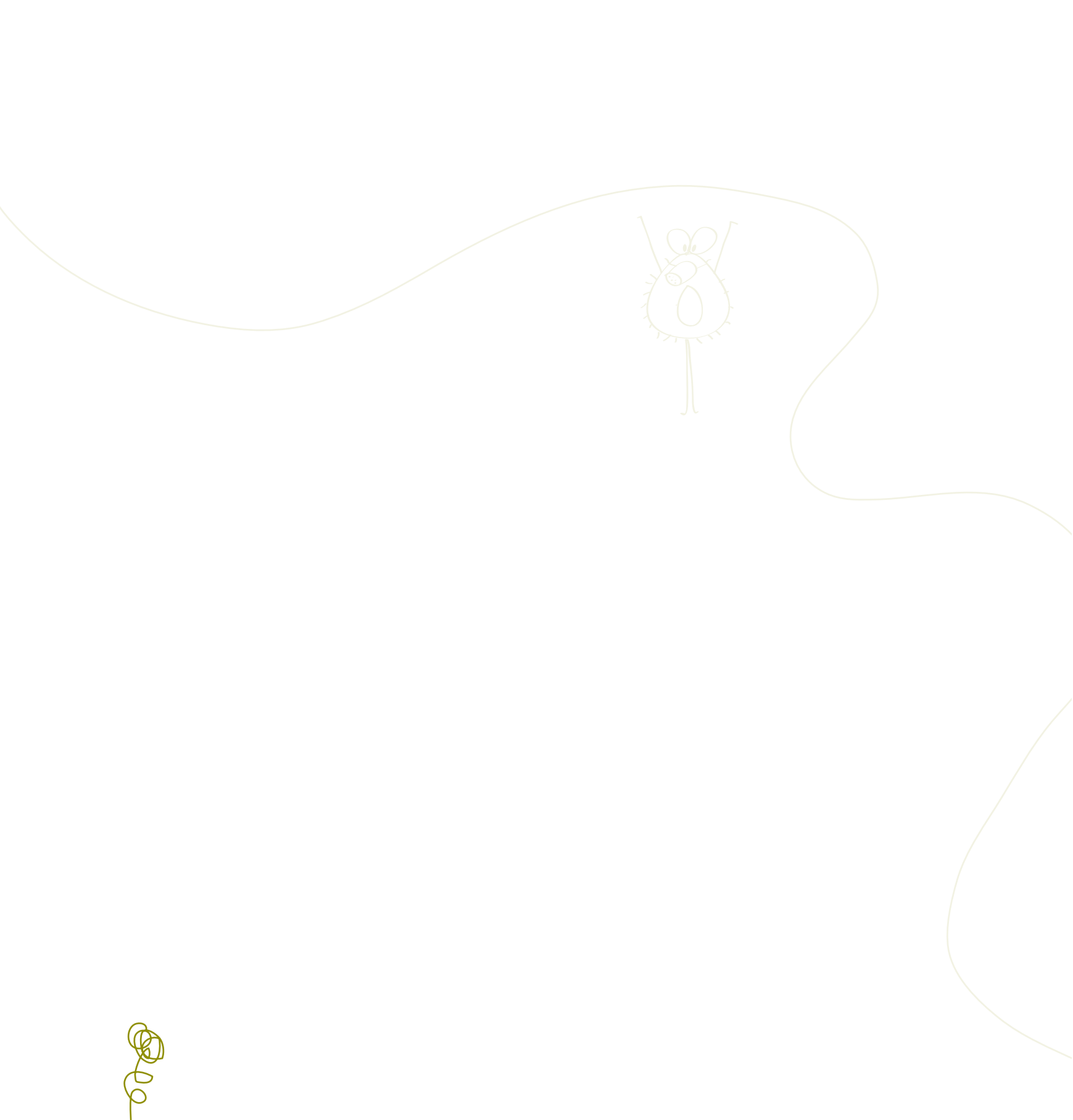
CHAPTER 7

OUTBREAK

the world's emergency room



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OUTBREAK

the world's emergency room

As the first flu pandemic of the 21st century has shown, it only takes a few hours for a disease to wing its way around the world courtesy of air travel. Now armed with sophisticated reporting systems, the World Health Organization and its partners are ready to help countries respond to any outbreak when public health is threatened.

Sudan and Zaire, 1976. At first, the illness looked like malaria or flu. The symptoms came on suddenly – a high fever accompanied by muscle pain. The sick took to their beds complaining of sore throats, nausea, dizziness, abdominal pain and diarrhoea. Then they began to develop a rash that spread all over their bodies. By the beginning of the second week it was clear it was not malaria. As the victims started to bleed from nose, mouth and ears, and pass blood, the doctors and nurses caring for them started to suspect that what they were looking at was something far more serious.

Ebola first appeared in 1976 in simultaneous outbreaks. One in a village called Yambuku near the Ebola River in Zaire, now the Democratic Republic of the Congo.

The other in Nzara in Sudan, now South Sudan. It just seemed to come out of the jungle one day, killing 151 of 284 people with the disease in Nzara and 280 of 318 people infected in Yambuku before returning to the leafy gloom. It re-emerged the following year in Zaire, killing one person.

