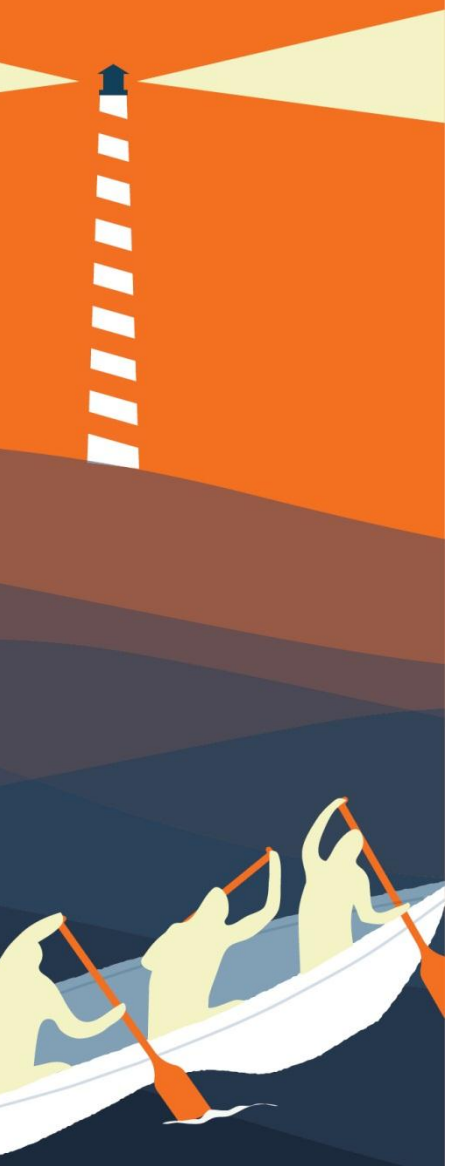
world development report 2014



Background Paper

Pandemic risk

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Pandemic Risk[1]

Olga Jonas[2]

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Everybody knows that pestilences have a way of recurring in the world; yet somehow we find it hard to believe in ones that crash down on our heads from a blue sky.

– Author and Philosopher Albert Camus, *The Plague*, 1948

We have some idea what might happen if, in the face of other pressing global challenges, we divert our focus from making systemic improvements in public health and veterinary services — and that prospect is frightening. We must continue to help countries develop essential human and institutional capacity. We must ensure that authorities have the resources to fulfill the responsibilities they have to their citizens, and to the world as signatories to the International Health Regulations and OIE International Standards for Animal Diseases.

– World Bank address to a ministerial conference on responses to pandemic threat, 2008

Even though we can't compute the odds for threats like bioterrorism or a pandemic, it's important to have the right people worrying about them and taking steps to minimize their likelihood and potential impact. ……. But bioterrorism and pandemics are the only threats I can foresee that could kill over a billion people.

– Microsoft Corporation Chairman Bill Gates, 2011

The real problems are setting up the delivery systems that can not only protect people from the diseases of today but the diseases of tomorrow.

– World Bank Group President Dr. Jim Yong Kim, 2012

Preparedness, including for potential pandemics, requires coordination and management of complex relationships across different sectors and between international, national, and local actors. We must work together in support of all societies as they prepare – in ways that reflect the interests of all people for whom preparations are being made. A community-based One Health approach is essential for reducing the risks to people that emerge at the interfaces between animals, humans, and ecosystems.

– UN System Influenza Coordinator David Nabarro, 2013

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[1]This paper was prepared as a background paper to the World Development Report 2014 on *Risk and Opportunity: Managing Risks for Development*. I thank Enis Baris, Dan Biller, Charles Blitzer, Milan Brahmbhatt, Siddharth Chandra, Alain Dehove, Tim Evans, Paul Forster, Marelize Gorgens, Cees de Haan, Jane Kirby-Zaki, John Lange, Piers Merrick, David Nabarro, Inci Otker-Robe, Maryse Pierre-Louis, John Pollner, Peter Sandman, Apurva Sanghi, Richard Seifman, Simon Strickland, Chadia Wannous, and Lucas Warford for their helpful comments. All remaining errors and misunderstandings are mine.

