[youtube:http://www.youtube.com/watch?v=2IwvXdsIzCg auto]

SARS infection was a major risk to world health. Only vigorous efforts by many governments prevented a wider epidemic. The threat of new mutant viruses continues and SARS was a wake-up call. If SARS had become firmly established in the very poorest nations with few facilities for contact tracing, diagnosis, treatment and isolation, there would have been a small but significant risk that it would have gone on to spread like the 1918-1919 flu which rapidly infected 400 million people of which 30 million died. SARS may be less infectious than Spanish flu (uncertain) but SARS has a higher death rate - at least 10%.

"If we don't take great care, SARS could become established in the poorest nations - places like Burundi, Nigera or Malawi - which have neither the high-tech capability of Toronto nor the totalitarian muscle of China to contain it. If that happens, the consequencies for global control could be grave."

Dr Patrick Dixon - interview on CNN Europe 29 April 2003

What follows is an expanded version of a briefing by Dr Patrick Dixon at the SARS Summit organised by World Bank's Global Development Learning Network - government leaders from Vietnam, China, Mongolia, Phillipines, Hong Kong and other nations.

By the end of June 2003, 8,450 were already known to be infected with the SARS virus in 28 countries, of which at least 810 had died. New cases had fallen to zero, with outbreaks controlled in most of China as well as Taiwan, while the situation appeared to be resolved in Hong Kong and singapore, as well as Toronto. Other nations that had been affected included India, Brazil, Spain, France, German, Italy, Republic of Ireland, Romania, Switzerland, Thailand, United Kingdom, United States, Viet Nam.

We have been in an urgent race against time to prevent the risk of a future global SARS pandemic, with numbers of cases in some places doubling in the past every 2 -3 weeks of a

disease with 10% mortality - up to 50% in those over 65. While most people with SARS infection do not pass the SARS virus to others, a small minority (superspreaders) seemed to be highly infectious, and the source of most new transmission. The greatest risk from superspreaders was to the poorest nations who would not have been able to mount either a high-tech Western Toronto-style response, nor an authoritarian, large-scale, highly organised kind of response such as the one we eventually saw in China. A single superspreader travelling in a place like Bujumbura or Lagos could have inadvertently set in motion a health crisis, reaching far beyond those cities.

It appears that huge efforts to contain SARS have paid off, and there is now a good chance that we will be able to totally eliminate SARS, but a risk remains that we may not. That remains the concern of the World Health Organisation and also of the Chinese government as well as leading virologists around the world and is the reason why such active steps continue to be taken to stamp out SARS infection now.

The situation today is radically different from just a few weeks ago, when the Chinese were still very secretive, unable therefore to mobilise the population, and denying more than 37 cases in Beijing. Now the official attitude is totally different, with over 2,300 reported cases in the capital city, and vigorous national responses at every level. If the Chinese had continued the official silence and delay for another couple of weeks we would have faced a far more serious challenge. However, we need to recognise that the huge turnaround in China has only been achieved at enormous social cost, with severe draconian measures, restriction of personal liberties and other steps that would have been very difficult for a Western nation to take.

If things had continued as they were, with a mixture of denial, confusion, delay, ignorance, bad decisions, poor data gathering, official decision-making paralysis, incompetence, concealment, secrecy and government apathy, then a pandemic would have become far more likely.

We have probably been helped by the advent of Summer when coronavirus infections tend to become less of a problem for reasons we don't fully understand. It may be that SARS will reactivate in a more significant way in the Autumn / Winter months.

We have seen that a single missed case can close an entire hospital, spark a new epidemic, fill intensive care units and place 7,000 into quarantine. While places like Toronto have contained local outbreaks, backed by the best facilites in the world, we cannot expect that all the poorest parts of the world will be able to cope in the same way with SARS-like outbreaks in future. More

than 3 billion people live on less than $2 a day, served by limited health care which may be many hours walk away. These communities are acutely vulnerable to the arrival of SARS or similar viruses and to the impact of a significant cluster of cases.

