



Review

From SARS in 2003 to H1N1 in 2009: lessons learned from Taiwan in preparation for the next pandemic

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SUMMARY

In anticipation of a future pandemic potentially arising from H5N1, H7N9 avian influenza or Middle East Respiratory Syndrome, and in large part in response to severe acute respiratory syndrome (SARS) in 2003, the city of Taipei, Taiwan, has developed extensive new strategies to manage pandemics. These strategies were tested during the 2009 H1N1 outbreak. This article assesses pandemic preparedness in Taipei in the wake of recent pandemic experiences in order to draw lessons relevant to the broader international public health community. Drawing on Taiwan and Taipei Centers for Disease Control data on pandemic response and control, we evaluated the effectiveness of the changes in pandemic response policies developed by these governments over time, emphasizing hospital and medical interventions with particular attention paid to Traffic Control Bundling. SARS and H1N1 2009 catalysed the Taiwan and Taipei CDCs to continuously improve and adjust their strategies for a future pandemic. These new strategies for pandemic response and control have been largely effective at providing interim pandemic containment and control, while development and implementation of an effective vaccination programme is underway. As Taipei's experiences with these cases illustrate, in mitigating moderate or severe pandemic influenza, a graduated process including Traffic

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Control Bundles accompanied by hospital and medical interventions, as well as school- and community-focused interventions, provides an effective interim response while awaiting vaccine development. Once a vaccine is developed, to maximize pandemic control effectiveness, it should be allocated with priority given to vulnerable groups, healthcare workers and school children.

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Introduction

Despite previous outbreaks such as the 1918 Spanish, the 1957 Asian, and 1968 Hong Kong influenza pandemics, attention to the possibility of a significant public health threat due to a pandemic outbreak was largely provoked only in 1997 with the outbreak of human cases of H5N1 avian influenza in Hong Kong.^{1,2} Following this outbreak, the Taiwan Centre for Disease Control (TCDC) began coordinating an influenza surveillance network, which, since 1998, has regularly monitored avian influenza focusing on potential emergence among wild birds, on poultry farms, and in poultry markets together with human epidemiological and virological patterns of influenza endemics.^{3–5} Despite enhanced surveillance efforts, severe acute respiratory syndrome (SARS) arrived unexpectedly in 2003.

The goal of this paper is to evaluate the various initiatives developed by the Taipei City government in response to pandemic outbreaks. As part of the evaluation, the paper includes a discussion of Taiwan (ROC) preparedness and response efforts because they directly impact all Taipei City government efforts. Under Taiwan law, the TCDC is responsible for developing and recommending disease control policies. Lower levels of government, including Taipei City and Taipei CDC can adapt TCDC policies to local conditions but may not weaken them.⁶

SARS background

Encountering SARS in 2003 had a major impact on Taiwan's strategies to prevent and control communicable diseases. In late April 2003, the first outbreak of SARS occurred in one municipal hospital in Taipei. Soon, Taipei became the centre of a SARS outbreak that spread over the entirety of Taiwan in the span of six weeks.⁷ By late June, SARS had caused 73 fatalities in Taiwan, affecting physicians and nurses as well.⁸ SARS was a highly contagious, emerging infectious disease (EID) that, just like influenza, was spread through droplet aerosols and contact transmission. When countermeasures were taken to control the epidemic, the initial efforts suffered weaknesses including lack of adequate inter-organizational coordination, an unclear chain of command, inefficient resource allocation, poor risk communications, and disrupted information flows. The consequence was a total of 347 casualties, of whom 70% were from healthcare-associated infections and 30% were of healthcare workers (HCWs).^{7,9,10}

Lessons from the post-SARS evaluation of pandemic response

The highly contagious character of SARS induced the TCDC to reform its hospital infection control strategy. Reforms included revising the surveillance system, and improving

educational and support systems. Annual inspection and on-site audits were also initiated, and in compliance with the 2007 World Health Organization (WHO) hand hygiene campaign, alcohol dispensers coupled with hand disinfection checkpoints first implemented during SARS were incorporated into Taiwan's hospital disease control strategy.^{11,12}

To increase HCW protection from nosocomial infections and EIDs, an additional step by the government included funding annual seasonal influenza vaccinations for all HCWs and emphasizing hand hygiene strategies. Although not mandatory, vaccination programmes were included in the accreditation and inspection process by the TCDC as of 2003. The average annual rate of vaccination against seasonal influenza by HCWs is currently around 90%. The emphasis on hand hygiene strategies has had a direct impact on reduced MRSA nosocomial infections in Taiwan.¹³

The TCDC also developed a systematic and integrated approach for countermeasures against highly contagious EIDs based on the Incident Management System (IMS) and Six Sigma. The IMS describes a chain of command and control system that consists of four components: action, planning, financing, and logistical support. It can be applied to any scale of disaster and enables the TCDC to coordinate responses across institutional spheres.¹⁴ 'Six Sigma' is a principle of process management that originated from industrial engineering and management systems. This tool simplifies complex processes into smaller, more manageable steps that can be more easily analysed to set control points in approaching a final product, achieving a failure rate of less than three per million.^{15,16} The TCDC deploys the principles of IMS and Six Sigma to enhance its efforts in the key spheres of Traffic Control Bundling, Communicable Disease Control Networks, and Crisis Management.

Traffic Control Bundling

During the SARS outbreak it became clear that HCWs were vulnerable to infection in the period between patients' arrival for care and when they were classified as 'probable SARS cases'.¹⁰ Sources of vulnerability included casual contact with fomites through contaminated environments, and the unwarranted assumption among HCWs caring for SARS patients that existing barrier precautions and personal protective equipment, such as gloves and gowns, provided sufficient protection and obviated the need for handwashing. Such incorrect assumptions led to some HCWs' exposure to, and acquisition of, SARS.^{9,17–20}

At the peak of the SARS epidemic, and in coordination with the TCDC, the Taipei CDC developed a new mechanism for integrated infectious disease control, namely Traffic Control Bundling. Traffic Control Bundling includes the following procedures: triaging and dispatching patients before they enter

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