

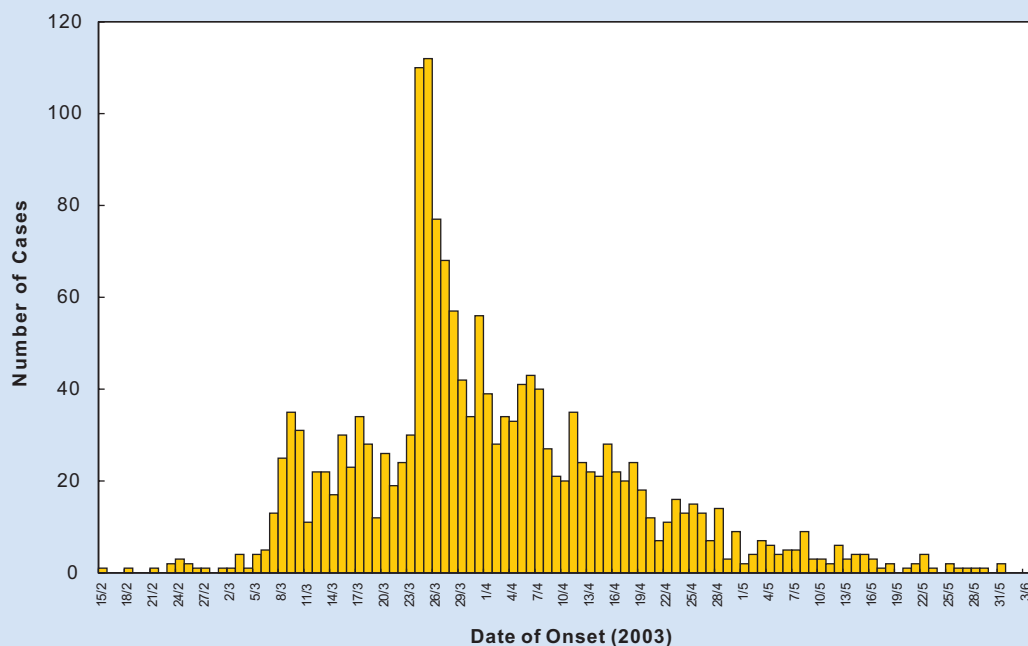
THE EPIDEMIC

General

3.30 The SARS epidemic in Hong Kong began on 10.3.03 when 11 healthcare workers from ward 8A of Prince of Wales Hospital went on sick leave simultaneously. It turned out to be a severe and prolonged epidemic, affecting 1,755 individuals over a period of approximately three months. The last SARS case was

confirmed and reported on 11.6.03, although the patient had been isolated in hospital since 2.6.03. The epidemic was declared officially over on 23.6.03 when WHO removed Hong Kong from the list of areas with recent local SARS transmission, based on the rationale that 20 days (i.e. twice the incubation period) had lapsed since the last SARS case was isolated, suggesting that the chain of infection was interrupted and terminated.

Figure 3.4 SARS Cases in Hong Kong
Epidemic curve by date of onset



The Prince of Wales Hospital Outbreak

3.31 Prince of Wales Hospital is a 1200-bed public hospital located in the New Territories East region. It is also the teaching hospital of the Chinese University of Hong Kong. The SARS outbreak in the hospital

occurred at a time when there was no knowledge of the existence of a novel coronavirus, let alone the duration and degree of infectiousness. Additionally, the pattern of symptoms had not yet been defined; WHO only first described the symptom complex of SARS on 15.3.03, followed by numerous revisions in

keeping with the steady accumulation of scientific knowledge about the SARS coronavirus.

3.32 The Prince of Wales Hospital outbreak affected a total of 239 individuals. Its epidemic curve is depicted in Figure 3.5.

