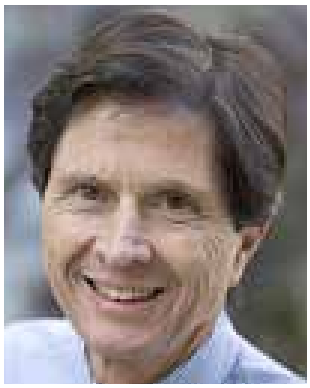

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Before joining WHO, Prof. Heymann worked for 13 years as a medical epidemiologist in sub-Saharan Africa on assignment from the US Centers for Disease Control and Prevention (CDC).

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POLICIES AND STRATEGIES

to Meet the Challenge of Emerging Disease Threat through Prevention, Preparedness and Response

David L. HEYMANN

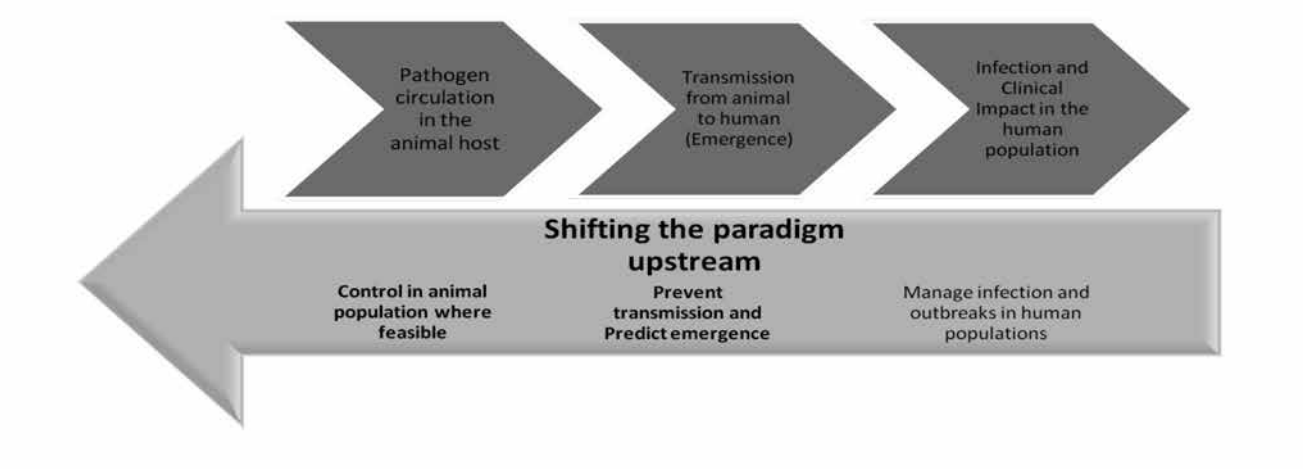
SHIFTING THE PARADIGM

The majority of emerging infectious diseases have their source in animals, and emergence occurs at the human/animal interface, when infections in animals breech the species barrier to infect humans, the population in which they are often first identified. The response is often a series of emergency activities to contain and manage the infection in human populations, and at the same time to identify the source of the infection in nature. If infection is found to have a source in animals, and if animals cause a continuous threat of human infection, culling is often recommended, with severe economic impact.

Currently efforts are being undertaken for more close interaction at the animal/human interface through joint surveillance and risk assessment between the animal and human medicine sectors, and research is underway in geographic areas where emergence from wild and/or domestic animals has occurred in the past. The goal of this research is to identify infectious organisms in tropical and other wild animals, to genetically sequence these organisms, and to attempt to predict which organisms have the potential to emerge in human populations.

It may be more cost-effective, however, to learn from past emergence events, and to shift the paradigm from disease surveillance, detection and response in humans; to prevention of emergence at the source by understanding and mitigating the risk factors, or determinants, that influence animal infection (see figure).

These determinants of emergence are clearly understood from the study of previous emergence events and include human-induced changes in natural environments, urban areas and agricultural systems; raising and processing animal-based foods; and the roles of global trade, migration and climate change. Better understanding of these factors learned from epidemiological investigation of past and present emergence events, and modelling and study of the cost effectiveness of interventions that could result in their mitigation, could provide evidence necessary to better address the political and economic barriers to prevention of infections in animals and/or their emergence in



humans further down stream. Such economically convincing arguments for change and mitigation are required because of the basic difference in animal health – often driven by the need for profit and financial gain; and human health – driven by the need to save lives, with cost a secondary consideration.

CASE STUDY

A close examination of the 2003 outbreak of Severe Acute Respiratory Syndrome (SARS) clearly demonstrates the public health emergency that can be caused by emerging infections, and how a paradigm shift from emergency response to prevention at the source might be accomplished.

