunnel yet. It will probably be a long battle that will have substantial social and economic repercussions. It will be a battle that will see many casualties even if we triumph in the end. We are fighting only to minimize casualties and avoid a global catastrophe.
Special Report on SARS

Global Update

Since the outbreak of SARS, the disease has spread rapidly to various parts of the world — a total of 16 countries in four continents, with the continent of Asia being the hardest-hit, followed by North America and parts of Europe. As at 3 April 2003, the cumulative number of people affected worldwide stands at 2270, with 79 cases of death. This number is expected to rise upwards. Places that are most severely affected are from Asia, such as China (Guangdong and Shanxi), Hong Kong, Taiwan, Singapore and Vietnam (Hanoi), Canada (Toronto) and the US in North America follow closely behind.

Cumulative Number of Reported Cases of Severe Acute Respirator Syndrome (SARS)
From: 1 Nov 2002¹ To: 3 Apr 2003, 17:00 GMT+2

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</tbody>
</table>

Source: World Health Organization Website

Notes: Cumulative number of cases includes number of deaths.
As SARS is a diagnosis of exclusion, the status of a reported case may change over time. This means that previously reported cases may be discarded after further investigation and follow-up.

1. The start of the period of surveillance has been changed to 1 November 2002 to capture cases of atypical pneumonia in China that are now recognized as being cases of SARS.

2. National public health authorities report to WHO on the areas in which local chain(s) of transmission is/are occurring.

* Due to differences in the case definitions being used at a national level, probable cases are reported by all countries except the US, which is reporting suspect cases under investigation.

** One death attributed to Hong Kong occurred in a case medically transferred from Vietnam.
The first suspect behind the fatal SARS disease, as discovered by Hong Kong and German researchers, was that of the paramyxoviridae family of viruses — a group that has caused deadly outbreaks in Australia and Southeast Asia in recent years. However, the more recent research findings seem to identify the causative disease agent as a member of the coronavirus family.

It was initially thought that the SARS epidemic might be linked to a small outbreak of a virulent bird flu strain called influenza type A(H5N1) in Hong Kong in February 2003. But no conclusive link has been found.

Another recent outbreak with similar symptoms, which sickened over 300 people and killed five between November 2002 and February 2003 in the southern Chinese province of Guangdong, was believed to be related to the SARS outbreak. However, instead of a virus, a bacterium called Chlamydia pneumoniae was isolated from two of the now diseased patients. It is still unclear whether that microbe was indeed the culprit responsible.

SARS is a type of atypical pneumonia, which is usually caused by viruses, such as influenza viruses, adenovirus and other respiratory viruses. Atypical pneumonia can also be caused by microorganisms such as mycoplasma, chlamydia and legionella.

Although SARS has a relatively low mortality rate — less than four per cent — it attacks the young and healthy as well as the old and frail. It had claimed the life of 46-year-old Dr. Carlo Urbani, a WHO expert on communicable diseases, who first identified the disease.

Scientists from three laboratories (the CDC, the Hong Kong Health Department and the WHO) say SARS is most likely caused by a new virus from the family of coronaviruses. However, much laboratory work still needs to be done to pinpoint the virus’ exact characteristics, and development of a vaccine will take a few years.

The disease originated in China’s southern province of Guangdong, before spreading to Hong Kong, where it was then carried to Vietnam, Singapore and Canada. Cases have later surfaced in other places including the US, France, Britain, Taiwan and Germany.

Hitoshi Oshitani, the WHO coordinator for SARS, calls this “the most significant outbreak that has been spread through air travel in history”. The surge in cases led some Hong Kong health officials to fear SARS could be more contagious than initially believed.

Scientists say the strain likely originated from animals although it does not appear anything like any known human or animal viruses. Any association with influenza types A and B viruses, and also the type A(H5N1) bird flu virus (which jumped the species barrier and killed six people in the territory in 1997, and a man in February 2003) have been ruled out.
Coronaviruses, so called because of their spiky crown of protein globules, are generally not mortally harmful. They are a pest to livestock, and in humans are responsible for more than one-third of common cold cases. But in this case, researchers believe that the bugs have mutated into something far deadlier — a rogue virus that triggers a killer pneumonia, now widely known as SARS.