In 1995, it returned with the ferocity of the first outbreak, this time in Kikwit, a town of around a half million people, 550 kilometres east of the capital, Kinshasa. A laboratory technician at Kikwit General Hospital had come down with fever and bloody diarrhoea a few days after he drew blood from a patient with similar symptoms. Misreading the diagnosis as a perforated bowel, doctors operated, exposing themselves to blood humming with virus.

Four days later, other medical staff at the hospital began to come down with fever, some of them bleeding profusely. But instead of being isolated straight away a few infected people left the town and journalists descended on Kikwit to report the story. A frightening new outbreak had been unleashed.

The World Health Organization first received notice of what was happening on 7 May from its office for the African Region in the Republic of the Congo. Ebola was confirmed on 9 May at which point the outbreak was at least a month old. It raised the prospect of a terrifying scenario: that of one of the world's most lethal diseases – for which there was no cure – had emerged from a rainforest not far from a city of five million people, a city with an international airport that was one connecting flight away from anywhere in the world (see Box 7.1 Fact file: Ebola and Marburg).

Box 7.1. Fact file: Ebola and Marburg

CDC/ Frederick Murphy

Ebola virus

Virus family: Filoviridae derived from *filum* meaning thread in Latin, characterized by long filaments.

Description: Severe acute viral illness often with loss of blood.

Transmission: Contact with contaminated blood, fluids or tissues.

Treatment: Intensive nursing care.

Reservoir: In Africa, the first cases of Ebola in outbreaks, known as index cases, are believed to been infected through contact with dead gorillas, chimpanzees, monkeys, fruit bats and duikers (a type of antelope). Index cases of Marburg are believed to have been infected by Egyptian fruit bats in caves or mines.

Ebola

First identified: 1976, simultaneous outbreaks, one near the Ebola River in Zaire (today's Democratic Republic of the Congo) and the other in Nzara in Sudan (today's South Sudan).

Outbreaks: Côte d'Ivoire, Democratic Republic of the Congo, Gabon, South Sudan and Uganda.

Incubation period: Two to 21 days.

Case–fatality ratio: 50–90% of the people who became infected in these outbreaks died.

Marburg

First identified: 1967 in Marburg, Germany, following importation of infected green monkeys from Uganda.

Outbreaks: Angola, the Democratic Republic of the Congo, Germany, Kenya, South Africa, Uganda and (the Socialist Federal Republic of) Yugoslavia.

Incubation period: Two to 21 days.

Case–fatality ratio: 25–80% of the people who became infected died during these outbreaks.

Deadly hitch-hikers

Since its inception in 1948 one of WHO's key roles has been to respond to outbreaks of dangerous diseases, such as cholera and typhus, by assessing their scale and nature, and by bringing together the international expertise and resources to stamp them out.

Two late 20th century developments – jet travel and mobile populations – make it easier for a disease to spread around the globe within hours. "A typhus louse or a plague flea brushed off the rags of a beggar in an eastern bazaar can be in Tokyo or Oslo, New York, Moscow or Sydney within a few hours." That sounds like a very 21st century observation, but it was in fact made in 1958 by Dr Brock Chisholm, the first director-general of WHO (Photo 7.1). He was talking about the speed with which diseases could travel and he was referring to the first public emergency that WHO faced as it came into being – the cholera outbreak of 1947 in Egypt.

The outbreak started in El Korein, a village on the eastern edge of the Nile Delta where merchants gathered every autumn for a date fair. Nearby, an army of 6000 workers were working on an airbase. A few fell sick and, before any kind of quarantine could be set up, word got out. Panic ensued and people fled the area desperate to escape what was seen as a death sentence.

Three days after the outbreak was declared cases were reported in Cairo. A few weeks later the whole country was engulfed, with run-down hospitals trying to cope with some 33 000 infections. There was mass panic. The last time cholera had swept through Egypt in 1902 it had killed 35 000 people. The government came down hard. The sick were crammed into makeshift isolation wards. Cairo's streets reeked after houses were sprayed with disinfectant. Markets were closed. Even praying outdoors along the banks of the Nile was prohibited and movements of pilgrims from Egypt to Mecca and other Muslim holy places were banned.

Egypt's neighbours looked on with a growing sense of alarm. As Chisholm put it in 1958 when reflecting back on the event 10 years later, "the powerful sanitary barrier of the Red Sea and Suez Canal" had been breached "and, in epidemic proportions, was again threatening the world".

The crisis blew up in the year before WHO's 1948 inception. At that time, the Interim Commission (Photo 7.2), the United Nations body whose job it

Photo 7.1. Switzerland, 1946. Brock Chisholm (left) in Geneva

WHO

Photo 7.2. Switzerland, 1946. Members of the Interim Commission gather in Geneva

WHO

was to look after essential international public health activities until WHO was set up, responded to Egypt's calls for help. Within a few hours telegrams went out to the Pasteur Institute in Paris, the Lister Institute in London and the Haffkine Institute in Bombay, now Mumbai, asking how much vaccine they had available, how quickly they could make more and how soon they could get it to Cairo. Eventually 20 million doses of cholera vaccine were delivered, enough to vaccinate every child, woman and man in Egypt.

With the first response to the crisis under way, the Interim Commission brought together a team of cholera experts in Geneva. One of the central concerns of this group was that there should not be an overreaction to the outbreak. There was good reason for this view.