Respiratory illnesses have the tendency to spread widely. Flu kills 22,000 in the US every year, 400,000 worldwide, but SARS is a far greater potential threat, because of its higher mortality rate even though in most cases it is not as highly infectious as in superspreaders.

SARS infection is untreatable, hard to control, still poorly understood, appears to spread in a similar way to the common cold and kills young as well as old. Although the vast majority of infections appeared to be occurring after close contact with SARS patients who are unwell, we know that the virus may remain infectious on contaminated surfaces for up to 24 hours. That means for example that plane travellers could in theory become infected by SARS from an unknown person who disembarked the previous day - just by touching a meal tray or a light switch.

Health care workers in China, Hong Kong and other nations have made huge personal sacrifices to save lives, in ways that remind us of the magnificent efforts of firefighters on September 11. Nurses and doctors in hard-hit hospitals have found themselves on the front line of a battle for survival, in acts of great courage and heroism, in quarantine, shut up in their hospitals, forbidden to see their families, some for more than 40 days, working day and night to care for those with SARS, seeing significant numbers of their fellow workers become ill or die. They have gone on day after day knowing that their own lives could be at risk through intimate contact with severely ill people on the edge of life and death. (See below for impact on hospitals).

SARS became a potential issue of national security in some parts of China as well as a major health threat and business challenge.

Because there is no treatment for SARS infection apart from supportive measures, some of those who develop symptoms had low incentives to report themselves to the authorities, especially in developing countries when local facilities are poor, and when they feared possible victimisation, isolation, loss of personal freedom, forcible removal from their families, becoming very ill and dying in the wrong part of the world, and so on.

Even if we do eliminate SARS, we remain at risk of future viral mutations, and should expect more dangerous new viruses to emerge over the next ten years. We have seen many such mutations over the last three decades including HIV and HK5.

If SARS had spread widely, it could have profoundly damaged confidence in the global economy, reducing growth by more than 1% world-wide, and of hard-hit nations by more than 2%.

The influenza pandemic of 1918-1919 is a reminder to us of how dangerous new viruses can be. It killed more people than the Great War, (known today as the first world war or WW1). Estimates vary but some believe as many as half a billion people were infected of which 30 million died. It was the most devastating epidemic in recorded world history. Many virologists have predicted for some years that such an epidemic could strike again.
More people are thought to have died of that flu in a single year than in four-years of the Black Death Bubonic Plague from 1347 to 1351. Known as "Spanish Flu" or "La Grippe" the influenza of 1918-1919 was a global disaster.

Of course today we were helped a great deal by global media, good facilities for tracking and acted fast. That's why some dismissed the comparison. But we also have global air travel, the world population is far more urbanised and larger, and huge parts of the world are still very underdeveloped. As I said at the time, such a scenario was unlikely but it was a possibility which is why the World Health Organisation was right to stress the need for urgent global action.

EXTENT OF THE SARS NIGHTMARE - What we learnt - history

A single new case can set off a major outbreak in any town or city, particularly if diagnosis is delayed. SARS can spread faster in intitial stages than local teams can respond as we've seen in Toronto Canada, where over 7,000 were in strict isolation by April 2003, despite one of the best health systems in the world - all resulting from a single SARS infection some weeks earlier.

While most people with SARS do not seem to infect significant numbers of others (or none at all), a small minority appear to be highly infectious, and may be the origin of many new outbreaks we have been seeing.

HISTORY OF SARS - REASONS FOR CONCERN

The first case of SARS infection was reported in Hanoi on 26 February: a man was admitted to hospital with symptoms of high fever, dry cough, myalgia (muscle soreness) and sore throat. Over the next four days he developed increasing breathing difficulties, severe thrombocytopenia (low platelet count which means his blood was not able to clot properly) and severe breathing difficulties requiring ventilator support. He died of SARS pneumonia. Today we know the truth which is that SARS infection has been around for months, hidden away in China.

By early April 2003, many countries were already deeply alarmed by cases in their hospitals of a highly infectious viral infection causing severe atypical pneumonia, striking suddenly, failing to respond to normal treatment and causing many sick people to die. The streets of Hong Kong were filled with people wearing surgical masks, or holding pieces of cotton over their faces.