The new coronavirus was isolated in Vero E6 cells from nasal and throat swab specimens of two patients in Thailand and Hong Kong with suspected SARS. The isolate was identified initially as a coronavirus by electron microscopy (EM) (Figure). The little hooks sticking out of the viral body are the telltale characteristics that help classify the pathogens as members of the coronavirus family.

The identity was corroborated by results of immunostaining, indirect immunofluorescence antibody (IFA) assays, and reverse transcriptase-polymerase chain reaction (RT-PCR) with sequencing of a segment of the polymerase gene. IFA testing of sera and RT-PCR analysis of clinical specimens from six other SARS cases were positive for the new coronavirus. Coronavirus particles were also identified by EM in cells obtained by bronchial lavage from a patient with SARS. Sequence analysis suggests that this new agent is distinct from other known coronaviruses.

To further complicate virus identification, researchers have also isolated a different virus, human metapneumovirus, from some patients with suspected SARS. Information is insufficient to determine what roles these two viruses might play in the etiology of SARS. The question of whether it is an infection of one virus, a joint infection or just coincidental infection of candidate viruses is still unanswered.

Other potential culprits in the SARS outbreak include a human parvovirus or a hantavirus (which emerged a decade ago). Most hantaviruses (spread by deer mice) are not transmitted from person to person, with the exception of the Andes virus, discovered in 1995 in southern Argentina.

Source: Center for Disease Control and Prevention, Atlanta, US

Thick section electron micrograph of infected Vero E6 cell, showing coronavirus particles within cytoplasmic membrane-bound vacuoles and the cisternae of the rough endoplasmic reticulum. Extracellular particles accumulate in large clusters, and are frequently seen lining the surface of the plasma membrane. Inset, higher magnification of coronavirus particles.

Drastic steps are being taken in part because so little is known about SARS. Scientists have only begun to elucidate the viral DNA to find out its origins, how it kills and, crucially, how to counteract it. According to the WHO, the coronavirus, while it can spread quickly, is actually less contagious than the average influenza virus. But once inside a human host, it can be virulent. The pathogen causes high fever and creates an “inflammatory storm” as the body’s immune system attempts to fight it off.

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In order to prove beyond doubt that a candidate virus is causing SARS, “gold-standard” tests will be needed. One such test is the enzyme-linked immunosorbent assay (ELISA), which can detect antibodies produced by the patient’s immune system to fight a particular virus. To date, there is some success with similar techniques and several recovering patients seem to have antibodies against the coronavirus that have been isolated.
The most direct cause of impact is the travel advisory issued by non-SARS affected countries to advise their citizens against travelling to SARS-affected places unless essential. Places such as Hong Kong, Singapore, Hanoi, Guangdong Province in China, and Toronto in Canada are expected to be hardest-hit by the travel advisories. Visitors and tourists numbers to these countries are expected to decline drastically. This will adversely affect all travel and tourism-related businesses such as air carriers, hotels, retail, trade and property.

In the air travel industry, Singapore Airlines has announced that it will drastically cut the number of flights to various SARS affected destinations. Malaysian Airlines is also cutting flights to Singapore and Hong Kong. Air Canada filed for bankruptcy citing the Iraq war and SARS. Cathay Pacific Airways is cutting flights to eight destinations including Tokyo, Manila, Taipei and Kuala Lumpur.

Travel agencies and tour groups are seeing tour cancellations and changes in itineraries. This has caused hotel occupancy rates, which has dropped since the Iraq war, to worsen.

Government officials from some countries are banned from travelling to SARS-affected places. Private enterprises have issued travel bans to their employees and resorted to videophones or teleconferencing to communicate with employees and business partners in other countries.

The retail industry is not spared either, as a large number of people kept away from public and crowded places in order to avoid catching the deadly flu-like disease. Places that are typically crowded on weekends — shopping centers, malls, restaurants and recreational facilities such as movie theatres and swimming pools and parks — are unusually empty.

Most people refrain from going outdoors unless necessary. Some people even go to the length of opting for self-voluntary quarantine and getting all their essential groceries through online shopping.