First detected because it caused a severe atypical pneumonia, SARS soon became a burden in hospitals in the Guangdong Province of China in late 2002, where many patients required respiratory support, and broad-spectrum antibiotics had no effect. Hospital workers caring for these patients became infected as well, and one of them – a medical doctor who had treated patients in the Guangdong Province of China - travelled to Hong Kong in February 2003 where he stayed in a hotel on the same floor as both Chinese and international guests. Some of these other hotel guests became infected but it is not clearly understood how – hypotheses ranged from transmission of the causative agent through the hotel ventilation system to transmission in a shared closed environment such as occurs when using the same lift (Chan-Yeung & Xu 2003).

Those who became infected at the hotel were admitted to Hong Kong hospitals when they became ill, or travelled to other countries, many times while still in the incubation period, to become seriously ill at their next destination. Hospitalized, they too became the source of infection of hospital workers who in turn unintentionally infected other patients and family members (Scales DC, Green K, et al).

Molecular and epidemiological investigation suggested that the infection of the index case (never identified) was a one time event. As more information became available, it was further hypothesized that this initial infection

was due to close contact with an infected animal, probably a civet cat, thought to have been a carrier of a coronavirus that mutated, either in the animal or an infected human, in such a way as to cause severe human illness (Wang & Eaton 2007).

The world's interconnectivity through air transport facilitated the international spread of SARS. Its electronic connections also facilitated a virtual collaborative effort for surveillance, and for an emergency outbreak investigation, management and containment. The most favourable patient management regimes and modes of transmission were rapidly identified; the causative organism was identified and characterized; international travel advisories were recommended to stop international spread; and after human to human transmission had been interrupted, the scientific evidence that was collected during the outbreak was used for guidelines to prepare for another similar outbreak should it occur(World Health Organisation 2004).

SARS resulted in 8422 probable infections and 916 (11%) deaths (Chan-Yeung & Xu 2003). The economic impact of the outbreak on GDP was estimated at US$30-100 billion from decreased commerce, travel and tourism (Keogh-Brown & Smith, 2008). Unlike HIV, the SARS coronavirus did not become endemic, and economic recovery was rapid.

SARS and other emerging infections share a common theme: infection is often first detected in human populations in which an emergency clinical response and hypothesis-generating outbreak investigation begin before the source of infection is understood. Initial recommendations for control are often precautionary - based on what evidence is available from the current outbreak or previous outbreaks caused by similar organisms – and they can cause severe negative economic impact.

At the time of the SARS outbreak there was a flurry of field research activity in the Guangdong Province during and just after the outbreak, but over time funding decreased and research slowed. A key piece of research conducted was a study of workers in some of the province's wet markets that suggested that up to 22% (12/55) had antibody evidence of a coronavirus infection related to the SARS coronavirus, but that none had a history of severe respiratory symptoms such as were occurring in persons with SARS (Parry, 2003).

Based on the evidence generated by this simple study, however, the determinants of emergence - in addition to the risk of being a wet market worker - could include being a hunter of wild animals, being a restaurant worker who kills and or butchers/prepares wild animal meat for consumption, or being a member of a household that buys live or recently killed wild game meat from a wet market.

It is clear that from this simple risk assessment that a series of actions outside the human and animal health sectors could be useful in decreasing the risk or preventing a future outbreak from an emerging pathogen in the Guangdong Province. These include education of all those who come into contact with wild game (and domestic animals) about how to protect themselves against infection; regulation with enforcement of safety practices in wet markets and eating establishments that does not drive these activities underground, but rather ensures safe animal handling; and regulation

and enforcement of less risky trade between hunters and markets, and between markets and those who purchase. Other activities might be research to determine whether any wild animals could be raised commercially under conditions that prevent their infection and risk to humans - or further downstream, more effective education of health workers about infection control. This latter activity would ensure that if other actions further upstream fail to prevent emergence, amplification of transmission of emergent organisms could be prevented.

Because of the cross-sectoral action required to mitigate the risks associated with these determinants, a [1]one health approach – defined as a collaborative effort of multiple disciplines to attain optimal health for people, animals and the environment - is required to change the existing paradigm of detection and emergency response to prevention, or to a decrease in the frequency of emergence, by mitigation of the determinants that have the potential to cause emergence.

Shifting the current paradigm from emergency response further upstream using a one health approach - to managing and mitigating the determinants or risks that lead to emergence - could help reduce or prevent the risk of emergence of infections at the animal/human interface at the source.

[1] American Verterinary Medical Association 2008

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