10.3.03 Monday

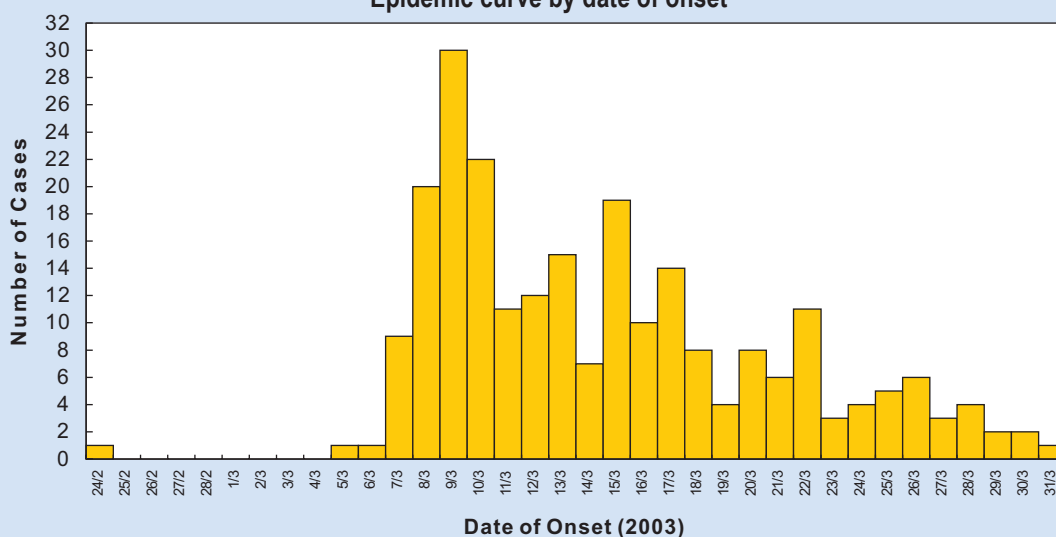
3.33 The outbreak first came to light on 10.3.03 when the hospital management was notified that a group of 11 healthcare staff, comprising 7 doctors and 4 nurses, working in ward 8A of the medical department had gone on sick leave simultaneously. A possible communicable disease outbreak was suspected. Ward 8A was immediately closed to admission and visitors.

11.3.03 Tuesday

3.34 On the next day, 11.3.03, there was media coverage of the sick healthcare staff with respiratory infection symptoms in Prince of Wales Hospital. DH's New Territories East Regional Office initiated contact with the hospital management who confirmed the abnormal pattern of sick leave amongst staff working in ward 8A. A special meeting was convened by the hospital later that morning, with participation of clinicians, the infection control team, hospital management and the community physician of DH's New Territories East Regional Office. Relevant points of the meeting were as follows –

- ◆ The number of healthcare staff on sick leave from ward 8A had increased to 14
- ◆ No abnormal pattern of illness was observed in in-patients of ward 8A
- ◆ Cessation of admission to ward 8A would continue

Figure 3.5 Prince of Wales Hospital Outbreak
Epidemic curve by date of onset



- ◆ The no-visiting policy was modified to restriction in visiting, with visitors required to wear surgical masks, disposable gowns and gloves
- ◆ All hospital staff on sick leave would be recalled to undergo physical examination in an emergency medical clinic
- ◆ An epidemiological study of the sick healthcare staff would be conducted by DH's New Territories East Regional Office using a purpose-designed questionnaire. This included items such as clinical, travel and exposure history, as well as movement in wards and health status of close contacts, to provide a basis for working out the case definition and estimating the incubation period.

3.35 By late evening, more hospital staff had become sick, including three cardiothoracic surgeons who had visited ward 8A the previous week. Significantly, two key action items were completed by then. First, DH's New Territories East Regional Office successfully interviewed 26 of the 36 hospital staff on sick leave, allowing epidemiological analysis to be undertaken. The symptoms were noted to be predominantly fever and chills. Advice on early treatment and personal hygiene was given. The remaining 10 could not be contacted or refused interview, but they were subsequently followed up.

3.36 Second, the hospital management recalled all healthcare staff on sick leave to undergo physical examination. By then, the number had increased to 50. Of these, 23 were assessed to require immediate hospital

Hospital visiting policy

The rationale to change no-visiting policy to ward 8A to that of restricted visiting were threefold –

- ◆ The uncertainty of the source or the causative agent at the time and the intense media publicity made ward 8A patients extremely anxious and agitated. Continuing with the no-visiting policy could have resulted in situations in which patients would be discharging themselves against medical advice, increasing the risk of spreading infection to the community
- ◆ The no-visiting policy was also regarded as having a deterrent effect to potential patients, preventing them from presenting early to hospital
- ◆ It was considered that appropriate droplet precautionary measures with mask, gown and gloves would confer adequate protection to visitors.

admission: 15 had fever of more than 38°C and the remaining 8 had chest x-ray signs of pneumonia. This first group of 23 staff were isolated in the observation ward of the accident and emergency department, which was vacated for the purpose. Those who were not as sick, or who were not admitted, were asked to return to a screening clinic, specially set up in the accident and emergency department, for follow up the next day. The screening clinic was also used to provide consultation and examination of other staff who developed fever and were suspected to have atypical pneumonia.