Ever since the city of Venice in Italy had turned away ships coming from areas infected with plague in 1348, public health officials have argued the merits of quarantine – the isolation of people for a period of time to ensure that they do not carry an infectious disease. But the use of quarantine also had the capacity to produce its own humanitarian crises, sometimes with grave economic consequences. A chilling example occurred in 1848, when the captain of the Matteo Bruzzo, a ship out of the Italian port of Genoa carrying 200 passengers, had declared that there was cholera on board and was kept on the high seas for four months because countries on both sides of the Atlantic refused to let the ship dock.

Such incidents sent a signal to every ship's captain to keep quiet the next time a passenger came down with cholera. And what was true of ships was true of 'ships of state'. Over-strict quarantine, the closing of borders – all such actions had the potential to discourage the disclosure of outbreaks, thereby encouraging the spread of disease.

These concerns prompted the first International Sanitary Conference of 1851, where 12 states debated but failed to agree on the quarantining of patients with diseases, such as cholera, plague and yellow fever. Finally in 1892 countries agreed on the first International Sanitary Convention on quarantine measures, and, by the time of the Egyptian outbreak of 1947, it was generally accepted that the only effective way of dealing with such outbreaks was through international cooperation. Indeed the fact that cholera forced the world's nations to focus their attention on these issues led some to call the disease "the founder of the public health services".

Photo 7.3. Sudan, 2007. This girl survived the cholera outbreak. Most of the people who die are the young children and the elderly

WHO/O. Maher

In the end, the Egyptian cholera epidemic of 1947 was brought under control in three and a half months, from confirming the outbreak to reporting the last case. During that time, 10 277 people lost their lives out of 20 804 confirmed cases – a fatality rate of around 50%. A mass vaccination campaign was launched, followed up with a second round in 1948, and drinking-water supplies and sanitation were improved. That year only 10 cases were reported. In 1949 there were none.

The cholera epidemic demonstrated the importance of having an international body to step in at times of crisis, when relations between individual nations are strained. The response of the Interim Commission to that outbreak became a model for WHO's future work. Far from being a debating society, as some critics suggested it would be, WHO went on to show that it was capable of drawing together the nations of the world in coordinated and rapid action to respond to a common threat.

Swifter reporting

Other lessons were learned in Egypt. If the El Korein outbreak had been reported and investigated immediately and the first patients treated promptly, cholera might never have reached Cairo (Photo 7.3). What was needed was a system that would cut the delay in reporting from days to hours.

The World Health Organization began working on such a system in 1948 using the most up-to-date telecommunications technology of the time – radio. It expanded its Geneva-based radio network and started broadcasting daily bulletins of disease information worldwide, using sources such as centralized public authorities, but port and airport medical services also contributed, as did ships at sea. It was the beginning of a global surveillance system for monitoring the outbreak of disease, but coverage was by no means complete. Many countries did not have effective systems to monitor and report disease outbreaks, while others feared the consequences – economic or otherwise – of reporting potentially lethal outbreaks. Indeed, openness and transparency on the part of countries is just as relevant today as it was back then (Photo 7.4).

Photo 7.4. Switzerland, 1950s. A map showing the location of the wireless stations transmitting epidemiological bulletins to the International Quarantine Service of the World Health Organization, Geneva. This intelligence network received reports about outbreaks of cholera, smallpox, plague and other diseases and kept health authorities informed about them

WHO/J. Mohr

Photo 7.5. Radio was one of the first technologies used to inform the public about disease outbreaks

WHO

While WHO worked to improve the flow and transparency of information, it was also developing the capacity to analyse the data. By the time the Asian flu pandemic of 1957 struck, WHO was able to draw on its global network of laboratories to analyse the virus and declare it to be a new subtype in a matter of days. Samples of the new virus were sent to vaccine manufacturers, while WHO, using radio and telegraph dispatches, got on with the job of alerting the world (Photo 7.5) (see Box 7.2 Three major pandemics in the 20th century).

These were promising beginnings, but they were not followed up. By the end of the 1950s, interest and investment in disease surveillance – including the identification of known cases and tracing of their close contacts – had not yet come into its own. There was a growing sense, particularly in the wealthy countries, that the threat of infectious diseases had gone away. After the Second World War, there was a common perception that antibiotics could kill any microbe and cure any bacterial disease. For many bacteria, initially, that was true. But over the years, microbes developed resistance to antibiotics so that new ones had to be developed. That race against time continues to this day (Photo 7.6).

Yet the stunning advances in the production of vaccines and antibiotics, along with steady progress in the eradication of smallpox combined to create a false sense of security. Reflecting the spirit of the time, the World Health Assembly turned its attention elsewhere, and WHO put some infectious diseases projects on a back burner.

Box 7.2. Three major pandemics in the 20th century

Influenza or 'flu' pandemics are recurring events and have been documented since the 16th century. Since then, each century has experienced, on average, three pandemics.

In the 20th century, the most serious one took place in 1918–1919. Sometimes called the Spanish flu, it is believed to have killed 20–40 million people, most of them young adults. A second pandemic in 1957, known as the Asian flu, killed more than two million people and a third in 1968, known as the Hong Kong flu, killed about one million.

In 1997, 18 people in China, Hong Kong Special Administrative Region, became infected with a type of flu that normally infects birds. Six of them died and it was named A (H5N1) avian influenza. The virus, which is sometimes called 'bird flu', has since infected many people around the world. In more than half of the cases that could be confirmed by laboratory tests, it has proved fatal.