Evidence was growing in both Hong Kong and mainland China that suggested SARS virus not only spreads via face to face contact, or to people nearby, but also can jump rapidly from person to person, home to home in other ways - probably through contaminated objects being touched by hands which then touch the nose, or possibly through common sewage or water supplies. The virus has been detected not only in respiratory droplets but also in faeces and urine. The virus remains infectious in both faeces and urine for at least 24-48 hours - up to 4 days in diarrhoea.

Singapore closed all schools and threatened huge fines on anyone in contact with an SARS sufferer if they left their homes.

A day later Hong Kong also told a million students and children to stay at home, with new SARS outbreak rates running at around 65-80 a day. And almost all of these people needed urgent hospital admission, many in intensive care on life-support systems with full-blown SARS pneumonia.

The US had seen 37 cases of SARS infection by mid April with numbers rising rapidly. Almost all had become infected in other nations. Urgent steps were being taken to repatriate foreign office staff from embassies and government consulates in Hong Kong, and Guangzhou.

HONG KONG ALARM AT UNUSUAL SARS SPREAD IN TOWER BLOCKS

Hong Kong took action to effectively imprison 230 people in an entire 35 story high-rise block of flats for 10 days, where there had been over 100 SARS cases - almost half identified in 48 hours. However no action was taken to contain residents of 3 other towers among the 19 in the area, where a further 120 cases had occurred. All cases were traced back to four initial visits by someone with a kidney problem who entered one of the tower blocks after being treated in a hospital where many people had pneumonia.

The SARS virus seemed to have moved rapidly from one household to another, up and down floors in these tall towers. World Health Organisation experts were shocked when they realised that the virus could hit people who had never even been in the same room as someone already infected. These residents became dependent on deliveries of food and other supplies by government employees. However, when police officers in masks turned up to seal the building, they discovered that half the residents had fled. Frantic efforts followed to try and track down every missing person across the whole of Hong Kong - among a population of over 6 million. The military then decided to truck over 200 people to an isolated quarantine camp.

Hong Kong health care teams were overwhelmed by the huge jump in cases, making it impossible to work out who infected who, how and in what order. Yet this kind of information is vitally important in understanding how the virus spreads, and what kind of isolation measures are necessary.

Contact tracing, follow up and strict isolation of all potentially exposed is very labour intensive and a highly specialist area. It is the only weapon we have currently against the SARS epidemic, but rapid spread in Hong Kong is making the job very difficult for a small number of infectious disease experts - even more so in China.

GLOBAL IMPACT WIDENS OF SARS INFECTION

Investor confidence was hit across the region, together with tourism and business travel. Intel Corp shut part of its Hong Kong office and sent a third of its 250 Hong Kong workforce home after a team member became sick with SARS pneumonia. HSBC opened its backup trading floor at a different location in case its entire top trading team was suddenly placed in quarantine. Airline routes were threatened by mass cancellations.

Other nations were also proposing radical action to save lives and their health care systems from meltdown. A single SARS infection was enough to close an entire hospital - with rapid spread to health care workers and threats to other sick patients and family members.

Measures in the US, Canada, Australia, Singapore and other nations allowed authorities to quarantine people against their will if thought to be at risk.
Many countries began delivering dire health warnings to travelers - for example Australia told citizens to avoid all travel to Canada and affected countries in the Far East.

Travelers in Japan, China and Hong Kong began to see large numbers of local citizens covering their faces in public places with medical masks or make-shift pieces of cotton.

Ontario, Canada declared a provincial SARS emergency allowing legal action to remove personal freedoms for those affected if necessary to prevent spread (compulsory quarantine). Ontario has a resident Chinese population of over 400,000 with frequent travelers to and from the Chinese mainland.
Taiwan decreed SARS an "infectious disease" subject to quarantine laws and banned visits by civil servants to affected areas, including mainland China, Hong Kong and Vietnam. Over 500 were in strict SARS quarantine by the end of March and the government announced they were thinking of a ban on air travel to or from China. Taiwan media has savagely attacked Chinese l eadership
for what they say has been slow action, risking the health of the whole world by being secretive. Hong Kong authorities have also been criticized for slowness to act - perhaps out of deference to the authorities in China.

