



衛生防護中心  
Centre for Health Protection

## Scientific Committee on Vector-borne Diseases

### Situation of Plague and Prevention Strategies

#### Purpose

To review the global and local epidemiology of plague and examine the prevention and control measures in Hong Kong.

#### I. Plague in Humans

2. Plague is a disease caused by *Yersinia pestis*, a gram negative coccobacillus belonging to the family *Enterobacteriaceae*. It has a characteristic bipolar staining with aniline dyes and appears as a “safety pin” under microscopy. It has low resistance to environmental factors that it is readily killed by sunlight, high temperatures, desiccation, and ordinary disinfectants or preparation containing chlorine.(1,2)

#### Clinical Manifestation

3. Plague infection in human commonly manifests as three clinical forms including bubonic plague, septicaemic plague, and pneumonic plague. Bubonic plague, the commonest form, refers to the lymphadenitis which develops in the lymph nodes that drain the site of flea bite. Septicaemic plague refers to bloodstream dissemination of the bacterium. Pneumonic plague is the infection involving lung parenchyma and is the only form that can lead to secondary spread by person-to-person transmission through the infectious respiratory droplets. Plague may also manifest in other less common clinical forms such as pharyngeal plague, meningial plague, and plague endophthalmitis. The incubation period of plague infection ranged from 1 to 7 days, but it is usually shorter in pneumonic plague which ranges from 1 to 4 days.(2)



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4. After the flea bite, patient with bubonic plague may initially present with fever, chills, malaise, myalgia, nausea, prostration, sore throat and headache. Subsequently, swollen, extremely painful and tender lymphadenitis (bubo) develops at the regional lymph nodes of flea bite. Inguinal lymph nodes are frequently affected while axillary and cervical lymph nodes are less commonly affected.(1)

5. Septicemic plague may occur without signs of local involvement, i.e. primary septicemic plague, or arise secondary from all plague infection. During septicemic plague, the patient may present with endotoxic shock and disseminated intravascular coagulation (DIC). Other parts of the body, e.g. lungs, meninges, may subsequently be involved due to bacteriaemic dissemination.

6. Pneumonic plague can be acquired primarily after inhalation of the infectious respiratory droplets while in close contact with patient or animal which has pneumonic or pharyngeal plague. In a bioterrorism attack, aerosolized plague sources may be disseminated efficiently causing pneumonic plague in large crowds within a short period of time. Alternatively pneumonic plague can arise secondarily from the bloodstream dissemination. The patient develops overwhelming pneumonia associated with high fever, chills, cough, and haemoptysis.

### Laboratory Diagnosis

7. Definitive laboratory diagnosis of plague is based on the isolation of *Y. pestis* from cultures of exudates aspirated from buboes, blood, CSF or sputum, or by a four-fold or greater change in antibody titre to *Y. pestis* fraction 1 (F1) antigen in paired serum specimens.(1,2)

8. Other laboratory tests which may assist in the diagnosis of plague include detection of *Y. pestis* F1 antigen by fluorescent assay or genome by PCR in a clinical specimen.(2-4) PCR test for genome is specific but insensitive and it is not adopted in routine clinical use.(5)

9. In 2003, a rapid diagnostic bedside test has been developed by WHO in Madagascar which is able to provide a result in 15 minutes.(6) Initial evaluation demonstrated 100% sensitivity and specificity on freshly isolated *Y. pestis* strains and positive control clinical samples. Its application in other places or settings is being further evaluated by the WHO.(7)

10. Emergence of multidrug-resistant strains of *Y. pestis* has become a concerned issue since 1995 when two multidrug-resistant strains of *Y. pestis* were isolated from a plague outbreak in Madagascar.(8) One isolate was resistant to all usual antimicrobial agents and the resistance was mediated by a transferable plasmid. While prevalence of this strain in natural plague foci is

unknown, performing antibiotic susceptibility test for any plague bacteria isolates is essential.