Every new pandemic has the potential to kill millions of people and have a devastating effect on the economies of the countries affected, given today's world of rapid, jet travel and mobile populations. That is why many countries have drawn up plans outlining what they would do if such a pandemic strain were to emerge and that is why the World Health Organization is working to keep governments and the public informed about the safe handling of animals, including birds, so that they know what to do when humans become infected with avian influenza.

Panic in Surat

Brock Chisholm's generation would have loved the Internet for its potential for real-time, global disease surveillance. But he and his fellow public health specialists might have been surprised to see how new problems have emerged as a result of the technological advances in media and communications. One of these

problems was in plain view in India in 1994 during an outbreak of pneumonic plague in the city of Surat. Pneumonic plague is the rarest and most contagious form of the disease with a high death rate (see Box 7.3 From animal to man). It attacks the lungs and spreads when people cough or sneeze, but people can wear a face mask to protect themselves and it can be treated with antibiotics.

However, such considerations tend to be forgotten when a city of two million people hears through a mix of official announcement and rumour that 100 people have died of the disease, that it is carried by the wind and that a sick person can die without treatment in the first 24 hours. In such situations people flee and that is what happened in Surat.

In the days after the media reported the news, as many as 500 000 people fled Surat and the surrounding area. Panic buying of drugs took supplies out of circulation. Further media reports that the central government was sending eight million doses of antibiotics to the city did nothing to quell people's fears.

Once people were on the move, there were serious concerns about the disease spreading to nearby Mumbai with its population of 11 million people.

Almost 40 years had passed since Egypt's cholera epidemic, and yet it seemed that little had been learned. Within a week of the first media reports of the 'outbreak of plague' circling the world with lightning speed, countries throughout Asia and the Middle East had stopped flights to and from India. Meanwhile, Bangladesh, Oman, Qatar and the United Arab Emirates all stopped importing India's foodstuffs, and many other countries followed suit. These measures were taken despite WHO recommendations that no travel or trade restrictions be imposed.

And none of it need ever have happened. The facts of the outbreak, as they later emerged, were that on 20 September 1994, Surat Civil Hospital admitted seven patients with pneumonia-like symptoms. Despite penicillin treatment, two died within a day; meanwhile other hospitals nearby were admitting similar cases. Examination of patient sputum revealed the presence of rod-shaped bacilli similar to the plague bacteria.

India's health ministry was notified and at that point government officials had the choice of declaring an outbreak of plague or waiting a week for laboratory confirmation of what the doctors in Surat thought they had seen. The government decided to go public. Three days later reports of the 'outbreak of plague' flashed around the world.

Photo 7.6. World Health Day 2011 poster

WHO

A subsequent investigation revealed that due to a lack of adequate equipment doctors had relied on clinical diagnosis instead of confirming the presence of plague bacilli through laboratory tests; this had led to the over-reporting of cases. In the end, it turned out that 52 people had died. A later report from the All India Institute of Hygiene and Public Health indicated that not a single case of plague had been confirmed by laboratory tests.

India's trade deficit doubled that year as a result of lost business. Other countries, having observed the price India had paid, would clearly be more reluctant to report similar outbreaks. It was a disaster for global disease surveillance. WHO's director-general at the time, Hiroshi Nakajima, even flew out to Surat – an indication of the depth of the political crisis provoked by the event. Surat showed that while openness and transparency are essential to mount an effective defence against a disease outbreak, rushing to report a suspected outbreak before cases can be laboratory confirmed can result in social upheaval, economic losses and damaged public confidence.

But there were other lessons too, not least the need for better diagnostic services and know-how in the country as well as the need to avoid inaccurate and sensationalist media reports by providing more complete information to journalists. People around the world read reports of a mass exodus from the city of Surat, but were not told that the risk of catching the disease was in fact low and that the spread of the disease was limited.

Box 7.3. From animal to man

More than 30 human infectious diseases, including viruses, have emerged over the past three decades. The emergence of these diseases is due to a number of factors, including urban expansion, population growth and agricultural practices, while their spread has been encouraged by international travel and migration.

Diseases originating in animals, known as zoonoses, account for about three-quarters of the new diseases that have affected humans over the last 30 years. These new infectious diseases do not necessarily affect large numbers of people, but they often trigger fear and panic among members of the public, health workers and governments because they are caused by pathogens that are initially unknown. Also, since they start out as new diseases – 'new' in the sense of being new to humans – no one knows how people become infected and die. This was the case with variant Creutzfeldt-Jakob disease (vCJD), also known as mad-cow disease, and with the Nipah virus, discovered in 1999, which scientists traced to fruit bats but that was originally transmitted to humans via pigs.

Humans can become infected with zoonotic diseases through contact with a wide range of animals and insects. To date, over 200 zoonoses have been identified. Some have caused devastating but isolated outbreaks. Others have threatened human health across the globe. For instance, plague is a bacterial infection carried by rats, mice, squirrels and cats that can be fatal in humans if left untreated. Rabies is a viral infection that can be transmitted to humans by wild and domestic animals.

With new zoonotic diseases appearing every year, we are not only dealing with pathogens spreading across countries and regions, but also diseases that cross the borders between humans, domestic animals and wildlife. That is why the World Health Organization is collaborating with the Food and Agriculture Organization and the World Organisation for Animal Health, as well as NGOs working on issues related to wildlife and agriculture.