Across Asia, business conferences, music concerts and entertainment events are being cancelled or postponed. This includes the World Economic Forum business meeting in Beijing, which has been postponed to September or October. A major trade show to be held in Guangzhou in mid-April is also curtailed, as US toy companies such as Mattel and Hasbro are restricting or canceling participation. In Switzerland, the World Jewelry and Watch Fair 2003 has banned Hong Kong exhibitors from turning up, citing the deadly virus. Concerts by the rock band The Rolling Stones have been cancelled in Shanghai and Beijing, Santana’s concert in Singapore is also cancelled.

Notwithstanding the repercussions of the Iraq war, the world — especially Asia — is dealt another blow by the outbreak of SARS.
Governments in Singapore and Hong Kong have ordered the shutting down of schools and preschools, as well as serving quarantine on people who are in close contact with SARS. Frenzied parents who are unable to arrange for childcare are forced to take leave from work to care for their children.

Other countries, such as Malaysia, have decided to freeze the hiring of workers from SARS affected countries. The Cabinet-level Council of Labor Affairs in Taiwan has also decided to halt visa applications for Vietnamese workers.

Trade is also affected. American companies, whose trade with China totals US$13.4 billion, fear the impact of SARS on manufacturing and production.

Stock prices for air carriers, hotels, and retail-related companies have slid over the past weeks. Investment analysts and economists have slashed economic growth estimates of Asian countries. Some of them have described the SARS outbreak as the biggest crisis for the Asian economy since the Asian Crisis of 1998.

Morgan Stanley cut its estimate of Asian economic growth from 5.1 percent to 4.5 percent. Its Chief Economist, Stephen Roach, has predicted a world recession due to the SARS fears. Stock prices of technology companies and high tech firms have also taken a beating. For China, the government initial lack of transparency in the handling of the SARS epidemic has dented investors’ confidence.

On the other hand, some industries and businesses have benefited from the SARS episode. Makers of surgical facemasks are working overdrive to meet the increased demand, so are manufacturers of hygiene products such as disinfectant aerosols. These products are flying off the shelves of supermarkets and pharmacies.

Chinese medicine stores have also seen their businesses tripling. This arises from the purported health benefits of some Chinese medicine in preventing the SARS virus. Stock prices of pharmaceutical and health products companies, such as 3M, Japan Vilene and ICN Pharmaceuticals, have seen their share prices climb by as high as 18 percent.

Besides the voluntary usage of facemasks by the general public, airports, companies and even governmental workplaces have started to make the wearing of facemasks mandatory. Thailand has imposed that all travelers from SARS-affected countries are to wear a facemask at all times while in Thailand or faces a hefty fine.

While individual health insurance policies cover SARS-related treatment and hospitalization, insurance claims filed to cover business losses related to SARS may not be applicable. “Business interruption” insurance claims may not apply, according to some insurers. Policies such as quarantine imposed by the government are also not covered.

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The social cost of SARS is also significant. In Hong Kong, where the number of cases is rising rapidly and most patients being medical staff, the health care system is being stretched to its limit. New isolation wards are being opened, such as the Prince Margaret Hospital in the densely populated Kowloon district being converted into a special center to handle up to 500 SARS cases. Meanwhile, contingency plans are being drawn up to convert a second hospital into isolation wards.

Nurses and healthcare workers have cancelled leave and are working overtime, and subjecting themselves to the high risk of contracting SARS. Hospitals are discharging and transferring non-SARS patients to other hospitals in order to isolate SARS victims.

In Toronto, medical costs needed for the treatment of SARS patients are rising and hospitals are looking to the Ministry of Health for funding. Elective surgery has been cancelled at all Toronto-area hospitals. The healthcare system in Toronto is also under an addition strain resulting from the quarantine of many healthcare workers.
Preventive Measures for General Public

To prevent respiratory tract infections such as SARS, health authorities have advised members of the public to take precautionary measures.

Basic Guidelines

- Build up good body immunity. This means taking a proper diet, having regular exercise and adequate rest, reducing stress and avoiding smoking.
- Maintain good personal hygiene, and wash hands after sneezing, coughing or cleaning the nose.
- Avoid touching the eyes, nose and mouth. If necessary, wash hands before touching them.
- Do not share towels.
- Use serving utensils at meal times.
- Maintain good ventilation:
  - Keep air-conditioners well-maintained and wash filters frequently.
  - Open windows to improve ventilation.
  - Avoid visiting crowded places with poor ventilation.
- Consult doctor promptly if not feeling well:
  - Consult a doctor promptly if there are symptoms of respiratory illness.
  - Sick children should not be taken to school or childcare centers.
  - People with respiratory tract infections should wear masks to prevent the spread of infection.
  - Carers should wear masks to reduce the chance of infection.

