Emergency preparedness for pandemics, bioterrorism or emerging infections: Lessons from SARS & H1N1

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Severe acute respiratory syndrome (SARS) emerged unexpectedly in November 2002 from the southern part of China and posed an enormous threat to global economy and international health. The World Health Organization (WHO) reported 8,098 probable cases in 29 countries with an overall mortality of 9.6% by the end of the epidemic in July 2003. A previously unrecognized coronavirus (CoV) was confirmed to be the causative agent and it became known as SARS-CoV. Retrospective serological surveys suggested that cross-species transmission of SARS-CoV or its variants from various animal species to humans might have occurred frequently in the local wet market and the reports in 2005 have suggested that horseshoe bats could be a natural reservoir of a close ancestor of SARS-CoV.

SARS seems to spread by close person-to-person contact via droplet transmission or fomite. A super-spreading event in which 138 patients were hospitalized with SARS within 2 weeks as a result of exposure to a single patient was believed to be related to the use of a jet nebulizer for the administration of aerosolized salbutamol to the index patient. SARS-CoV has been detected in respiratory secretions, faeces, urine and tears of infected individuals. There was evidence to suggest that SARS might have spread by airborne transmission in a major community outbreak at a residential complex in Hong Kong. When the SARS epidemic ended in early June 2003 in Hong Kong, there were 1,755 confirmed cases with 384 (21.9%) infected health care workers (HCWs) and among them 8 have succumbed. The hospital facilities for isolation and infection control were then suboptimal. There were no ante rooms for the isolation cubicles, and the air changes and ventilation system were similar to the general wards. Personal protective equipment, infection control practice notably contact precautions, preparedness plan for outbreak of infectious disease were deficient. Various mechanisms and bodies were established on an ad hoc basis in response to the SARS epidemic without a clear chain of command. The SARS experience has helped to identify a number of positive lessons as well as highlighting a number of challenges for future preparedness. After the SARS epidemic, the Government

of Hong Kong has committed to build up the surge capacity for infectious disease outbreak. A Centre for Health Protection was established for the prevention and control of communicable diseases. Contingency planning was developed, tested, reviewed and implemented. A new infectious disease centre was completed in 2007 with state-of-art facilities capable to handle highly contagious pathogen with airborne transmission. The Prevention and Control of Disease Bill was enacted to bring the local legal provisions in line with the requirements of the International Health Regulations 2005 of the WHO. The bill provides for the implementation of effective disease surveillance systems to ensure timely detection of diseases and of control measures to prevent cross-boundary spread of diseases.

There are no definitive treatment modalities for SARS. Ribavirin and steroid therapy seems to be the most frequent choice of clinicians during the epidemics. Randomised controlled trials were not available to evaluate various treatment regimens. A review in 2006 of therapy administered during the epidemic found that finding clear-cut treatment benefits was elusive. There were 26 reports of inconclusive benefits and 4 reports of possible harm related to ribivarin therapy, 25 inconclusive reports and 4 reports of possible harm related to steroid therapy, and inconclusive reports to lipinavir/ritonavir therapy, IFN-ϒ therapy, and convalescent plasma or immunoglobulin therapy.

Influenza is always a disease of global public health significance. The influenza virus has caused diseases in humans, birds and swine for many centuries. Pandemics and epidemics have occurred throughout history and reports of new strains continue to emerge after the 1918 H1N1 subtype pandemic causing millions of death. The emergence of the novel influenza pandemic virus (pH1N1) in April 2009 since 1968 surprised us by zoonotic origin of the virus from swine rather than avian and by geographical origin as from the Americas rather than the Southeast Asia. The WHO declared Pandemic Phase Six on 11 June 2009 and the pH1N1 cases in Hong Kong started to rise sharply in July which is the usual time for summer influenza surge.

The pandemic peak was noted at the end of September and by mid-October there was evidence of a real decline. The pandemic preparedness plans at international, national, regional, institutional levels that were already in place to combat the more expected avian influenza pandemic (H5N1) have been used. The strengthened surveillance of clinical cases, laboratory confirmation, treatment plan, infection control training of HCWs, stockpiling of antivirals & personal protective equipment, basic and applied research into developing vaccines against the novel influenza viruses were commenced shortly. Vaccination is the most effective measure available for the control of influenza. Government vaccination program with recommendations

for use of vaccine against the 2009 H1N1 influenza virus were released timely. However, the immunization uptake rate was low due to the early report of a case who developed Guillain-Barre syndrome following vaccination. The development and application of mathematical models incorporating traditional epidemiological models and phylogenetic analyisis of viral genomes sparkled by SARS has enabled us to describe and predict the evolution of the influenza pandemic as well as identifying and prioritizing interventions in public health policy.

In Hong Kong, the notable success of e-SARS before has paved the way to e-flu as a platform of enhanced data management system for disease notification, monitoring and data analysis within the hospital information system. Protocols and guidelines for treatment and disease management were readily available and disseminated. Adults with severe pH1N1 pneumonia exhibited slow viral clearance particularly in the lower respiratory tract despite oseltamivir treatment. Studies were conducted to investigate clinical effectiveness of convalescent plasma and hyperimmune intravenous globulin in the management of severe cases. Mortality in the treatment group with convalescent plasma was significantly lower than in the control group (20.0% vs 54.8%; $p<0.01$). Some intensive care units have offered veno-venous extracorporeal membrane oxygenation [ECMO] for the treatment of cases with adult respiratory distress syndrome.

Before the lowering of the response level from 'Emergency' to 'Alert' under the Framework of Government's Preparedness Plan for Influenza Pandemic on 24 May 2010 in Hong Kong, the cumulative number of notified and laboratory-confirmed cases was 36,546 with 279 severe cases (0.76%) and 79 mortality cases (0.22%).

References:

1. Severe Acute Respiratory Syndrome Expert Committee. SARS in Hong Kong: from Experience to Action. [cited 30 Jan 2011]. Available from: http://www.sars-expertcom.gov.hk/english/reports/reports.html
2. David S.C. Hui & Paul K.S. Chan. Severe Acute Respiratory Syndrome and Coronavirus. Infectious Disease Clinic of North America 2010; 24: 619-638.
3. Influenza page. Centre for Health Protection, HKSAR. [cited 30 Jan 2011]. Available from: http://www.chp.gov.hk/en/view_content/14843.html
4. Burke A. Cunha. Swine Influenza (H1N1) Pneumonia: Clinical Considerations. Infectious Disease Clinic of North America 2010; 24: 203-228
5. Julian W. Tang et al. Features of the new pandemic influenza/H1N1/2009 virus: virology, epidemiology, clinical and public health aspects. Current Opinion in Pulmonary Medicine 2010; 16: 235-241