Then came Ebola

A year after Surat came the Ebola outbreak at Kikwit, in Zaire. Here the information problem was the opposite – a case of 'too little, too late' (Photo 7.7). A WHO team reached Kikwit on 10 May 1995, less than three days after the government reported the outbreak and obtained a blood specimen for laboratory tests. The government report, however, came four months after the first victim died. The first Ebola death, on 6 January of the same year, was never reported because health workers had no idea why the patient had died. It was only subsequent detective work carried out in the field by WHO experts that traced the chain of transmission back to him.

The WHO team, led by Dr David Heymann, were the first experts to arrive at the site of the outbreak. They were later joined by experts from the Centers for Disease Control in Atlanta, USA, the Pasteur Institute in Paris, France, the National Institute for Virology in Sandringham, South Africa, the NGO Médecins Sans Frontières and other partners.

Soon health workers were driving up and down the broken streets telling people to report family members who showed signs of the disease. People were also asked not to use traditional methods of preparing bodies for burial, as many people had become infected in this way in past Ebola epidemics. People were subdued, scared. Many thought the disease was some sort of curse.

Heymann's experience in outbreak response went back to the 1970s, when he had been recruited into WHO's smallpox eradication programme straight from the London School of Hygiene and Tropical Medicine. After that he'd worked for CDC where his first assignment had been to investigate the outbreak of a puzzling pneumonia-like disease in Philadelphia, Pennsylvania – a disease that came to be known as *legionella* or Legionnaire's disease. That same year, 1976, he had been sent out to the first Ebola outbreak in Zaire.

The outbreak in Kikwit was 20 years later. Heymann knew Africa, and he knew Ebola. Even so, the scenes he saw at Kikwit General Hospital came as a shock. Lacking running water, Kikwit General was like an abattoir. There was virus-infected blood everywhere – on the mattresses, the floors and the walls. The wards themselves were crammed with frightened people – either dying or watching others die. The hospital had no fresh linen to change beds and few sterile syringes. Wearing protective vinyl suits, the WHO team members

Photo 7.7. Zaire, 1995. Sanitary procedures during the Ebola outbreak in Kikwit

CDC/ Ethleen Lloyd

Box 7.4. Marburg virus mystery solved

WHO/C. Black

Bats hanging from the ceiling of the cave

WHO/C. Black

Dissecting bats through the night

The news reached Dr Sam Okware of the Ugandan health ministry by text message on his mobile phone. "Marburg virus isolation confirmed by CDC lab in Atlanta. More later …" This confirmation in July 2007 from the US Centers for Disease Control and Prevention in Atlanta was the trigger for a hunt for the virus's natural reservoir – the animal or other living organism that hosts the virus.

Humans need to know where such a dangerous pathogen is housed so that they can protect themselves against infection. That is why the natural reservoir is an important piece in the outbreak jigsaw puzzle. Another important piece of the puzzle is the 'index case' – the first person to become infected in an outbreak. In the Ugandan outbreak, this was a 21-year-old gold miner who came down with a fever and bleeding, and later died in hospital.

The health ministry began investigating and WHO sent in a team of international experts to work with them. The investigation focused on a cave in Uganda's Kikasi Forest Reserve, where the miner had been working with two others who also became infected with the virus. Only one of the three survived and no further cases were found. But important questions remained: in particular how the miners got infected.

Bats had been found carrying Marburg virus in Gabon, but apparently they had not infected any humans there. The Ugandan cave was home to about 100 000 bats. "These bats sleep during the day and come out of the cave at night," says WHO expert Dr Pierre Formenty. "Every night we set up nets in the entrance of the cave and caught 100 to 200 bats."

To enter the cave, Formenty and the other team members had to wear several layers of protective clothing, covering every inch of their bodies. Outside the cave, the temperature was 27 degrees centigrade, but inside it was a sweltering 32 degrees centigrade.

They brought the bats back to a make-shift laboratory set up in a local hospital, put them to sleep and spent the whole night dissecting them to provide samples. "We were wearing full protective suits and masks that completely cover the face. We breathed through a respirator. It wasn't easy to do the autopsies with scalpels while wearing two pairs of gloves, but we had to," Formenty says.

They sent samples from 611 bats to CDC and tests showed that 5% of them were infected with the Marburg virus.

"It's the first time we could actually link the natural host and carrier of the Marburg virus – in this case the bats – to an outbreak among humans," Formenty says. "The miners were wearing gloves but no face masks. The bats spread the disease by droplets of blood or through urine and faeces in the air, which the miners breathed in. That's how they got infected."

and their partners set up a strict isolation ward, and went about showing the local health workers sterilization techniques and the use of protective clothing so that they could safely treat the sick without becoming infected themselves.

By 14 May, the outbreak had killed 64 people. The government set up roadblocks around the capital, Kinshasa, while WHO sought to calm people by announcing that the outbreak could be contained, even if it reached the city. By 17 May, the investigation had identified 93 suspected cases, 86 of whom had died.

The Organization and its partners moved on to actively look for other cases by tracking down people who had been in contact with the sick. They went house by house through Kikwit and the surrounding area, trying to unravel the tangled chains of transmission and trace the source of the outbreak in order to contain it (see Box 7.4 Marburg virus mystery solved).

Special teams of experts toured the region, some slogging along the muddy roads on foot. Everywhere they stopped to ask questions and take notes. It was in this way that they traced the likely first case of the outbreak – the 'index case' – to a charcoal maker who had died on 6 January in Kikwit General Hospital.