### Clinical and Public Health Management

11. The disease is curable when appropriate antibiotics are given early enough. It is especially critical for pneumonic plague patient which should be initiated within 8 – 18 hours after onset of symptoms.(1) According to the consensus statements developed by the Working Group on Civilian Biodefense in 2002, in a contained casualty setting, intravenous treatment with streptomycin and gentamycin are the preferred drugs while doxycycline and ciprofloxacin are the alternatives.(9) Oral antibiotics are recommended in a mass casualty scenario, e.g. after a deliberate release of plague as a biological weapon, when parental therapy was either unavailable or impractical. Either doxycycline or ciprofloxacin would be the preferred choices in these scenarios. Besides, tetracycline and chloramphenicol are the other two traditional alternatives for treating plague while chloramphenicol is the preferred treatment of plague meningitis due to its good penetration across the blood-brain barrier.(2) Surgical drainage may be required for suppurative bubo. Other intensive care may be required in complicated cases.

12. Public health measures are crucial to prevent further transmissions through the vector flea on the patients or person-to-person contact especially in those with pneumonic and pharyngeal plague. These include patient isolation and infection control measures, removing and killing fleas from the patient and the clothing, contact tracing and antibiotic prophylaxis.

13. Patients with suspected or confirmed pneumonic plague should be isolated for the first 72 hours of appropriate antibiotic therapy with indications of clinical improvement and sputum culture negative for *Y. pestis*.(3,10-14) When caring these patients, health care workers should also take droplet precautions by using surgical mask and eye protection in addition to Standard precautions.(15) Standard precautions should be applied to all other clinical forms. In the event of deliberate release of plague in a biological attack, US and UK has different recommendations on respiratory precaution. Working Group on Civilian Biodefense recommends wearing a surgical mask for caring patients with suspected or confirmed pneumonic plague whereas HPA recommends wearing at least a surgical mask but preferably a medium efficiency FFP2 face mask for caring patients with all forms of plague.(9,10)

14. Disinsection of flea from the patient's body should be done concomitantly by showering and application of insecticide, such as malathion emulsion, that is effective against local fleas and known to be safe for people. The contaminated clothing of the patient should be removed on admission and placed in a sealed bag pretreated with insecticide for autoclaving or

incineration.

15. Contact tracing is essential in preventing the spread of plague. All persons who may have the same exposure history as the case, e.g. home contacts, travel collaterals, workplace contacts, or who have been in close contact with pneumonic plague patients or in direct contact with the body fluid or tissue of the plague patient, e.g. health care and laboratory workers, should be identified for interview and medical surveillance. Quarantine of the exposed persons may be necessary. A course of post-exposure chemoprophylaxis should be given within 6 days of exposure to close contacts of a pneumonic plague patient and those in direct contact with the body fluid or tissue of plague patient. Doxycycline and ciprofloxacin are the drugs of choice while chloramphenicol is an alternative.

16. As for the prognosis, untreated bubonic plague has a case-fatality rate of about 50-60%.<sup>(1)</sup> Untreated primary septicemic plague and pneumonic plague are invariably fatal. Appropriate and early initiation of antibiotic reduces the overall mortality rate to less than 15%.<sup>(7,16)</sup>

## **II. Epidemiology and Mode of Transmission**

### *Mode of Transmission and Reservoirs*<sup>(2,17)</sup>

17. Plague transmission in nature is maintained primarily by a cycle involving wild rodents and their fleas. Wild rodents are relatively resistant to plague so that transmission of the disease can be maintained and become enzootic. A plague focus refers to an area, usually wild or rural, where such enzootic cycle is established. Many species of wild rodent and fleas have been implicated in transmission of plague in natural plague foci.

18. Natural plague foci can be found in Asia and extreme southeastern Europe, ranging from the Caucasus Mountains in Russia, through the Middle East, eastward through China, and then southward to Southwest and Southeast Asia. In Africa, plague foci are distributed from Uganda south on the eastern side, and in southern Africa, especially in Madagascar. In North America, natural plague foci occur from the Pacific Coast eastward to the western Great Plains and from south-western Canada on the border with the United States southward to northern Mexico. The world distribution of plague is shown in Figure 1.<sup>(17)</sup>

Figure 1: World distribution of plague(18)



