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REVIEW ARTICLE

What Have We Learned from the Novel Influenza A (H1N1) Pandemic in 2009 for Strengthening Pandemic Influenza Preparedness?

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We need to apply lessons learned from previous influenza pandemics to continuously update preparedness and response plans. It has become evident that strengthening networks of international referral laboratories coupled with scaling-up efforts to expand epidemiological surveillance networks is critical for responding and mitigating the impact of influenza pandemics. The current swine-related influenza A (H1N1) pandemic has also shown that international collaboration remains a critical component to effectively respond to influenza pandemics in the current globalized world. © 2009 IMSS. Published by Elsevier Inc.

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The Overlapping Link between Bioterrorism and Influenza Preparedness Plans

Bioterrorism preparedness became a leading public health priority in the U.S. and many other countries with the advent of the terrorist events of September 11, 2001 followed by the intentional release of anthrax spores through the postal system, leading to a multi-state outbreak of lethal inhalational and cutaneous anthrax. Other countries fostered this new paradigm after the ensuing terrorist events in Spain on March 11, 2004 and then in the UK on July 7, 2005. These actions diverted the attention of public health authorities to bioterrorism preparedness activities, shifting many resources (human and financial) from existing public health priorities. Many considered that chasing the chimera

of the unforeseen consequences of bioterrorism was a misallocation of public health resources.

Despite some of these valid concerns, bioterrorism preparedness has demonstrated to have some unintended favorable consequences for responding to any public health emergency. Indeed, it has provided a window of opportunity to define some structures and processes that can withstand the test of time in dealing with epidemics and pandemics of emerging infections including pandemic influenza (1). Some of these benefits were evident during the outbreak of severe acute respiratory syndrome (SARS) in 2003–2004 when a recently developed network of international reference laboratories collaborated to identify the SARS-associated coronavirus in a timely manner; and many countries activated their emergency preparedness response plans relying on international epidemiologic surveillance networks (2–3). This opened a new area of unprecedented collaboration among scientists, epidemiologists, and policy-makers in the present globalized world. In a similar fashion, many countries including Mexico were in a more suitable vigilance position and international

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collaboration efforts to effectively respond to the emergence of the novel swine-related influenza A (H1N1) pandemic in 2009 (3).

The Imperative Role of Influenza Preparedness Plans

In spite of these gains in pandemic influenza preparedness and response efforts, influenza epidemics and pandemics need to be considered one of nature's preferred and unyielding bioterrorist threats (4–5). Nowadays, while intentional bioterrorism continues to represent a minor threat, influenza pandemics carry a constant menace to humans due to the capricious biological behavior of these highly unstable viruses from a genomic perspective. This risk is amplified by the constant reservoir of influenza strains in wild birds with different combinations of hemagglutinin and neuraminidase protein combinations in wild birds. These potential emerging influenza strains can benefit from some aspects of modernity such as travel and high-population densities ubiquitous in many settings (6–7). In this manner, there is a dynamic and relentless evolutionary struggle between humans and influenza viruses demanding a permanently and proactive revision and strengthening of influenza pandemic preparedness and response plans.

Influenza A viruses have the potential to cause pandemic at random intervals (8). Viruses that contain surface glycoproteins to human populations that are immunologically naïve to these strains are responsible for influenza pandemics. Such genomic segments can be introduced into human populations through genetic reassortment between human and avian viral strains or through the direct cross-transfer of an avian influenza virus to humans (9). Regrettably, given this large reservoir of antigen types for reassortment, the possibility of pandemic influenza could emerge from any part of the world at any time (10–11). This is a critical issue frequently forgotten by leading international public health agencies and the reason why it remains crucial to scale-up international networks for surveillance, laboratory detection, and collective international responses. The recent human and economic burden caused by a new strain of the H5N1 highly pathogenic avian influenza and the current pandemic caused by the novel H1N1 strain both underscore the continued danger posed by the uncontrolled spread of zoonotic disease. In each case, failure to either effectively anticipate the outbreaks or to coordinate an immediate, integrated, and effective response after they jumped species and infected humans suggests that much work remains to mitigate the risks emerging infectious diseases pose to human health and economic livelihoods, especially in developing countries (11–12).

Pandemic influenza may arise when three epidemiologic conditions are met: 1) emergence of a novel influenza virus subtype, 2) the new virus demonstrates the ability to infect humans and cause disease, and 3) human-to-human trans-

mission occurs easily and in a sustainable fashion. In the last few years, the emergence of human of highly pathogenic influenza A (H5N1) strains in southeast Asia has paralleled large outbreaks of avian influenza A (H5N1), although the avian epizootoses in 2004 and 2005 have only rarely led to disease in humans. In fact, since 1997, at least six distinct avian influenza outbreaks affecting humans have occurred: Hong Kong 1997 (H5N1) with 18 cases and six deaths, Hong Kong 1999 (H9N2) with two cases and 0 deaths, Hong Kong 2003 (H5N1) with two cases and one death, The Netherlands 2003 (H7N7) with 83 cases and one death, Canada 2004 (H7N undefined) with 2 cases and 0 deaths, Egypt 2004 (H10N7) with two cases and 0 deaths, and the one that began in southeast Asia and then spread to many other countries between 2005 and 2009 (4,13). Currently, only the first two of these pandemic requirements have been met by highly pathogenic influenza A (H5N1). Despite the significant international attention paid to influenza A (H5N1), this particular type of influenza virus has clearly met only the first two criteria for causing a pandemic (high mortality and the absence of widespread immunity). Nevertheless, efficient person-to-person transmission and spread has not yet occurred (4,14).