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This paper looks at pandemic risk, what it means for development, and how management of this risk could be improved, both in countries and internationally. The paper was motivated by the prevalence of pandemic myths. Widely held beliefs—that pandemics are inevitable and thus not worth worrying about, that the health sector is managing the risks, and that the pandemic risk is not a development issue—lead to underestimation of pandemic risk, scant preparedness, and inadequate prevention. Examining the reasons why these myths persist could help governments and international organizations improve management of the risks associated with pandemics.

These risks are substantial. A single severe flu pandemic could cost $3 trillion. It is hard to imagine a more severe threat to ending absolute poverty or to boosting shared prosperity in developing countries. Indeed, OECD, among others, see a severe pandemic as a top global catastrophic risk, one that is higher than terrorism risk. It would bring shared misery, economic decline, and societal disruptions on a global scale, with the poor and those in fragile states hit the hardest.

Setting a goal to reduce pandemic risk should be the first step toward risk governance, complemented by mandates for international organizations to work toward the goal. Risk governance should ensure strengthening of public veterinary and human health systems in developing countries, and the bridges between them, to eliminate the weakest links in global defenses against pathogens. Reduction of pandemic risk is a public service that only governments, through their coordinated actions, can provide. Delivery of this service can benefit from systematic application of 'science of delivery,' notably by using One Health approaches for early effective control of contagion.

All countries can build and operate systems that meet international standards; the annual spending required to reach that goal is not only modest but also ten times less than the expected annual cost of inaction. Advocacy and communications for prevention and preparedness are key public sector responsibilities at global, country, and community levels. The main beneficiaries of pandemic risk reduction will be our children and future generations because their lifetime odds of experiencing a pandemic are now high and growing; they face worse odds than present-day adults, including the political and business leaders who need to lead if this risk is to be reduced. Preparedness for pandemics is low everywhere, but especially in developing countries, with potentially high-cost impacts on health, economies, and society. Whole-of-society planning for responses is a low-cost activity that will mitigate these impacts.

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Acronyms

AIDS	acquired immunodeficiency syndrome
ASEAN	Association of South East Asian Nations
Cat DDO	World Bank development policy loan with a deferred drawdown option for catastrophe risk
FAO	Food and Agriculture Organization (of the United Nations)
CEO	chief executive officer
GDP	gross domestic product
H1N1	influenza virus, also cause of the 2009 influenza pandemic
H5N1	a highly pathogenic avian influenza type
IHR	International Health Regulations
MERS	Middle East respiratory syndrome
OECD	Organisation for Economic Co-operation and Development
OIE	World Organisation for Animal Health (OIE kept its historical acronym from Office International de Epizooties, established in 1924)
PVS	Performance of Veterinary Services assessment methodology
SARS	severe acute respiratory syndrome
TASW	Toward a Safer World initiative (on pandemic preparedness)
UHC	Universal Health Coverage
UN	United Nations
UNSIC	UN System Influenza Coordination
WHO	World Health Organization (of the United Nations)

Four pandemic myths

Global concern about the pandemic threat escalated in 2005-2008. But then it dropped rapidly, especially when the 2009 H1N1 flu pandemic fortunately turned out to be less disruptive than many flu seasons. The drop in concern reinforced four pandemic myths, creating a challenge (Box 1), because when the public and policymakers accept the myths, reducing pandemic risk is difficult. Acknowledging these myths, and analyzing why they persist, could help governments and their international organizations improve management of the risks associated with pandemics. These global risks are large and growing. They threaten to rapidly unravel progress toward poverty elimination and boosting of shared prosperity. When prevention falls short, as is the case now, the occurrence of the next pandemic is not a question of 'if', but 'when.' In any year, the probability that contagion will start is not zero. Its severity is unknowable in advance, but it could be high. Thus, OECD, among others, see a severe pandemic as a top global catastrophic risk that would trigger shared misery, sharp economic decline, and societal disruptions and violence on a global scale, with the poor and those in fragile states hit the hardest.