19. When plague is introduced from enzootic areas into areas of more susceptible rodent species, such as rodent species in urban or domestic settings, an epizootic with high mortality may occur. *Rattus rattus* and *Rattus norvegicus* are important domestic rodent hosts of plague and they usually died after being infected. In China, *Rattus flavipectus* is another commensal rat that can be affected by plague. This species can be found in southern Yunnan, the coastal areas of Zenjiang, Fujian, Taiwan, Guangdong and Guangxi of southern China.(2) *Xenopsylla cheopis*, a common parasite found on these *Rattus* species, is the most important cosmopolitan vector of plague. A high incidence of plague-infected *X. cheopis* in a certain areas will greatly increase the risk of transmission to humans residing or visiting to the areas.

20. Other animals may occasionally be infected with plague after bitten by the infected fleas. Predators of the infected rodents or animal may also acquire the disease by eating the infected tissues. Domestic cats tend to develop severe illnesses after infection.(24) Over 75% of the infected domestic cats became acutely ill, developed buboes and had bacteremia, and over one-third of them died. Cat flea (*Ctenocephalides felis*) and dog flea (*Ctenocephalides canis*), which are occasionally found on domestic rodents, are regarded as poor vector of plague and do not cause significant human disease.(2, 24)

21. In a natural setting, human are almost invariably affected when rodents in urban or domestic settings are affected. Large number of domestic rats dying of plague usually preceded human outbreaks or epidemics. Human can be infected by flea bite, direct contact with the carcass of the infected rodents or animals, or inhalation of infectious respiratory droplets during close contact with persons or pets (e.g. cat) with pneumonic plague. In the United States, 18 cat-associated human cases were reported, with 5 of them developed primary pneumonic plague.(24) Since *Y. pestis* can be isolated from the oral cavity in about 90% of the symptomatic cats, this might explain the high rate of pneumonic plague transmission from cats to humans.

### Plague as a Biological Weapon

22. A plague outbreak following use of a biological weapon is considered as a plausible threat. In 2000, the United States have developed a consensus statement on plague and quoted WHO's estimation in 1970 that in a worst scenario, an aerosol release of 50 kg of *Y. pestis* over a city of 5 million population may cause 150,000 pneumonic plague cases and 36,000 deaths.(9) Considering the facts about the capability of person to person transmission with pneumonic plague, high mortality of the disease, the probability of causing public panic and social disruption, and the requirement of a broad-based public health preparedness efforts, plague has been given the highest priority among possible bioterrorism agents and classified as a Category A bioterrorism agent by the United States Centers for Disease Control and Prevention.(19,20)

23. A plague epidemic as the result of its use as a biological weapon may have the following characteristics: suddenness, severe disease pattern, large number of affected cases, and unusual geographical or demographic characteristics. Suddenness refers to the occurrence of plague cases within a time period that is unusual or incompatible to the time course under natural exposure. In case of aerosol release of plague, the affected persons may present with primary pneumonic plague which is more severe and have higher mortality when compare with diseases due to other routes of entry.(3,9,21) When a large-scale attack taken place in a population centre, large number of person would be affected. A deliberate release of plague will produce an unusual geographical or demographical distribution in regard to the probable time of exposure.(22)

### Global and Local Epidemiology(2,23,24)

24. Plague is an ancient disease which has caused three deadly pandemics in the last two millennia. It had been suggested that the total death toll of plague throughout the recorded history was 200 million.

- (a) The first plague pandemic (A.D. 542 to 750) began with the Justinian plague (A.D. 541 to 544) in Egypt in the sixth century. The disease then spread across Europe and to Asia and Africa. During the Justinian epidemic, nearly 100 million lives were claimed.
- (b) The second pandemic began with the well known "Black death" epidemic in the fourteenth century (A.D. 1347 to 1351) and last for about 130 years. During this pandemic, about 50 million people died in Asia, Africa and Europe.
- (c) The third pandemic began in the Yunnan Province in China in the mid-nineteenth century (1855 – 1950s). The disease had reached Guangdong and Hong Kong in 1894 and subsequently spread to other parts of world by rats on board of fast-moving steamships.(2) India and China were the two most affected countries with more than 12

million deaths.(9)