12.3.03 Wednesday

3.37 Both DH and HA continued to strengthen their actions on outbreak and infection control. DH's New Territories East Regional Office set up a special control team to handle matters relating to the Prince of Wales Hospital outbreak, including case follow-up, contact tracing and surveillance, epidemiological analysis, and prevention of spread to the community.

3.38 Prince of Wales Hospital implemented the following –

- ◆ The 8th floor of the main building, where ward 8A was situated, had been made a restricted area
- ◆ Specific medical wards were designated cohort wards for cases of suspected and confirmed atypical pneumonia
- ◆ The medical team was divided into a “dirty” team and a “clean” team. The former was responsible for taking care of patients with atypical pneumonia, while the latter was responsible for all non-atypical-pneumonia cases. There would be no crossover between the two teams. The purpose was to prevent cross-contamination among staff and cross-infection to patients
- ◆ The Disease Control Centre was established to coordinate data collection and reporting, and facilitate exchange of information with DH for contact tracing and disease control.

Preliminary epidemiological findings

On 12.3.03, preliminary results of the epidemiological survey of sick hospital staff were presented by the community physician of the New Territories East Regional Office, as follows –

- ◆ The incubation period was estimated to be between 1 and 7 days
- ◆ The mode of spread was probably droplets and through fomites, ie contaminated materials via body secretions.

Based on the clinical symptoms of fever and chills, a working case definition was formulated for active case finding and surveillance.

13.3.03 Thursday

3.39 To improve communication and facilitate outbreak investigation, DH's New Territories East Regional Office stationed an initial team of staff which comprised an experienced medical officer and two nursing staff at Prince of Wales Hospital. The team commenced interviewing patients of ward 8A to identify the source of the outbreak and to assess the risk of spread to other patients. Prince of Wales Hospital introduced further control measures in response to the outbreak –

- ◆ Suspension of non-emergency surgical operations, day services and cardiac specialist out-patient clinics
- ◆ Diversion of patients with medical emergencies who were not pneumonia cases to nearby Alice Ho Miu Ling Nethersole Hospital and North District Hospital

- ◆ Upgrading of droplet infection control guidelines and measures
- ◆ Commencement of training sessions twice a week on infection control for staff
- ◆ Establishment of a “cluster meeting on atypical pneumonia”, which met twice daily to steer direction and make decisions on disease and infection control.

Global alert

There was no doubt that the most significant event on 12.3.03 (Geneva time) was the announcement by WHO.

Based on the information supplied by DH on the Prince of Wales Hospital outbreak, WHO placed the international community on high alert about cases of acute respiratory syndrome with unknown aetiology in Vietnam, Hong Kong and Guangdong Province in China that appeared to place health workers at high risk.

A high level review

The outbreak situation in Prince of Wales Hospital was reviewed by SHWF on 13.3.03. Participants included a senior expert from the Centers for Disease Control and Prevention (CDC) Atlanta, USA, who participated in the meeting in his capacity as a representative of WHO, the Director of Health and HA's Chief Executive, their respective officers, and public health and clinical experts. Relevant points of the meeting are summarised below –

- ◆ Local surveillance data on pneumonia cases were presented, with the principal observation that there was no unusual increase of pneumonia cases in the community
- ◆ Observation that there was no other hospital outbreak similar to that of Prince of Wales Hospital
- ◆ An update on the Prince of Wales Hospital outbreak was made, and the meeting agreed that –
 - Both DH and HA would work together to investigate the outbreak, including the sharing of laboratory specimens
 - Surveillance of cases and contacts would be intensified
 - Both DH and HA would inform their relevant departments, divisions or groups to ensure adherence to the infectious disease guidelines
 - Exchange of information with WHO, Mainland China and CDC Atlanta, USA would be maintained and strengthened
 - SHWF would chair a steering group to coordinate efforts of outbreak control and enhance information exchange
 - Deputy Director of Health would chair an expert group with experts from DH, HA, the University of Hong Kong, the Chinese University of Hong Kong and WHO to focus on investigation.