The World Health Organisation also blamed China for being slow to tell the world what was going on - and China also apologized profusely for being inefficient in communicating the situation.

WHO teams declared that despite great efforts to contain SARS spread in Guandong, where facilities were good, there was grave risk of uncontrolled spread into more rural areas or other cities with less strongly developed health care systems (including Beijing). Rumours in early April suggested the true number of Beijing SARS cases could be double those reported.

On 15 April WHO discovered that SARS cases in military hospitals were not being included in China statistics, a serious omission that increased official figures in Bejing alone from 37 to almost 400 actual cases with hundreds more suspect cases, and many thousands more at risk from recent contact. To make matters worse, suspect SARS cases were being nursed next to

confirmed cases, and SARS infections were being reported across many other parts of rural China where facilities for monitoring, contact tracing, isolation and treatment were, according to WHO, likely to be poor.

The scale of global mobility is breathtaking - with over 750,000 visitors from India to the UK each year for example. Containment becomes even more difficult when you consider that passengers could in theory be infected in-flight from a passenger who disembarks before they even board the plane - just by touching a food tray, or a light switch contaminated the day before.

MEDICAL TEAMS HIT HARD BY SARS VIRUS

Medical teams have been badly affected by SARS pneumonia. In Hong Kong Chief the Medical Officer described his horror as seeing over 60 doctors and nurses struck down with SARS symptoms of fever, cough and atypical pneumonia, decimating the ability of his hospitals to cope, and creating terrible fear - from a single person with SARS.

Some of these health workers then unknowingly infected their own children, husbands, wives and friends.

8% of all medical staff at the Hong Kong Prince of Wales hospital fell sick with SARS in two weeks, with suggestions in local press that a significant number may have been infected despite infection control measures being taken. It is not clear whether some / all had just been using masks or whether they had been following the strict disciplines of full isolation and barrier nursing, which does seem to be very effective - see below. Doctors in clinics have been infected as well as family doctors (General Practitioners) working in the community.

The Italian doctor who identified the SARS virus himself died: Dr Carlo Urbani, a 46-year-old Italian and expert on infectious diseases, identified Severe Acute Respiratory Syndrome in an American businessman admitted to hospital in Vietnam in February with severe atypical pneunonia.

Health care workers were still becoming ill with SARS from new infections in early May, despite all the guidelines from the World Health Organisation on infection control. Experience shows that protecting health care workers while delivering care to those with SARS is a major

challenge.

Symptoms of SARS, which is believed to be spread mainly through droplets by sneezing and coughing, are hard to diagnose as SARS infection because they include common health problems as high fever, chills, coughing, cold, headache, aches and pains, and breathing difficulties of various kinds - read on for more below on SARS symptom profile.

An average of 10 in every 100 who are infected go on to die of SARS, usually 5-6 weeks after becoming ill.

Many people are recovering from SARS pneumonia, but often only slowly, after long treatment in hospital, including the need for support from mechanical respirators (life support systems / ventilators) in intensive care units. The demands on health care resources from a single case are immense. SARS infection produces a spectrum of very severe illness and longer term effects on health are unknown. A very small minority relapse with SARS a second time after appearing to recover fully.

Hong Kong has had 200 people with SARS in intensive care, creating severe strains on health care resources, especially when intensive care workers themselves have been struck down. Four doctors and nurses became infected trying to resuscitate just one patient.

Several entire hospitals have been cleared for SARS in Beijing and a 1,000 bed new hospital built in 7 days, with 1,000 separate rooms on the ground floor, each opening directly to the grounds of the hospital.

ORIGINS OF SARS VIRUS

Because the SARS epidemic suddenly seemed to appear from nowhere just as the Iraq war began, some feared SARS infection was a biological warfare attack - a germ warfare virus released by Saddam. We know this is not the case since the spread of SARS began months earlier. However scientists do have the technology to produce viruses like SARS - see video on biological warfare and feature on biological weapons / news of disturbing experiments using common cold virus.