25. Since mid-19th century, regional and international sanitary convention aimed at controlling the spread of infectious diseases from one nation to another had been gradually established. The discovery of the causative agent and a better understanding of plague's epidemiology since late 19th century have led to the use of effective treatment and control of plague foci and hence the chance of extensive plague epidemic has been greatly reduced. The international collaboration on infectious disease control has further been enforced after WHO's establishment. International Health Regulations (IHR) implemented by WHO had included plague, as one of three infectious diseases that were subject to international control since 1969.(25,26)

26. Nowadays, outbreaks of human plague are commonly associated with poverty, civil disturbances and war leading to massive population displacement, breakdown of health infrastructure and facilities, deterioration in sanitary conditions in developing countries, and natural disasters.(23) Based on the available data up to 2003 from WHO, over 38,000 cases with about 2,850 deaths were recorded in 25 countries since 1989. About 2,500 cases and 190 deaths were reported each year, mostly in Africa and Asia. Case fatality rate is dependent on the local health care systems and ranged from 4.8% to 11.8% with an average rate of 8.0%.

27. As regards the geographical distribution, human plague cases have been consistently reported from eight countries including three African countries (Democratic Republic of the Congo, Madagascar and the United Republic of Tanzania), two in the Americas (Peru and the United States), and three Asian ones (Mainland China, Mongolia and Vietnam).

- (a) In Africa, most cases were reported from Madagascar which constituted 42.0% of all cases followed by the United Republic of Tanzania and Democratic Republic of the Congo which reported 15.8% and 16.8% of the cases respectively. The most recent plague outbreaks in the world occurred in several districts of Oriental province in the Democratic Republic of the Congo in between December 2004 and November 2006 affecting about 1,500 persons and 130 deaths.(27)
- (b) In the Americas, Peru reported over 80% of all cases while the America only constituted about 6% of the case load. The yearly figures of human plague cases reported in Americas decreased steadily from 55 in 1996 to 1 case in 2003.
- (c) In Asia, Vietnam reported over half of all cases while Mainland China and Mongolia constituted 9.5% and 2.1% respectively.

- (i) Vietnam had experienced major plague epidemics in 1967 – 1971 with over 21,000 human plague cases reported, comprising 89.2% of the global total. Prolonged armed conflict resulted in disruption of the economy, ecosystem and infrastructure and defoliation of vast areas during military operations in Southern Vietnam contributed to the increased plague morbidity in this period.(2) The disease remained very active in Vietnam throughout 1970s and 80s, until 1990s when its activity decreased from relatively active to low in the 2000s. The average number of case reported per year dropped from about 270 cases in 1990s to 10 cases in 2000s. Cases had been reported from 7 provinces in the region of South-central coast and Central highlands. Plague is probably maintained by commensal rat species in a domestic or peridomestic cycle. According to WHO, no human plague case had been reported in Vietnam since 2003.(28)
- (ii) In China, human plague cases mainly occurred in Yunnan and Qinghai provinces and Xizang autonomous region since 1990.(29) Among the three provinces, Yunnan was the most severely affected province, contributing over 60% of all human plague cases reported in China from 1989 to 2003.(30,31) In 1996, China recorded their highest number of cases during this period with a total of 98 cases. Eighty-eight and 3 bubonic plague cases occurred in Yunnan province and Qinghai province respectively while 7 fatal pneumonic plague cases occurred in Xizang autonomous region. In the same year, the number of active natural plague foci was the highest in the preceding 40 years. Outbreaks of epizootic plague occurred in 49 counties of 6 provinces including Yunnan, Qinghai, Inner Mongolia Gansu, Xinjiang and Xizang.(32) In Yunnan, human plague case was reported almost yearly since 1986 after a silence period of 30 years. Persistence of plague foci involving the commensal rat species, mainly the *Rattus flavipectus*, contribute to the continual plague activity in this province. The increased number of human cases reported in Yunnan coincided with the increased number of epizootics reported in 1990, 1996 and 2000. Although southeastern part of China including Guangdong province had been areas badly affected by plague during the third pandemic, there had been no human plague cases reported from these areas since 1960s.(29)
- (iii) In Mongolia, the number of human plague cases reported remained relatively stable at about 8 cases per year.