Box 1. Four pandemic myths

	Plausible…	***… but:***
Myth 1	Nothing can be done to prevent pandemics. It's just nature.	Human activity helps or hinders the onset of contagion. Most pandemics start in animals, so human-managed **livestock health makes a big difference.** Robust public veterinary and human health systems can work to **stop contagion early**, so it does not become a pandemic. The science is clear; tools and effective disease control methods are well known in most cases.
Myth 2	We can deal with it when it comes. There is no risk. Do you want to scare people?	Severity of pandemic impact would depend on human reactions, on the resilience of communities, and on whole-of-society preparedness, including for official communications. Preparedness for household, community, country, and international responses will reduce costs. **Risk awareness** is a necessary first step.
Myth 3	Health authorities will protect us from pandemics.	Pandemic risk reduction is **not a priority for the health sector**, which is mainly concerned with existing patients, not potential ones. Since prevention brings few observable recognized rewards, it is often grossly neglected. Vaccines are no panacea and will not prevent a pandemic with current technologies. They may be available with delay after a pandemic starts, in limited quantities, and have low effectiveness. There is still no AIDS vaccine, decades after the onset of the AIDS pandemic. Vaccines and antiviral medicines could protect the health of a fortunate minority with access to them, while possibly harming social cohesion if scarce vaccine is allocated arbitrarily. Mitigation of pandemic impacts requires **measures in all sectors**, not only health interventions.
Myth 4	Pandemic risk is not a development concern.	This is mistaken, on at least three counts. First, a severe pandemic would impose widespread health, economic and social costs, **setting back progress by years**. The poor and vulnerable could be most affected. Second, pandemic prevention hinges on **robust public health systems (veterinary and human) that collaborate** to detect contagion early, respond rapidly, and stop it. These same systems are needed to prevent and control other diseases as well, especially the human diseases that are caused by 2.3 billion infections of animal origin every year. Third, pandemic preparedness, which supports **resilience across the whole-of-society and business continuity in key sectors**, will help developing countries reduce the impacts of other disasters, especially complex ones.

Characteristics of pandemic risk

Wide range of outcomes, with expected loss of some $30 billion annually. Pandemic risk is the expected value of the impact of widespread infectious disease in humans on human health, economies, and communities. Pandemics are epidemics (occurrence of disease above an expected norm) that affect at least several countries on more than one continent. A salient characteristic of this risk is that it combines a low probability of occurring with high, potentially catastrophic, global impact. The most severe of the four flu pandemics in the last 100 years, the 1918 pandemic, killed 50 million-100 million people in a global population of less than 2 billion. In such a severe-case scenario, economic losses could amount to 4.8 percent of global GDP, or more than $3 trillion.[3] A moderate flu pandemic could have an impact of about half this amount; weak pandemics such as the 2009 H1N1 flu pandemic may have economic impacts of less than 0.5 percent of GDP. Pandemic risk has an annual expected value of an order of magnitude of $30 billion,[4] which is equivalent to more than one fifth of the average annual losses from all disasters in the past decade. Respiratory infections like flu are often highly transmissible (it is easy for an infected person to transmit the pathogen to several other people in a short span of time) so they can spread fast; if they are also sufficiently virulent, they pose a formidable threat. A severe pandemic would resemble a global war in its sudden, profound, and widespread impact.[5] Pandemics can fortunately also be moderate or weak, such as the 2009 H1N1 flu pandemic, and can develop slowly. For instance, the AIDS pandemic increased over decades because of the characteristics of the virus and its transmission.