(NB: For operational efficiency, the steering group and the expert group were later combined to become the HWFB Task Force, chaired by SHWF with participation of experts from DH, HA, the University of Hong Kong, the Chinese University of Hong Kong and WHO.)

14.3.03 Friday

3.40 SHWF convened and chaired the first meeting of the HWFB Taskforce. Areas of discussion centred on –

- ◆ Refinement of case definition to include fever of more than 38°C
- ◆ Further epidemiological and laboratory investigations needed for cases in Prince of Wales Hospital, the case transferred from Hanoi, and sick healthcare workers from Pamela Youde Nethersole Eastern Hospital and a private clinic
- ◆ Contact tracing as a part of the epidemiological investigation and control measures
- ◆ Infection control measures with particular emphasis on droplet precautions
- ◆ Treatment of cases with anecdotal evidence of effectiveness involving high dose steroids plus ribavirin in certain category of patients
- ◆ Messages for public communication to include the fact that pneumonia was common in Hong Kong and a causative agent could not be identified in about half of the cases.

3.41 In the afternoon of 14.3.03, SHWF held the first of a series of daily press briefings with a view to maintaining openness and transparency in the outbreak management. Two key messages were provided –

- ◆ Background pneumonia cases in Hong Kong on average totalled 1,500 - 2,000 per month. Surveillance data at that time did not reveal any unusual or abnormal increase in cases in the community.
- ◆ The Government was investigating four groups of cases of atypical pneumonia that appeared to have a tendency to affect healthcare workers –
 - The Prince of Wales Hospital cluster with a large number of staff affected
 - The Pamela Youde Nethersole Eastern Hospital with six staff affected
 - The patient transferred from Hanoi who infected a number of healthcare staff in Vietnam

Transcript of SHWF's first message (14.3.03)

SHWF said: *"In Hong Kong, every month we have 1,500 to 2,000 cases of pneumonia, and about half we can identify the bacteria and the other half usually we can't. The pattern has not changed and our experience is very similar to those other developed countries. So we are not talking about any outbreaks in the community and that is why yesterday we were talking about particularly looking at particular group. We are not saying that infection is [not] going to occur in the community, that it doesn't go into the community. What we are saying is that all these community pneumonias seem to have a subset which is very very particular that it does appear to [have a] predisposition [to] affect healthcare professionals who care for these patients and also very close family contacts."*

- The case of a private doctor and three of his nursing staff, who were reported to have come down with pneumonia after seeing a patient.

3.42 By late evening of 14.3.03, the teams from DH's New Territories East Regional Office and Prince of Wales Hospital jointly confirmed that an in-patient of ward 8A, *JJ*, was the index case of the hospital outbreak. Because of clinical suspicion, the patient had already been placed in a single isolation room of ward 8A the day before. Both teams also agreed that persons exposed to *JJ* should be traced. They further agreed to share the workload as follows –

- ◆ For hospital staff, medical students and in-patients exposed to the index case, *JJ*, hospital management would initiate the work of contact tracing
- ◆ For hospital visitors and discharged patients who had been exposed to the index case, *JJ*, DH's New Territories East Regional Office would initiate the work of contact tracing

3.43 On the same day, Prince of Wales Hospital management decided to stop all clinical admissions to the medical department.

15.3.03 Saturday

3.44 On 15.3.03, WHO issued a rare emergency travel advisory in response to the reported outbreaks in a number of countries in Asia of a respiratory illness. It named the disease Severe Acute Respiratory Syndrome (SARS), declaring it a worldwide health threat.

Openness and transparency

WHO has praised Hong Kong openly on a number of occasions for its openness and transparency in the territory's management of the SARS epidemic. The "honesty is best" policy could be traced to three strategic decisions made on Friday, 14.3.03 at the weekly Senior Officials Meeting chaired by the Chief Executive of the Hong Kong Special Administrative Region, as follows –

- ◆ Information on the outbreak should be disseminated to the public on a daily basis
- ◆ Advice should be given to the public on precautionary measures
- ◆ Hong Kong should work closely with international organisations and seek expert help if necessary.