28. Re-emergence of plague in areas other than the above countries

after a long period of silence is another issue of concern. In the past fifteen years, outbreaks affecting 909 people have been reported in India, Indonesia, and Algeria, where no human case had been reported for about 30 to 50 years. India reported the biggest outbreak in 1994 affecting 876 persons who were reported as presumptive plague cases including 54 deaths occurred in five states.(33) This outbreak captured local, national and international media interest which resulted in wide spread panic among local residents and flee from the affected states, and an economical lost of about US\$ 1.7 billion in India due to unnecessary travel and trade restrictions imposed by a number of countries.(25) The occurrence of these plague outbreaks was believed to be related to severe ecological changes following an devastating earthquake in that region in 1993.(34) Other factors like crowded living condition, poor sanitation, growth of rat population, limited health care support, poor public health system and religious practice of rat worship may also contribute to these outbreaks in the deprived population.(35) Important lessons learnt from this outbreak include the essence of specimen collection for doing diagnostic tests for potential causative agents in an outbreak of uncertain cause, thorough initial assessment of the situation by multidisciplinary team of experts, good quality of public health infrastructure including effective surveillance and laboratory systems, epidemiologic response capability, and vector and animal host control programs, getting clinician informed with clear guidelines, and the importance of risk communication especially among the media, health professionals, and the health policy makers.(36,37)

29. Hong Kong had also been suffering from plague epidemic during the third pandemic in 1894 to 1929 with over 20,000 deaths.(38,39) As in other parts of the world, the epidemic came gradually under control in the early 20th century. Since 1929, Hong Kong has been free from plague.

### **III. Prevention and Control of Plague**

30. Plague control is focused on both border and local control measures. Moreover, prevention and preparedness of plague as a biological weapon, as well as the use of plague vaccine are also concerned areas.

#### *Cross-border Control*

31. Plague has been classified as a quarantinable disease in the International Health Regulation (IHR) since the first version developed by WHO in 1969 mainly focusing on protection against spread across international borders. In 2005, WHO revised and expanded the IHR (IHR (2005)) to cover any significant public health risks and events which constitute a public health emergency of international concern and plague remains as one of the diseases of concern.(25,26) In respect to cross border control, the IHR(2005) requires all member states to have certain core capacity to implement surveillance, notification, investigation, control and prevention at the community and

national levels as well as points of entry. Such measures should cover persons, baggage, cargo, containers, conveyances goods as well as postal parcels and should be provided on a 24-hour basis.

32. In Hong Kong, the Port Health Office of the Department of Health enforces the Prevention and Control of Disease Ordinance (Cap. 599) and observes the International Health Regulations. Detailed requirements, including inspection and supervision of vector surveillance and control at points of entry, and cross-boundary conveyances, and the issuance of ship sanitation certificates, import permits for human remains and biological materials. Currently, temperature screening for inbound travelers is still maintained at all immigration control points in Hong Kong. The Port Health Office will continue implementing the health measures regarding cross-boundary conveyances and the ports of entry in accordance with IHR(2005).

### Local Control

33. WHO recommended that a plague prevention and control program in local or regional level should have four elements including human disease surveillance and medical intervention, epidemiological and epizootical investigation and emergency control, surveillance and control of plague foci, and a long-term environmental management of the plague foci identified during surveillance.(2) Moreover, public health education, in both disease awareness and vector control is included as an important aspect in Hong Kong.

#### 1. Disease Surveillance

34. Plague is a statutory notifiable disease in Hong Kong. Doctors are required to report any plague case to the Department of Health. Table 1 shows the latest surveillance case definition of plague.(40)

35. Regarding the laboratory diagnostic capacity for plague in Hong Kong, the Public Health Laboratory Services Branch of the CHP provides support for bacterial and serological testing for suspected cases in both public and private sectors, and to confirm the diagnosis.