Man-made disaster. While infectious disease is a natural hazard, a pandemic is a disaster that is largely man-made. Once human effort to stop contagion early has proven inadequate and a pandemic starts, much of the disaster would arise from human behaviors that disrupt interconnected economic and social systems. This could entail massive international damage. A pandemic may appear to be primarily a health concern, but this is misleading. Focusing on health impacts alone leads people and governments to underestimate the total risk and to neglect policies, prevention, and preparedness actions to increase resilience and enable business and household continuity. Substantial negative impacts will occur in economic sectors other than in the health sector, as well as in society more broadly. Reactions by governments, businesses and consumers to the 2003 SARS outbreak (which was arrested after 8,000 cases and 800 fatalities) gave rise to economic costs of $54 billion, confirming that impacts of contagion outside the health sector predominate, possibly by a very wide margin. Figure 1 shows a plausible distribution of total costs in a flu pandemic. Some 60 percent of the impact would be due to demand and supply shifts driven by people's avoidance reactions. The other major driver of costs would be lost production due to high worker absenteeism, amounting to about 28 percent of total costs. This kind of a distribution of impacts means that the health sector cannot be expected to undertake, on its own, an adequate level of pandemic risk management for influenza and similar highly-transmissible diseases.

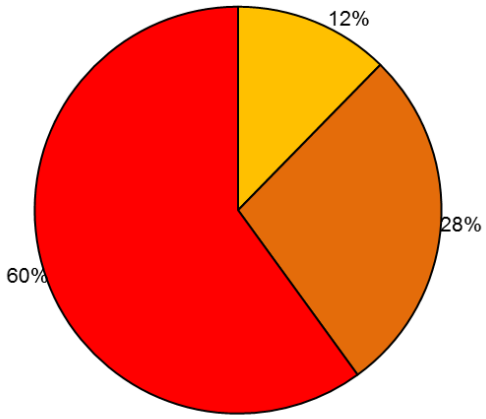
[3] World Bank (2008). The 'severe' case modeling was based on the atypically severe 1918 flu pandemic. On the other hand, yet more severe cases are possible and could occur in the future. As recovery would set in once the pandemic ends, the decline would be temporary.

[4] This calculation assumes a 1 percent probability of occurrence of a severe flu pandemic in any year, or that it is a once-in-a-hundred-years event. The same expected value obtains for a scenario with two less severe pandemics per century, with costs of 2.4 percent of GDP each, or four relatively benign pandemics per century, each costing 1.2 percent of GDP.

[5] US Homeland Security Council (2006).

Human actions are a factor in whether an epidemic escalates into a pandemic. Pandemics of infectious diseases have occurred throughout history.[6] There have been four influenza pandemics since 1918, and the acquired immunodeficiency syndrome (AIDS) pandemic is ongoing. Some disease outbreaks are unlikely to become epidemics because the pathogen is not readily transmissible, a sufficiently large part of the population is immune thanks to vaccination or earlier exposure, or the pathogen is too deadly and kills the human host before others are infected (e.g., the Ebola virus). While the hazard – an infectious pathogen – is natural, human actions can substantially affect the chances that a disease outbreak becomes an epidemic. For instance, inadequate sanitation and access to clean water fuel food borne diseases and cholera epidemics, but these are unlikely to spread to nearby areas or other countries that have a robust sanitation infrastructure. Once a pandemic is underway, the impact will also depend in part on human actions. Though the toll on the health of the young, elderly, men, women, and different ethnicities may differ because of biology, the undernourished and already-ill may be hardest-hit.[7] Identification of vulnerable groups, and ways to mitigate impacts on them, is a key task for the public health authorities as they prepare contingency plans and during the course of a pandemic.