By late May the outbreak was under control. The Organization and its partners helped establish a regional surveillance system that would report any new outbreaks of the disease. In September of that year, having allowed two incubation periods of 21 days to elapse without any repeated cases, WHO announced that the outbreak was over. This time the death toll was 244 of the 315 people who had been infected – a mortality rate of 77%. Yet again, if only the first case had been properly diagnosed before passing on the virus to family members; if only someone had notified the authorities; and if only the authorities had notified WHO, the outcome would have been very different.

Heymann and the WHO team returned to the WHO headquarters in Geneva with one question on their minds: how to improve the sequence of diagnosis, notification and response. One of the team members, Dr Guénaël Rodier, had also studied tropical medicine in London before joining the US Navy laboratories to work on infectious diseases. Like Heymann, he was also committed to developing WHO's disease surveillance and outbreak response. In fact, in the autumn of 1995, it seemed that everyone was pre-occupied with this.

Change in awareness

The re-appearance of Ebola in 1995, coming on the heels of the plague outbreak in Surat, which itself had followed news of a cholera outbreak in Peru, and an alarming outbreak of multi-drug resistant tuberculosis in New York, had contributed to a sea-change in the general public's awareness of the threat from the world's lurking pathogens.

This change was reflected in a World Health Assembly resolution that year urging countries to step up their surveillance of infectious diseases so that they could spot any re-emerging varieties and identify new ones. In October 1995, in response to the resolution, WHO announced that it was setting up a new division devoted to the surveillance and control of communicable diseases, especially new diseases or old ones that had made a comeback, such as tuberculosis. The division would include a rapid response unit whose staff could be mobilized and sent to an outbreak within 24 hours.

It was a promising development, but as Heymann said at the time, its success depended on "the ability to obtain information about infectious diseases and a willingness to communicate this information nationally and internationally".

Finding a way to encourage nations to be more open was the big challenge. One way was to use the International Health Regulations, which were first introduced in 1969 to protect countries from six diseases – cholera, smallpox, yellow fever, plague, relapsing fever and typhus – while minimizing disruption to global trade and travel. In 1995, these rules were revised to require governments to report public health threats within 24 hours, notably disease outbreaks and natural disasters, but the definition also included threats from chemical, biological or radiological materials.

The regulations were revised again in 2005 and came into force in June 2007. This time they were legally binding. The onus is now on countries to implement the regulations, which means they must build their own capacity – that is establish systems and employ technical staff – to notify and report public health events with potential to affect other countries. This could be a disease outbreak, a chemical spill or a bio-terror attack. Countries are also required to report all cases of four diseases: smallpox (which was eradicated in the 1970s, in case of a comeback), poliomyelitus due to wild type polio, severe acute respiratory syndrome (SARS) and cases of human influenza caused by a new subtype (to monitor for a potential new pandemic flu).

However, no enforcement mechanism exists, that is a means to compel countries to report such events. Rodier, the WHO official who was for many years in charge of implementing these rules, said the idea was that countries comply with the rules rather than risking international disapproval and distrust. "A country that knows something but does not report it may make a short-term economic gain, but will incur long-term losses when it gains a reputation as being unreliable as a country and as a business partner," he said. Beyond that, states are likely to be mindful of the fact that today it is simply not possible to keep such incidents secret. In a world of real-time reporting, blogs and Internet chat rooms, the truth will eventually come out.

But if official sources can't always be relied upon for accurate reports of disease outbreaks, and news media have to be treated with caution because of their tendency to sensationalize, where does WHO go to get its information? The answer is everywhere. Almost.

The Organization receives 'formal reports' of suspected outbreaks. These are supplied by ministries of health and national institutes of public health; WHO's regional and country offices; WHO collaborating centres, such as the CDC, also provide information as do civilian and military laboratories, academic institutes, and NGOs.

It also searches for 'informal reports' of outbreaks by trawling the Internet using a powerful search tool called the Global Public Health Intelligence Network, or GPHIN. This web crawler acts as an early-warning system, often picking up reports in many languages about possible outbreaks before they hit the headlines. Up to 60% of initial outbreak reports come from these informal or unofficial sources.

One of the biggest challenges is to verify the information – whether from formal sources, such as governments or informal sources, such as the Internet. In 2004, the team working on verifying these reports moved into a new room specially equipped with the most up-to-date communication technologies for that very purpose at WHO headquarters in Geneva, known as the Strategic Health Operations Centre or 'SHOC room' for short (Photo 7.8). Experts regularly meet to review outbreak reports that have come in. When there's a doubt, WHO contacts governments to verify the reports.

Photo 7.8. Switzerland, 2008. The Strategic Health Operations Centre (SHOC) room in Geneva

WHO/C. Black

Ready to go

The World Health Organization's work often relies on external experts, and its work in helping countries to contain outbreaks is no exception. In the 1990s, WHO realized that to be really effective in this field, it would need to draw on a wide range of external experts. In 2000, it established the Global Outbreak Alert and Response Network (GOARN) for this purpose.

"The Kikwit experience was very clearly a warning that we needed to do something and needed to be better prepared for such incidents," says Rodier. The "capacity to respond was only one element, and we also needed not just experts in whatever pathogen happened to have come to light, but experts in the local language, and familiar with the local terrain".