Due to political commitment and increased financial resources vested after these outbreaks, the world is in a slightly better position to respond to annual seasonal epidemics and the constant threat of influenza pandemics. At the same time, it is relevant to consider that the influenza pandemics of the 20th century and of the SARS and the influenza A (H5N1) outbreaks have demonstrated that their impact depends on multiple factors that include social, economic, political determinants and the virulence of the pandemic strain, making difficult to forecast and prepare for influenza pandemics (4). Such is the case of the swine-related novel influenza A (H1N1) that emerged in early spring (2009) and currently has spread to all continents (6).

Influenza Preparedness after the Influenza A (H1N1) Pandemic in 2009

We need to apply lessons learned from influenza pandemics and outbreaks of other transmissible respiratory viral infections such as SARS to constantly update influenza pandemic preparedness plans (1). However, this process does not constitute a public health insurance policy. Indeed, as already evident with the ongoing influenza A (H1N1) pandemic, the illusion of the potential effect of rapid containment protocols has been replaced by the reality of implementing mitigating activities (2). Whereas the media and many scientists focused their attention during the last few years to outbreaks of H5N1 in different countries, the current pandemic demonstrates that we can never be sufficiently prepared for the sudden and unexpected emergence of novel influenza strains (2–3,6). Pandemic influenza A (H1N1) continues to be the

predominant circulating strain of influenza in most countries with influenza activity with widespread outbreaks in some parts of North America, Europe and Asia (15–17). In this sense, the World Health Organization (WHO) strategic plan for influenza is intended to ensure that measures are in place to mitigate the high levels of morbidity and mortality and social and economic disruption that can be expected during an influenza pandemic (18–19).

A few strategic actions contemplated by WHO include the strengthening of the early warning system, build capacity to cope with a pandemic, and coordinate global scientific research and development activities (18–20). Within these activities, the current novel influenza A (H1N1) pandemic has shown to support preparedness plans that contain control interventions for both mitigating the potential impact of an influenza pandemic including non-pharmaceutical strategies (social distancing, infection control and quarantine), and pharmaceutical strategies (antiviral drugs used for the treatment and prophylaxis of influenza, and the use of influenza vaccines). In this regard, we need to focus our planning and response efforts on those interventions that are critical during the early phases of a pandemic where there is no availability of a specific pandemic vaccine (2,19). In particular, those related to non-pharmacologic measures such as social distancing measures (isolation and quarantine; school closing and prohibiting mass gatherings). There is great historical value of nonpharmacological interventions with immediate applicability (11,19–20). Nonetheless, further evidence-based data need to be collected in order to optimize decision-making ability of policymakers in terms of the efficacy of social distancing measures (2–3).

Pharmacologic interventions including the use of antiviral drugs and medical interventions such as antimicrobials to treat secondary bacterial pneumonias, along with the use of supportive medical care such as oxygen, anti-inflammatory drugs, and antipyretics, have also shown to be a critical component of the overall response activities during the current influenza pandemic (2,6). With the support and leadership of international public health agencies, most middle- and low-income countries should plan to augment their stockpiles of antiviral drugs and antibiotics as well as to begin preparing their vaccine/antiviral deployment plans and strengthen their infection control protocols with locally available supplies and basic infection control procedures. Most high-income countries are also pursuing these objectives (17).

Another important aspect learned during previous pandemics and the current pandemic pertains to the importance of building human surge capacity. This activity allows the allocation of health resources including the provision of essential health services and those institutions selected to respond to a pandemic (3). Paying careful attention to infection control activities has been identified as a key step to protect healthcare workers and prevent the nosocomial

spread of influenza infections (4). Additionally, there is an urgent need to have better detection methods for influenza viruses including the creation or strengthening and scaling-up of laboratory capacity for influenza diagnosis in most settings (low-, middle-, and high-income countries) through international networks of collaboration, technology transfer, and capacity-building efforts (2).

Finally, all countries should develop pandemic influenza vaccine deployment or antiviral deployment plans regardless of the current absence of availability of pandemic influenza vaccine (21). WHO guidelines for vaccine deployment build on the premise that each country has drawn up an overall influenza pandemic preparedness plan that includes a deployment plan for the activities involved in delivering a pandemic influenza vaccine. Developing a deployment plan allows the identification of human resources, medical supplies, and logistic gaps prior to the occurrence of a large number of cases or deaths prior to a pandemic.

We should continue to carefully monitor the events associated with the current influenza pandemic. In particular, we need to observe the impact of the pandemic in low-income countries because most epidemiologic data about the pandemic come from high- and middle-income countries. We also need to monitor antiviral susceptibility patterns and examine the molecular epidemiology of the pandemic in close collaboration with veterinary surveillance protocols. We live in a highly interconnected biological world and we frequently neglect the key role played by epizoonosis in the emergence of infectious diseases.

In summary, dealing with seasonal influenza epidemics and the unavoidable threat of influenza pandemics needs to become engrained as a worldwide public health priority, which translates into a continuous process of updating pandemic influenza preparedness and response plans. These public health efforts should continue to be matched by political and financial commitments for both developed and developing countries and the leadership of WHO.

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