Investigations by Hong Kong authorities suggest SARS infection was brought into that territory in February 2003 by a semi-retired professor of medicine from Guangdong Province. Three cases of strange "atypical" pneumonia reported in November 2002 point to the Foshan area of Guangdong as the likely geographic origin of the SARS virus. Other SARS cases followed but there were no reports permitted in the Chinese press, despite (as we later learned officially) growing numbers of deaths. By late March the Guangong Province admitted they had seen almost 800 SARS cases with 34 deaths.

The Chinese government only disclosed official figures of infections and deaths at the end of March, after deaths were reported throughout the world caused by a rapidly spreading atypical viral pneumonia, all trailing back it seemed into China. This crucial delay has meant that China itself is now likely to face a far more severe SARS epidemic, and made spread much more likely elsewhere. The SARS epidemic is acutely embarrassing to all countries with cases on their own soil, and particularly to the Chinese who are deeply sensitive to losing face, appearing weak or blameworthy to the rest of the world.

By the end of March WHO officials were working their way through patient records in Beijing where there were also growing numbers of cases, but had still not been permitted to make their first visit to Southern China which it is thought to be the global epicentre of the SARS epidemic, raising growing concerns about the real nature of the problem in Guangdong. Health care workers in the area had been forbidden to talk about what is happening. Stories are circulating in Taiwan that local journalists have also been instructed not to report what they are seeing.

Judging by the experience of Hong Kong, and the slow reluctance of the Chinese authorities to allow observers into Guangdong, it was becoming hard to believe that the Chinese epidemic had been fully contained. Control depends on full co-operation by the whole population, reporting symptoms early, taking sensible precautions. But how can you control disease like SARS during an information blackout with strict censorship?

The Chinese government sacked the health minister and the major of Beijing but the damage was done, with accelerated spread and loss of confidence in government by the population.

China faced a national crisis with thousands fleeing cities like Beijing, possibly carrying infection with them across many SARS-free areas. Normal life in some places ceased. After much delay the government went to the other extreme, with draconian measures including quarantine for

entire buildings, thousands of workers, entire hospitals, severe limitations on travel, cancellation of public holidays, huge fines for spreading false rumours and so on.

SARS BACKGROUND - WHY WE ARE VULNERABLE TO MUTANT VIRUSES

Since 1987 I have been predicting the great vulnerability of our world to new mutant viruses or mutations of existing ones, in my book The Truth about AIDS, and again in Futurewise published in 1998 (now in a third edition). The SARS virus currently causing such global concerns is just one of a large number of totally new agents emerging each year, the vast majority of which are relatively harmless causing combinations of aches, pains, fevers, rashes, gut problems and other symptoms. Twenty years ago medical students were trained to diagnose virus infections by their typical symptoms and skin rashes, but today the range of low-grade viral infections is huge and rapidly growing. Few are formally diagnosed. Doctors just tell people they are suffering from a "self-limiting condition" which is another way of saying there's no treatment but it is unlikely to kill you. But that was before SARS.

Southern China is a place where new viruses often emerge, sometimes jumping from animals to humans. Viruses have the capacity to recombine with new genetic material as they spread. Most viruses are species-specific but occasionally they cross over. We saw this in 1998 with a severe outbreak of bird flu in Hong Kong which killed several people and only halted after over 1.3 million chickens were slaughtered. We have seen it again in April 2003 in the Netherlands with a further outbreak affecting humans and the slaughter of over a million chickens there. Fortunately the virus does not seem to be able to spead very well between humans.

Last year we saw a new virus emerge called H5, also in Hong Kong. It killed 50% of those infected but fortunately proved difficult to catch. However, another of these recent mutant viruses is of course HIV, which already has spread to 1% of the entire world's 15-55 year olds, with almost 100% death rates from AIDS. Another, a hundred years ago, killed 30 million people - see below.

Most new viruses are either harmless or relatively uninfectious, or both. HIV is an example of a dangerous virus that is far harder to catch that SARS virus, yet a global menace because people can live for many years in an infectious state without realising they are a potential risk to others.