Table 1: Surveillance case definition of plague

<b>Clinical description</b>	<p>Plague is characterized by fever, chills, headache, malaise, prostration, and leukocytosis that manifests in one or more of the following clinical forms:</p> <ol style="list-style-type: none"> <li>1. <b>Bubonic plague:</b> Regional lymphadenitis</li> <li>2. <b>Septicemic plague:</b> Septicemia without an evident bubo</li> <li>3. <b>Pneumonic plague:</b> Plague pneumonia             <ol style="list-style-type: none"> <li>i. <b>Primary pneumonic plague:</b> resulting</li> </ol> </li> </ol>
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	<p>from inhalation of infectious droplets</p> <p>ii. <b>Secondary pneumonic plague:</b> Plague pneumonia, resulting from hematogenous spread in bubonic or septicemic cases</p> <p>4. <b>Pharyngeal plague:</b> Pharyngitis and cervical lymphadenitis resulting from exposure to larger infectious droplets or ingestion of infected tissues</p>
<b>Laboratory criteria</b>	<p>Any one of the following:</p> <ol style="list-style-type: none"> <li>1. Isolation of <i>Yersinia pestis</i> from a clinical specimen</li> <li>2. Four-fold or greater change in serum antibody titre to <i>Y. pestis</i> fraction 1 (F1) antigen</li> </ol>
<b>Case classification</b>	<p><b>Confirmed case</b> - A clinically compatible illness with confirmatory laboratory results.</p> <p><b>Probable case</b> - A clinically compatible illness with presumptive laboratory results:</p> <ol style="list-style-type: none"> <li>1. Elevated serum antibody titer to <i>Y. pestis</i> F1 antigen in a patient with no history of plague vaccination; <b>OR</b></li> <li>2. Detection of <i>Y. pestis</i> F1 antigen in a clinical specimen by fluorescent assay</li> </ol>

## 2. Investigation and Emergency Control

36. In response to a human plague case, the Centre for Health Protection (CHP) of the Department of Health will carry out prompt epidemiological investigation and control measures including source finding, contact tracing and prescription of post-exposure chemoprophylaxis to the contacts. Relevant investigation and control measures will also be carried out when *Y. pestis* is detected from local rodent, flea or other mammals. At the same time, Department of Health will collaborate with other government departments and organizations, such as Food and Environmental Hygiene Department (FEHD), Agriculture, Fisheries and Conservation Department (AFCD) and Hospital authority (HA) to carry out control measures to prevent spread of disease in the community.

37. The government is prepared to respond to emergency situation such as increased plague activity in the neighbouring region or re-emergence of plague in Hong Kong. A contingency plan for prevention and control of plague is in place to ensure efficient and coordinated response within the Department. When such situations occur, disease surveillance, vector surveillance and control, infection control and port health measures mentioned in the previous paragraphs would be enhanced. Surge capacity in terms of manpower and resources would be mobilized and arranged to deal with these emergency

situations. Collaboration with the stakeholders and public is of utmost importance in such situations. Therefore, mechanisms on information exchange and strategies for risk communication are in place to ensure that relevant stakeholders and the public will be well informed of the latest situation.

### 3. Surveillance and Control of Plague Foci(41)

38. In Hong Kong, the major species of rodents found are *Rattus norvegicus*, *Rattus rattus* and *Mus musculus*. The habitats of *Rattus norvegicus* are mainly flower beds, sewers and holes on ground, while those of *Rattus rattus* include false ceilings, roof top and upper floors of a building. *Mus musculus* mainly lived in store room and warehouse. All the three commonly found rodent species are susceptible to plague. As *Rattus norvegicus* usually carries more rat flea (*Xenopsylla cheopis*) amongst the three species, it is more susceptible to infection of plague. So far, natural plague foci have never been detected in Hong Kong.

39. The emphasis of plague prevention is plague vector surveillance and control aiming at a continuous assessment of the rodent and rat flea problems in the territory. Baseline data is compiled for formulating rodent control strategies and evaluation of the effectiveness of rodent control measures. The risk of plague transmission in specific biotopes is assessed by studying the rat-flea index. FEHD has carried out territory-wide rodent infestation survey covering 18 districts, and rat-flea survey in selected biotypes and port areas annually to monitor the situation of flea and rodent infestation in Hong Kong.