3.45 WHO defined a suspected SARS case as disease in a person with a documented fever (temperature: >38°C), lower respiratory tract symptoms, and contact with a person believed to have had SARS or a history of travel to a geographical area where there had been documented transmission of the illness. A suspected case that involved chest radiographic findings of pneumonia, acute respiratory distress syndrome, or an unexplained respiratory illness resulting in death with autopsy results demonstrating the pathology of acute respiratory distress syndrome without an identifiable cause was considered a probable case.

3.46 Although the emergency travel advisory issued on 15.3.03 did not contain a recommendation to member countries to

restrict travel to any destination, all its recommendations were directed at preventing international spread of the disease, through professional and public awareness, heightened

surveillance and the rapid implementation of case management. WHO subsequently issued a travel advisory against Hong Kong and Guangdong Province on 2.4.03.

The search for the index case

Intense efforts by the teams from DH's New Territories East Regional Office and Prince of Wales Hospital paid off on 14.3.03 when *JJ* was successfully identified as the index case of the hospital outbreak. The clues were cumulated over the previous few days. An epidemiology study conducted on the evening of 11.3.03 revealed that medical students and some staff not from ward 8A, but who had visited ward 8A, had also become affected. Subsequent interviews showed that they only went to ward 8A to attend selective patients. On 13.3.03, both teams undertook to review the contact and clinical history of ward 8A in-patients and those who had been discharged since mid-February with respiratory or unexplained febrile illness. In the process, *JJ*, who had the earliest date of onset of symptoms, was identified as the suspected index case.

JJ, aged 26, was admitted on 4.3.03 to ward 8A of Prince of Wales Hospital with a diagnosis of community-acquired pneumonia. He gave a history of fever, chills and rigor since 24.2.03. Six days after admission, his fever and chest condition gradually improved. Throughout this period, *JJ* had neither required assisted ventilation nor received treatment in the intensive care or high dependency care units, although he was put on nebuliser treatment between 6-12 March. Hence, he was never categorised as a case of severe community-acquired pneumonia, and his admission to ward 8A did not trigger off infection control measures, including droplet precautions. Similarly, no notification was activated to initiate case investigation and contact tracing.

Three relatives of *JJ* were noted to have been admitted with fever to Prince of Wales Hospital on late 13.3.03 and early 14.3.03. A fourth relative was identified to have been admitted to the private Baptist Hospital on 13.3.03. Detailed exposure history to *JJ* amongst sick staff was therefore specifically examined. It was not long before the linkage of sick healthcare staff to *JJ* was also established. Hence, *JJ* was confirmed in the evening of 14.3.03 as the index case of the Prince of Wales Hospital outbreak. Eventually, *JJ*'s infection was linked to Professor *AA* through his visit to *Hotel M*.

The use of nebuliser treatment on *JJ* was subsequently identified on 18.3.03 as an important factor contributing to the extensive spread of the infection in ward 8A. In all, 143 individuals were subsequently found to have acquired the infection through direct contact with *JJ*, as follows –

Category of individuals	Number
Healthcare workers	50
Medical students	17
Ward 8A patients	30
Ward 8A visitors	42*
<i>JJ</i> 's relatives	4
Total	143

* all the 42 visitors made their visit to ward 8A on or before 10.3.03

16.3.03 Sunday - 23.3.03 Sunday

3.47 During the period between 16.3.03 and 23.3.03, key events of relevance to the Prince of Wales Hospital outbreak are summarised below –