The GOARN is a diverse network made up dozens of scientific institutes, laboratories and NGOs with a wide range of expertise in infectious diseases. It has the capacity to dispatch these external experts at very short notice into the field, where they work alongside WHO staff to contain outbreaks. Many of these experts keep a packed suitcase at home with them and are ready to fly out at any time of the night or day at short notice, when their expertise is required somewhere in the world.

Dr Mike Ryan joined Heymann and Rodier at WHO in 1996, and is referred to by his peers as "the father of GOARN", remembers the chaos of the pre-GOARN days with typical good humour. He compares outbreak response to a game of football: "WHO, and the other agencies were always meeting in the field and trying to work it out like a soccer team with players coming from all over the place and arriving on the day of the game and deciding what jersey to wear and who's going to be in goals, who's going to play striker and all this without a manager."

To develop the capacity for a uniform response, Ryan and his colleagues invited 50 agencies to meet in Geneva, put a proposal on the table and asked for suggestions. In the end all of them agreed to establish a network of external experts run by WHO staff.

Since 2000, GOARN has honed its ability to respond, learning how to deal with political realities on the ground and about the importance of listening to local communities. Managing an outbreak is not about parachuting in to stricken communities wearing white suits and masks. It's about engaging with local people, who are affected, to explain to them in their own language what they can do to protect themselves and halt the outbreak. This is particularly difficult when it comes to preparing the dead for burial – as some traditional methods have led to further spread of Ebola and Marburg in African countries – and need to be adapted to protect relatives (Photo 7.9).

Photo 7.9. Uganda, 2008. Testing for Ebola

WHO/P. Formenty

The SARS test

On 21 February 2003, a 64-year-old medical doctor from China's Guangdong Province, flew to the Hong Kong Special Administrative Region (Hong Kong SAR) of China, and booked into a hotel room in the city. That night would change the world as he unwittingly transmitted a new, mysterious respiratory disease to at least 16 other guests. Those people travelled on to Canada and Viet Nam setting off a scenario that infectious disease experts had long predicted, courtesy of jet travel and mobile populations. Crowds of people going about their everyday business in the streets of Hong Kong SAR all wearing face masks was one of the defining images of the outbreak that flashed over television screens across the world. By July 2003, when the outbreak had been contained, there had been 8422 cases of people with SARS in more then 30 countries and areas, of which 916 had died.

But for WHO, this new and highly contagious disease that spread by droplets in the air or by touching contaminated objects provided a major test for its surveillance and reporting mechanisms. In November 2002, WHO received reports of a severe flu outbreak in Beijing and Guangzhou in China.

In December of the same year, WHO asked the Chinese government if it could confirm the outbreak. A week later China sent WHO a report confirming the presence of a type B flu strain. It was an outbreak of seasonal flu, nothing

Photo 7.10. China, 2004. Health worker (right) talks to people who may be infected with SARS in Beijing

WHO/P. Virot

more. But later it turned out that there had in fact been two respiratory disease outbreaks in Guangdong Province in mid-November of 2002. One was caused by the flu virus and the other by an unknown pathogen that was causing a new kind of pneumonia infecting a large number of health workers. This first wave of what later turned out to be SARS rolled through December 2002 and January 2003, until a second wave broke during the first 10 days of February 2003. This time even more health workers were getting sick (Photo 7.10).

On 10 February, the WHO office in Beijing received an official e-mail describing an infectious disease in Guangdong Province that had killed more than 100 people. The next day, the Chinese health ministry reported to WHO that there were 300 cases and five deaths in an outbreak of what they were calling "acute respiratory syndrome". The following day, the health ministry said the outbreak dated back to 16 November 2002, that the flu virus had yet to be identified and that the outbreak was being contained.

A week later, a Chinese-American businessman flying from Hong Kong SAR to Singapore came down with pneumonia-like symptoms so severe that the plane had to be diverted to Hanoi in Viet Nam. The businessman had been staying at the same hotel in Hong Kong SAR as the doctor from Guangdong. After his condition worsened, Dr Carlo Urbani, a WHO medical officer, was asked to examine him. Urbani took specimens and sent them to laboratories of the WHO Global Influenza Surveillance Network for analysis.

Several of the health workers who treated the businessman began to develop the same symptoms – a dry cough, fever and difficulty breathing – despite having followed hospital procedures. Urbani told the hospital to isolate patients and staff, and the hospital was closed to the public. He reported these new cases to WHO and the Viet Nam government on 10 March. The severity of the symptoms and the fact that hospital staff there had also been infected prompted WHO to issue a global alert warning governments and the public about a new highly infectious disease of unknown origin in Viet Nam and Hong Kong SAR. The Organization issued the alert on 15 March, when more than 150 suspected new cases had been reported from several parts of the world, including Canada, Hong Kong SAR, Singapore and Viet Nam.

The ultimate price

With that alert, WHO provided a case definition that also named the syndrome as 'severe acute respiratory syndrome' or SARS, beginning a coordinated global outbreak response. Across the world authorities scrambled to prevent and contain SARS outbreaks. Thanks to Urbani and his colleagues in Viet Nam, WHO was able to act with decisive speed, alerting the world to a new global public health threat. But Urbani paid the ultimate price for his professionalism. After the two weeks he spent caring for SARS patients, he caught the disease himself and died on 29 March aged 46.