With 6 billion people alive today, a small risk of viral mutation every time a single person is infected with any existing viral type, dense urbanisation in many countries, dramatic growth in

international travel, and the lack of an antiviral equivalent to penicillin, conditions have been perfectly set for some time for just such outbreaks as SARS. We should therefore expect more to follow - less or more dangerous than SARS.

All this underlines the urgent need to develop effective antiviral medication. It is shocking that 60 years after the discovery of penicillin we still do not have a single antiviral that is as effective as the earliest antibiotics. When we do, we will have a cure for common cold, flu, polio, smallpox, viral meningitis and viral pneumonia - amongst many other conditions. Genetic engineering may be a key weapon in vaccine development.

SARS SYMPTOMS, INCUBATION PERIOD, INFECTIVITY, TRANSMISSION, TREATMENT AND PREVENTION

SARS stands for Severe Acute Respiratory Syndrome.

SARS symptoms start with a fever of more than 38.5 centgigrade or 100.4 degrees F, sometimes with shaking, headache, muscular stiffness, body aches, confusion, rash, diarrhoea, loss of appetite and malaise (feeling generally unwell). Within a short period, the patient develops a dry cough, and in many cases shortness of breath.

On average it takes 3-5 days from first symptoms to someone seeking hospital treatment. In 10% to 20% of cases, patients require mechanical ventilation to breathe. Symptoms of SARS start in most cases 2 to 5 days after exposure but sometimes it seems to take as long as 10 days - rarely up to 2 weeks.

At first WHO said only 4% with SARS died, then 5%. Latest analysis of data from Hong Kong suggests the rate is probably around 10% on average. A key factor is age. Death rates are up to 50% in those who are over 65 even if treated early. Fatalities can be as low as 4% in those in their 20s - but even this is very high compared to most other infectious diseases today.

Up until recently most deaths were in the elderly or those who were unwell from other causes, but recent deaths have included women in their 30s, while babies have become ill after women with SARS have given birth. Some fear the virus is becoming more virulent.

People in early stages of incubation without symptoms do not seem to be infectious.

Some people have been in very close proximity to those with SARS without becoming infected - infectivity can vary greatly from person to person.
Prompt medical care with supportive treatment seems to reduce fatalities significantly.

SARS diagnosis is by exclusion: there is no specific reliable test at present which can be used in the early stages of infection. Physicians and health care teams work hard in every suspected case to rule out every other known cause of severe pneumonia. And then as a last resort they conclude this must be SARS. In the meantime, all with severe pneumonia anywhere in the world who have been potentially exposed must be regarded as possibly suffering from SARS until otherwise proven. That is why many with symptoms similar to SARS are at present often included for a while in SARS statistics, later being eliminated from the infection list as the real cause becomes clear.

As infection continues, levels of specific antibodies always rise as the body starts to fight, and blood tests can then reveal the causative organism.

However it takes 20 days of infection for the Elisa test to detect antibodies accurately The immunofluorescence assay (IFA), detects antibodies reliably as of day 10 of infection, but is a comparatively slow test that requires the growth of virus in cell culture. The PCR test for virus genetic material in theory could detect infection very early but is presently still innacurate for SARS. The German biotechnology company Artus claims it has developed a test for SARS virus which gives accurate results two days after infection. However the fact is that at present, many can carry SARS infection without realising anything is wrong.

Cause of SARS has been thought to be a coronavirus, the same group as those causing common cold. However the virus has not been found in 40% of those in Canada with SARS infection, yet occurs in some who are perfectly healthy. The reason may be that the virus is already mutating again. if so this is a significant sign of instability. If the SARS virus really has changed after no more than a couple of thousand cases, then vaccine development could be very difficult or impossible with current technology.

Coronaviruses are notorious for changing their outer surface antigens rapidly in subtle ways to confuse the immune system. We call this process antigenic drift. That's why vaccines don't work against colds.

Of course until this basic issue is resolved we can't even develop a testing system, let alone a vaccine (See book chapter on what exactly is a virus? which explains why viruses are such a problem for human beings).