Figure 1. Impacts of efforts to avoid infection dominate



Source: World Bank, 2008

Key role of information and communications. Much of the economic and other impacts of a flu pandemic are not directly due to death and illness. Even when up to 30-40 percent of the population would suffer from flu in a pandemic, most of the impact would be due to people's reactions and avoidance behaviors and would be, moreover, aggravated by likely confusion triggered by incomplete or inaccurate information and other inadequacies in individual subjective risk assessments. As experience in the 1918 flu pandemic showed, individual and community responses would depend on communications by the authorities, private communications, public trust, public health measures, and preparedness and level of knowledge. Failures in these respects may result in cascading failures in the provision of public (security, health, education, etc.) and private (food, water, power, transport, banking, communications, etc.) goods and services at the local, national, and international levels. Notably, panic and its negative impacts are most likely in response to gaps in official candor, which often occurs, paradoxically, to allay panic. Officials' fear of panic, which would be likely in the absence of adequate preparedness, is thus a potential source of risk that could aggravate pandemic impact.

Health risk at the interface between animals and humans. Human exposure to pathogens from animals is a key determinant of pandemic risk. These pathogens cause disease in animals, including livestock. In some cases the animal pathogens may adapt to infect humans and transmit

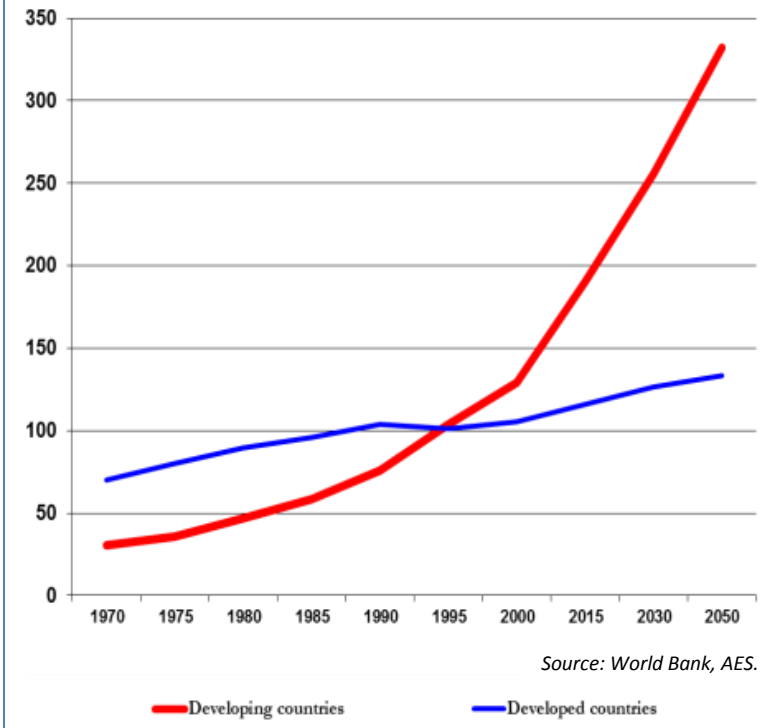
[6] Particularly devastating pandemics include: the Plague of Justinian, which started in 541 AD, killed some 40 percent of the population of the Byzantine Empire capital Constantinople and 25 percent of the population in the eastern Mediterranean region and, among other impacts, devastated agricultural production; the Black Death (plague), which started in the 14th century and killed one third of Europe's population in just six years; and the 1918 flu pandemic.

[7] There have been exceptions, however. The AIDS pandemic has afflicted the educated, urban, and non-poor populations the most. The 1918 flu pandemic had a disproportionately severe impact on healthy young adults.

among them. An estimated 75 percent of pathogens capable of causing human disease are now of animal origin – they are "zoonotic."[8] All flu viruses are zoonotic. They are notable for frequent mutations, such that a novel flu virus, one to which humans have no immunity, is certain to emerge from among the many flu virus strains circulating in birds, poultry, and pigs. Other diseases of animal origin include the plague, tuberculosis, severe acute respiratory syndrome (SARS), Middle East respiratory syndrome (MERS), rabies, and AIDS.