Following outbreaks in Canada, Hong Kong SAR, Singapore and Viet Nam, China permitted WHO epidemiologists to enter Guangdong Province to verify that the disease there was in fact SARS, a coronavirus related to the viruses that cause the common cold.

By then, WHO teams were working at every SARS outbreak site in Asia. The GOARN network had been able to bring together some of the world's top laboratory scientists, clinicians and epidemiologists in virtual networks, enabling them to quickly arrive at an understanding of the virus and how it was transmitted (see Box 7.5 SARS and the Internet). The Organization then provided that information to health workers with advice on the clinical management of SARS and the protective measures needed to prevent further spread.

Many lessons were learned during the 2002–2003 SARS outbreak – above all that infectious diseases know no borders and are everyone's problem. As Heymann puts it: "The SARS outbreak made one thing very clear – inadequate surveillance and response capacity in a single country can endanger national

Box 7.5. SARS and the Internet

When an outbreak of a highly fatal respiratory disease occurred in late 2002 and early 2003 in China, doctors thought it was a new type of flu. But as cases were admitted to hospitals in Canada, Hong Kong SAR and Singapore, it seemed that the outbreak was crossing borders and spreading fast. When scientists took samples of the 'diseases' and analysed them, they soon realized clear that they were dealing with one and the same disease – not flu, but a new respiratory condition.

The World Health Organization gathered the scientists who were based in the places where cases had been admitted to hospital and invited them to share their findings in telephone conferences. By working together and pooling their knowledge online about the new health threat, they knew that they could quickly identify the new disease. Once identified, experts could then find the best ways to contain the disease and save as many lives as possible. That is exactly what happened, thanks to their joint efforts and the Internet.

To enable the scientists to share their findings, WHO set up a password protected web site. Often scientists prefer to work in isolation and to be the first to make a scientific breakthrough. But this time, they shared their information by telephone and online, and within about a month the scientists had identified and genetically sequenced the new virus. They found out that it was a coronavirus, and gave the disease a neutral name – severe acute respiratory syndrome – because they felt it would be unfair to associate it any geographical place unlike Marburg, which was named after a German city, and Ebola, named after a river in the Democratic Republic of the Congo. Today, the new disease is best known by its acronym, SARS, and – as far as we know – has not made a comeback.

populations and the public health security of the entire world." In other words, if one country fails to keep an eye on disease outbreaks and does not report promptly an outbreak that has the potential to spread fast, that country and the rest of the world will pay the price later.

At the beginning of the 21st century countries faced a test of their ability to do just that. It came in the form of a new flu virus that became known as A (H1N1) 2009 influenza that was first identified in spring 2009 and that by July of the same year, had spread to more than 100 countries, prompting WHO to announce the first flu pandemic of the 21st century (see Box 7.6 The first flu pandemic of the 21st century).

This time it seemed that some lessons from history had at last been learned. Many countries that were affected – in particular Canada, Mexico and the United States where the new virus seems to have struck first – were praised for their willingness to share information and join forces with other countries to combat the new global health threat.

"Mexico gave the world an early warning and it also gave the world a model of rapid and transparent reporting, aggressive control measures and generous collaboration as their own outbreaks began to spread," said WHO Director-General Dr Margaret Chan. Referring also to the contribution of Canada and the USA, she said on a visit to Mexico in July 2009: "WHO and the international community have much to thank these three countries for setting a precedent that, up to now, nearly every country has followed." ■

Box 7.6. The first flu pandemic of the 21st century

Though often confused with the common cold, influenza – the real 'flu' – can be lethal. Influenza viruses are particularly difficult to fight because they are constantly changing. These viruses are new and therefore not recognized quickly by our immune system and that is why new vaccines are developed every year to protect us from them. A new influenza virus crosses from animal species into the human population every decade or two infecting people with no immunity and leading to an influenza pandemic.

WHO/H. Ruiz

Measures taken during the influenza A (H1N1) outbreak in Mexico in 2009

That is precisely what happened in 2009. In March of that year, WHO received reports from Mexico and the USA of an unusually high number of flu cases for early spring in the northern hemisphere. It turned out to be a new influenza virus, named pandemic A (H1N1) 2009 to which the vast majority of people around the world at the time had no immunity, but to which some people aged over 65 years had succumbed.

After early outbreaks in North America in April 2009, the new virus spread rapidly around the world. By the time WHO declared a pandemic in June 2009, a total of 74 countries had reported laboratory confirmed infections. As of February 2011 most countries in the world have had confirmed infections with the new virus.

The Organization has been working closely with governments to slow the spread of the pandemic influenza virus A (H1N1) 2009 and to encourage rapid vaccine production and distribution, including vaccine donations to poor countries.

Since previous flu pandemics (see Box 7.2 Three major pandemics in the 20th century), new antiviral medicines have been developed to provide treatment especially for the people who develop more severe illness or who are at higher risk of complications. In addition to vaccines and antiviral medicines, WHO and governments have distributed information on how individuals can protect themselves and others from getting infected in the first place, through simple hygiene measures, such as hand washing.

Unlike typical seasonal flu (which is mainly deadly for the elderly and for people with chronic medical conditions) pandemic A (H1N1) 2009 virus has led to unusual patterns of illness and death, particularly among younger people who were otherwise healthy. Still, two years into the first flu pandemic of the 21st century, most people who caught the new virus have experienced only a mild illness and recovered without treatment.