Other factors may be at work. In some parts of China, chlamydia bacteria have been found in the lungs of people with SARS - not found elsewhere.

Chlamydia infection is a well known STD (Sexually Transmitted Disease) associated with pelvic inflammatory disease in women.

SARS virus spreads mainly occurs through droplets created by coughing or sneezing, but also spreads far less efficiently through hand to nose contact, if hands become contaminated with virus - for example through picking up or touching an object such as a pen, or an elevator button, and then touching the nose. It may also spread through other routes - for example through faecal contamination or sewage - we don't yet know.

We have no idea how long the SARS virus can survive on contaminated objects (called formites) but latest research shows that the virus can remain infectious outside the body for several days depending on the environment. Surface contamination remains active for up to 24 hours, urine and faeces remain infectious for at least 1-2 days, while the virus survives in diarrhoea for up to 4 days.

We also have little idea how soon carriers become infectious, or if someone can be infectious without significant symptoms (silent carrier). It is likely that we will find that a small minority of people with genetic resistance will shake off SARS infection without becoming very ill or being diagnosed, creating further problems with tracking spread.

If the virus becomes less virulent it could be harder to track and control. The sudden onset of

tyical severe symptoms of SARS are helpful in making a rapid diagnosis. If many cases in future are far milder, it becomes more likely that they will escape labelling as SARS, and spread may be harder to prevent.

We assume at present that people can become an infection risk 24-48 hours before they feel ill.

Hand-nose contamination is a very common way cold viruses spread - and the answer is frequent hand washing as well as avoiding hand - nose contact.

Surfaces can be sterilised with diluted bleach or disinfectants.

Sales of face masks have soared in Hong Kong and elsewhere, although there is little direct evidence that they will protect the health of the wearer when walking around outside. They may prevent infected droplets released by coughing or sneezing from landing on the skin around the nose or from being inhaled, however, individual virus particles are far too small to be filtered by such masks. It all depends whether free virus particules are causing infection, or far larger droplets of secretions which contain virus.

Those in recent contact with people who have SARS, or with others who could be incubating SARS infection (themselves SARS contacts in the last 10 days to 2 weeks), should quarantine themselves, keeping at home, away from others, in a well ventilated room, eating and drinking a normal diet and getting plenty of rest. Urgent medical advice should be sought, whether the person feels sick or well, about detailed procedures to be followed to protect the health of others while also enabling the person in quarantine to be properly looked after.

213 people appear to have been infected by SARS in one apartment complex alone in Hong Kong - all of which landed up in hospital - with a further 240 people from the same block in strict quarantine. The question is how and why did they all become infected? Of the 213, over 100 were in a single residential block. The greatest risk of transmission seems to have been to those living directly above or below others already infected, suggesting a new factor is involved other than normal person to person spread, such as infected body secretions entering common ventilation or plumbing systems of other flats. Huge efforts are being made to answer this question. The Amoy Garden complex is in the Kowloon district and has many 35 story residential blocks, housing a total of 15,000 people.

The vital question is this: how close do you have to be to someone with SARS virus infection, and for how long, in order to be at significant risk of SARS? We don't know, just as we know very little about the level of exposure required in normal day to day situations to catch flu or a common cold. In China a man suffering from an early case of SARS did not infect any of his own family, despite being in close proximity, yet others outside the home were infected. So there are many puzzles to be solved.

Most experts believe that SARS virus is caught mainly by inhaling an aerosol spray of fine particles comprised of body secretions, released through someone nearby coughing or sneezing. Such aerosols tend to fall to the ground and so, it is hoped, long distance airbourne spread is highly unlikely - for example through an air conditioning system in hotels, apartments or aircraft. Huge efforts are being made to work out how every person with SARS became infected: from whom and in what way but the situation is still very unclear. There has certainly been no evidence of true airbourne spread so far.

Some people with SARS are much more infectious than others for reasons we don't understand - superspreaders. For example one person infected 56 health care workers in a Vietnam hospital. Some treatments seem to be very dangerous to those around -for example using nebulisers to create an inhaled mist. The mist can fill the room with billions of infectious water microparticles.