- ◆ 16.3.03
 - Following WHO's advisory on 15.3.03, DH's New Territories East Regional Office and Prince of Wales Hospital revised their case definition to include chest x-ray features of pneumonia as an additional parameter.
- ◆ 17.3.03
 - Prince of Wales Hospital diverted all medical emergencies to hospitals outside the New Territories East Cluster. It eventually closed its accident and emergency department completely on 19.3.03.
- ◆ 18.3.03
 - The use of nebuliser on the index patient was identified as an important factor contributing to the extensive spread of SARS in ward 8A. An alert was issued by HA head office on the use of nebuliser in HA's Guidelines on Management of SARS the next day, 19.3.03.
- ◆ 19.3.03
 - DH announced the chain of transmission of the *Hotel M* cluster and established that the index patient of the Prince of Wales Hospital outbreak was connected to this cluster of infection.
- ◆ 20.3.03
 - Chief Executive of HA had a meeting with Prince of Wales Hospital management and the Faculty of Medicine, the Chinese University of Hong Kong regarding their concern on community spread and the need for urgent contact tracing. The meeting was triggered by the admission of two general practitioners, *PP* and *NN* from the Tai Po and Shatin districts. He later contacted the Deputy Director of Health around midnight on the need to step up contact tracing and disease control in the community.
- ◆ 21.3.03
 - Deputy Director of Health visited Prince of Wales Hospital and further enhanced DH's contact tracing team based in the hospital with the addition of a senior Principal Medical Officer. DH also extended its surveillance of SARS symptoms of visitors to all acute medical wards.

- ◆ 22.3.03
 - The University of Hong Kong announced the identification of a novel variant coronavirus as the causative agent of SARS.
- ◆ 23.3.03
 - Chief Executive of HA, who had visited Prince of Wales Hospital eight times over the past two weeks, was admitted to Queen Mary Hospital with suspected SARS.

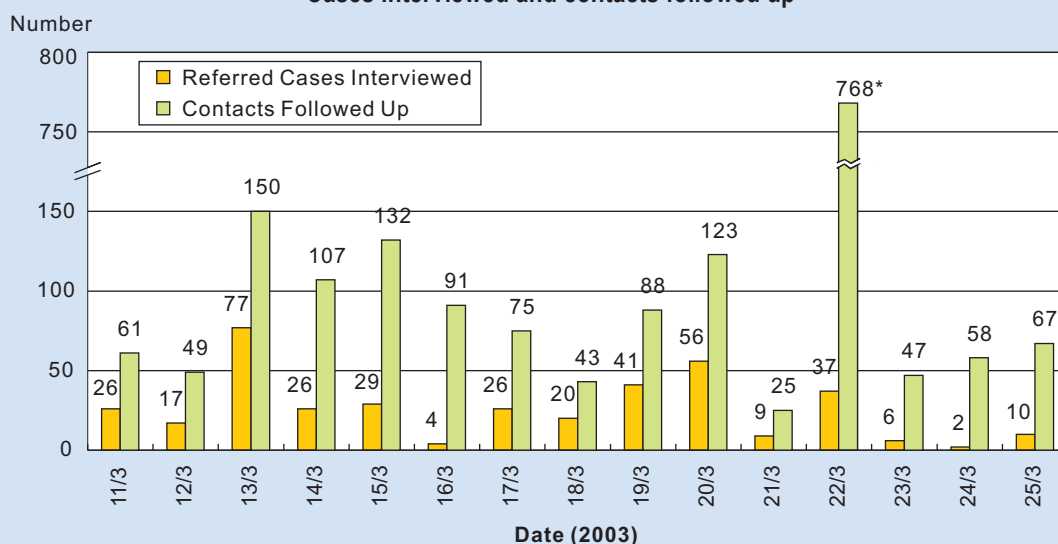
Contact tracing and workload

In the Prince of Wales Hospital outbreak, DH's New Territories East Regional Office interviewed cases referred by hospital physicians on a daily basis. For those who were seriously ill, their informants would be approached. Through these means, information on the contacts would be ascertained. Once identified, two specific public health actions would be taken, as follows –

- ◆ All contacts would be screened for symptoms of infection, and if negative, alerted to potential symptoms. They would be further advised to get in touch with the New Territories East Regional Office if they subsequently became ill. Additionally, advice on personal hygiene and measures to prevent respiratory tract infection would be provided
- ◆ Medical surveillance would be instituted for all contacts, initially for 14 days during the early phase of the epidemic and later for 10 days when the incubation period of the SARS virus was better documented, commencing from the last day of exposure to a case.

Illustrated below was the initial workload of contact tracing at Prince of Wales Hospital.

Figure 3.6 Prince of Wales Hospital Outbreak
Cases interviewed and contacts followed up



* this figure was contributed by the large number of contacts involving a private doctor, PP's clinic.