40. Since 2000, annual territory-wide rodent infestation survey has been conducted at selected rodent biotopes to monitor the extent of rodent infestation and evaluate the effectiveness of rodent control measures. The survey result is expressed by rodent infestation rate (RIR) which refers to the number of census baiting consumed per total number of census baits retrieved at a particular location. A higher RIR indicated a more extensive distribution of rodents in the surveyed area and FEHD will carry out corresponding control measures. From 2000 to 2006, the overall RIR declined from 15.9% to 2.9%.

41. On the other hand, the severity of flea infestation of rodents is monitored using annual rat-flea surveys. Such surveys on selected rodent biotopes have been conducted in the community for over thirty years, whereas those on rodents found in the airport and other port areas has been started in 1998 and 2004 respectively. During rat-flea survey, rat captured alive by cage trap would be examined to determine the species and examined for any signs of plague infection. The number of rat flea(s) collected from the rat examined per total number of rats examined gives the Rat-flea Index (RFI). WHO considers that a RFI of greater than 1.00 represents a potentially dangerous situation with respect to increased plague risk for human when plague has been introduced.(2) In response to the results on capturing of rodents in the rat-flea survey, pest

control staff of FEHD and the parties concerned will carry out rodent control and prevention. When Rat-flea indices are greater than 1, pest control staff will carry out flea disinfection in addition to rodent control operation.

#### 4. Public Health Education

42. Prevention and control of rodent infestation is the key to prevent plague and other infectious diseases related to rodents. Health education materials and fact sheets on plague are available at the websites of CHP and Travel Health Services. FEHD has organized territory-wide anti-rodent campaign annually to keep arousing the public on the importance of rodent prevention and control. FEHD has also produced various educational materials on environmental hygiene, prevention and control of rodent infestation, and the proper use of rodenticides including leaflets and posters. These materials can be accessed electronically on FEHD website and are distributed to the community through a network of various governmental departments. Public should also be reminded to take personal protection by using insect repellants while staying in the countryside, especially when they travel to plague endemic areas.

#### Other Considerations

##### 1. Prevention of Plague as a Biological Weapon(42)

43. The Government has in place the well established Emergency Response System (ERS). Led by Security Bureau, the ERS lays down the policy, principles and operation in response to emergencies resulting from accidents, natural disasters or terrorist attacks. At present, the chances of terrorists using Chemical, Biological, Radiological or Nuclear (CBRN) devices against Hong Kong is very low. The Government does however, maintain comprehensive contingency plans to respond to a CBRN incident. The emergency services and key Government responders are trained, exercised, equipped and resourced to deal effectively, efficiently and safely with such an incident

##### 2. Plague Vaccine(2,5,15)

44. Historically, both live attenuated and formalin-killed-whole-cell *Y. pestis* vaccines had been used in the past. While the live attenuated vaccines retain enough virulence to make them unsuitable for human use, the killed vaccines are only moderately efficacious against bubonic disease and not effective against primary pneumonic plague. According to WHO, mass community vaccination against epizootic and enzootic exposures and during human plague outbreak are considered of limited use because several months are required to complete the primary series and to develop adequate levels of protective antibodies. As a result, these vaccines had been recommended only

for high risk groups including person who works with the live *Y. pestis* in the laboratories, or those working in plague-affected areas or with potentially infected animals or fleas. These plague vaccines were no longer available internationally and locally.(43) However, the concerns of bioterrorism leads to on-going research aiming at developing a plague vaccine that is efficacious against primary pneumonic plague.

#### **IV. Conclusion**

45. Hong Kong has put in place a comprehensive surveillance and control programme against plague and has effectively prevented its occurrence in Hong Kong. However, in the presence of susceptible rodents and vector flea, a close proximity to endemic areas and busy ports for international travel and trading activities, Hong Kong is still highly receptive to the disease. As such, the Hong Kong Government remains vigilant in the prevention and control of plague through surveillance and control of human diseases, plague vector and rodent surveillance and control program in the community and the port areas, public health education on disease awareness, environmental hygiene and rodent control and be prepared for responding to emergency situation.

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