Barrier nursing using gloves, masks, gowns, aprons, head covers and goggles seems to provide good SARS protection for nurses, doctors and other health care workers - but it is not 100%. Barrier nursing is a standard procedure for many conditions and most hospitals in the world should be able to protect most of their health care workers from occupational SARS infection this way. Ideally rooms (containing of course only one person or only others proven to have SARS already) should be well ventilated with negative pressure systems so that air is drawn into the room as the door is opened, and stale air is constantly expelled outside the building.

Every object inside the room must be regarded as an infectious hazard including eating utensils, plates, medical records, windows, door handles, ventilators and all other medical equipment.

SARS has been called flumonia because it spreads like flu and kills like pneumonia.

SARS deaths occur when lung tissue swells so that breathing becomes impossible - something that can occur in perhaps more than 10% of the elderly and less than 5% of the young.

SARS experimental treatments have included the use of high dose steroids and antiviral medication using Ribavirin, with uncertain results.

SARS recovery rates seem to be higher in the young and those without other illnesses. In a mixed population 85% with SARS pneumonia recover within a week of becoming sick, perhaps 5% are ill for far longer and it is thought that around 10% die - but these are early days, and figures are changing. There is also the possibility that we may see various strains of SARS virus with different mortality rates.

SARS is probably a spontaneous viral mutation from other viruses infecting animals and humans, a process called recombination.

In countries like Singapore there has been a rush to sign up for health insurance but people may be disappointed. Health insurance cover may exclude SARS in countries where SARS has become a notifiable infectious disease - check the terms of your policy.

THE POTENTIAL FOR CATASTROPHE IF ACTION FAILS NOW

So then, SARS had the potential to produce a global pandemic unless radical action was taken by governments.

A single SARS-virus infected individual can spark a fresh outbreak, and since some people can be highly infectious before the diagnosis is obvious, and since the early symptoms (cough and fever) are similar to many other conditions, it can be hard to track spread.

We also know that a small number who seem to have recovered can later relapse, becoming infectious and unwell all over again.

Global travel has never made it harder to stop spread of illnesses such as colds and flu - which appear to spread like SARS. So SARS has the potential to spread far faster and wider than the 1918-1919 flu epidemic.

Set against that we have a far better understanding of the disease than was the case with Spanish flu, far better monitoring and surveillance and greater global awareness.

We have seen that containing SARS means tight control, and most importantly excellent national communication, with well understood health campaigns so that the whole population is mobilised rapidly. This may be particularly difficult in remoter parts of China or India or Africa.

If a significant future SARS outbreak hits a densely populated city like Calcutta or Bombay and the rural areas beyond, (these cities already have cases) it will be very difficult to contain with a highly mobile population of over a billion people, huge overcrowding, ignorance of the disease, difficulty in diagnosis, poorly developed health infrastructure, low access to radio and TV, high levels of illiteracy among the poor and the impossibility of quarantining many tens of thousands of people. Only those who have traveled to India or live there can fully understand the vast scale of the challenge if India should see an established outbreak on its own soil.

THE FUTURE OF SARS EPIDEMIC

What should we expect of SARS in the future? Hopefully the virushas been contained or has mutated into a less virulent form - as happened with the 1918-1919 Spanish flu. Aggressive public health measures seem to have succeeded in preventing SARS from spreading into populations where there are few public health resources. We will soon have much more data on the virus, and the ability to collect serum from those who have recovered that may help save lives. We may be able to develop a vaccine quite rapidly - by injecting people with damaged virus particles, or by finding a variant which produces very mild illness, but is similar enough to provoke protective antibody responses. But that will only be possible by bypassing normal strict safety testing.

A key challenge with SARS is the fear governments have of spreading panic, not only among their own people, but also among tourists and investors. However, the epidemic has had the potential to become a real threat to global health and if allowed to spread much further, could have become a wild-fire impossible to put out.

Conclusion: the World Health Organisation was correct to take this SARS epidemic very seriously indeed. Outcome will still depend on global efforts by every government and every health agency, working together.