As at 25.3.03, DH's New Territories East Regional Office successfully interviewed 386 cases, of whom 134 were eventually confirmed to have SARS, and followed up 1,884 contacts, of whom 59 eventually developed SARS.

Decisions on hospital operations

Prince of Wales Hospital was severely hit by the SARS outbreak, with a total of 87 healthcare workers eventually becoming infected. In particular, the medical department was the most heavily inflicted, with 15 physicians acquiring the infection. In a rapidly changing situation, assessments had to be made continually on whether the hospital could continue to deliver services safely.

In providing information to the Committee, the New Territories East Cluster Chief Executive highlighted the establishment of the “cluster meeting on atypical pneumonia” on 13.3.03 as the paramount decision-making body. He mentioned that this forum met twice daily, at which decisions on hospital operations were made collectively. Membership included senior members of the cluster management, the chiefs of service (mostly professorial staff of the Chinese University of Hong Kong), various clinical heads, heads of infection control team and the Dean of the Faculty of Medicine, the Chinese University of Hong Kong. He also described the level of input required from HA head office, particularly on matters requiring coordination or approval at the head office level, such as diverting emergency cases to other hospitals and closure of the accident and emergency department.

Based on the above structure and input from HA head office, a series of stepwise decisions were taken to curtail service provision and hospital operations, as follows –

- 13.3.03 ♦ Suspension of non-emergency surgical operations, day services and cardiac specialist out-patient clinic
 - ♦ Diversion of patients with medical emergency who were not pneumonia cases to nearby Alice Ho Miu Ling Nethersole Hospital and North District Hospital
- 14.3.03 ♦ Stoppage of all clinical admissions to medical department
- 17.3.03 ♦ Diversion of all medical emergencies to other hospitals outside the New Territories East Cluster
- 19.3.03 ♦ Closure of the accident and emergency department completely, stopping all emergency attendances and admission until 30.3.03. The decision was due, in part, to the surge in need for beds in the intensive care unit. It was noted that quite a number of patients started to deteriorate in the second week of admission, requiring treatment in the intensive care/high dependency care unit.

- DH received notification about a couple who was admitted to HA’s Tuen Mun Hospital the previous day with fever. They were symptomatic during their group tour to Beijing from 15.3.03 to 19.3.03. Contact tracing revealed that some members of the Beijing tour group were also symptomatic. In all, 23 passengers and 2 crew members

on board the flight bound for Beijing on 15.3.03 were later found to be infected. The source of infection was eventually traced to a Beijing resident who visited ward 8A of Prince of Wales Hospital between 4.03.03 and 09.03.03, and who developed symptoms on 11.03.03.

Piecing together the *Hotel M* epidemiological jigsaw

The global alert issued by WHO on 12.3.03 on cases of acute respiratory syndrome played a facilitating role in solving the epidemiological jigsaw puzzle of the *Hotel M* outbreak. On 13.3.03, DH received reports from the Singapore government that three Singaporeans who visited Hong Kong in late February had developed pneumonia and were hospitalised in one of its public hospitals. No causative agent had yet been identified. All had stayed in *Hotel M* while in Hong Kong. On 18.3.03, information on three similar cases was also received from Canada, with one of them having stayed in *Hotel M* as well.

With the two reports indicating a linkage to *Hotel M*, DH proceeded to examine in depth patient records of severe community-acquired pneumonia cases and that of Prince of Wales cases. Patients were re-interviewed. It was found on 19.3.03 that seven of the patients were related to *Hotel M*, including the Guangzhou professor, index patient of the Prince of Wales Hospital (PWH) outbreak, and the index patient of the St Paul's (SPH) Hospital outbreak. They had either stayed on or visited the same floor of *Hotel M* during the same period. The Guangzhou professor was identified as the index case as he had the earliest onset of symptoms. The Government held a press conference that evening to announce the findings and the chain of transmission of the *Hotel M* cluster.

On 20.3.03, WHO informed DH that *DD*, the patient transferred from Hanoi, had also stayed in *Hotel M* around the same time. By then, major pieces of the epidemiological jigsaw had been pieced together. The SARS outbreaks in Canada, Singapore and Vietnam were formally linked to *Hotel M*. More cases were subsequently discovered from active case finding and assistance from the respective consulate offices. The chain of transmission of *Hotel M* is illustrated below.