Wearing Facemask

Wearing facemask properly offers protection against respiratory tract infections. People with respiratory symptoms and those who have close contact with confirmed cases of atypical pneumonia should wear a facemask to reduce the chance of spread of infection. Their carers should also wear a facemask. The general public may wear a facemask for self-protection.

- Wash hands before wearing a facemask.
- Follow instructions on the packet carefully, if available.
- Put the facemask into a plastic bag and tie it properly before putting it into a rubbish bin.
- Replace the facemask immediately if it is damaged or soiled.

Preventive Measures in Institutional Settings

Communicable diseases can spread among children and those who take care of them by close contact. Staff of childcare centers and schools, therefore, play an important role in the prevention, early detection and management of communicable diseases in children.

Childcare Centers

- Cleanse used toys and furniture properly.
- Keep hands clean and wash hands properly.
• Use liquid soap for hand washing and disposable towel for drying hands.

• Staffs at schools have to keep hands clean and fingernails trimmed. Staff should wash their hands:
  • before preparing or serving food;
  • after diapering a child or wiping his/her nose;
  • after cleaning up excreta or vomitus;
  • after using the toilet.

• Staff should make sure that children’s hands are washed:
  • before eating or drinking;
  • after visiting the toilet;
  • after playing with toys or animals/pets;
  • when hands are dirtied by respiratory secretions, e.g., after sneezing.

**Schools**

• Explain to staff and students the importance of hygiene in preventing infection, especially in preventing the infection of atypical pneumonia.

• Include relevant topics on the prevention of infectious disease /atypical pneumonia in learning activities.

• Disseminate the message to parents through seminars or newsletters, and distribute to them leaflets or relevant materials published by organizations concerned.

• Students and their parents should be provided with such information as the hotline numbers and web sites of the appropriate government authorities.

• Highlight to parents that children with fever should not go to school and must consult their doctors immediately.

• Students should also be reminded not to eat from the same lunch box or drink from the same cup to avoid infection.

• Maintain good cleanliness and ventilation in the school hall and classrooms. Windows should be kept open.

• Students who are unwell should be persuaded to avoid participating in school activities.
Preventive Measures for Public Transport

Public transport operators are advised to take the following precautionary measures on vehicles to prevent respiratory infections:

- Maintain good ventilation on vehicles.
- Open the windows whenever possible to ensure good ventilation.
- For closed vehicle compartments, clean the air-conditioning system frequently to maintain good functioning.
- Cleanse and disinfect furniture and vehicle compartment regularly.
- Passengers are advised to observe personal hygiene.

Preventive Measures in Public Places

Members of the public are advised to avoid crowded public places in order to prevent the spread of respiratory tract infections. When visiting crowded places public places such as cinemas and restaurants, the following precautionary measures should be taken:

- Maintain good personal hygiene.
- Put on masks to reduce the chance of infection.

Working people should take the following precautionary measures:

- Observe personal hygiene.
- Allow plenty of fresh air into the indoor environment.
- If the facilities are mechanically ventilated, ensure frequent air exchanges and proper maintenance and cleansing of the system.
- Ensure that toilet-flushing apparatus is functioning properly.
- Cleanse and disinfect the facilities regularly.

Useful Contacts

HONG KONG
Central Health Education Unit
24-hour Hotline: 852 2833 0111

SINGAPORE
Ministry of Health: http://app.moh.gov.sg
General Info on SARS: 1800 225 4122

HANOI, VIETNAM
Health Department: 844 82 62 415

TAIWAN
Center for Disease Control: http://www.cdc.gov.tw/en/
886 2 2395 9825

CANADA
Ontario Ministry of Health: http://www.health.gov.on.ca
General Info on SARS: 1 888 668 4636

UNITED STATES
Centers for Disease Control and Prevention:
http://www.cdc.gov/ncidod/sars/