Poor veterinary services, encroachment on wildlife habitats. The ongoing rapid growth of production of poultry, pigs, and other livestock contributes to pandemic risk because most of this growth is in developing countries that do not have the resources to maintain good veterinary standards (Figure 2). Human and livestock populations also encroach more and more on wildlife habitats, increasing the opportunities for spillover of disease from wildlife to livestock and humans. The risks arise from both frequency of interactions, which give pathogens opportunities for transmission, and a lack of veterinary and human public health[9] capacities to detect and diagnose contagion early enough to rapidly take effective control measures. Increased internal and international trade in livestock and related products, which generates substantial economic benefits, also provides growing opportunities for wide geographic spread of pathogens.

Figure 2. Meat Production, 1970-2050, million tons



Risk origin in zoonotic pathogens. Disease in animals is a key driver of the risk of pandemics (in humans) because it increases the probability of a pandemic occurring at all. Many pathogens infecting livestock are zoonotic, or also capable of causing illness in humans. Some pathogens first transmit from wildlife to livestock, which has much more frequent contact with humans than does wildlife. Some of these pathogens have, or can develop, transmissibility and virulence characteristics that give them a pandemic potential. Without good surveillance of livestock diseases and diagnosis, the extent and nature of these threats are uncertain.

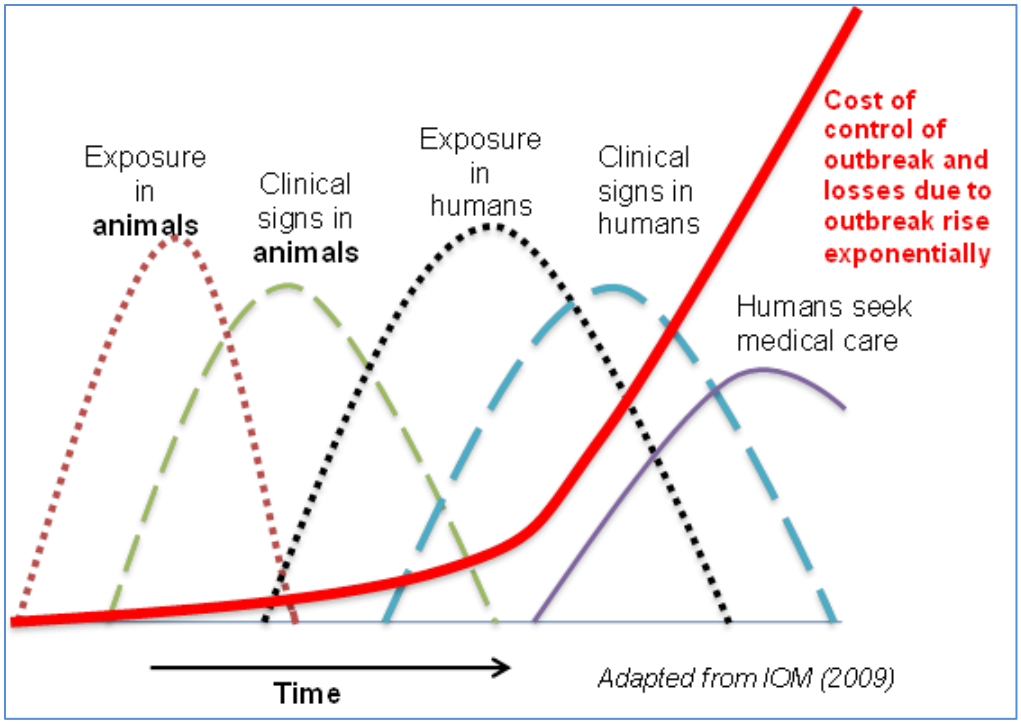
[8]Of all known pathogens capable of causing disease in humans, 60 percent are zoonotic. Among pathogens that have emerged in recent decades, 75 percent are zoonotic. Among agents with bioterrorism potential, 80 percent are zoonotic. Source: OIE.

[9]In this paper, "veterinary and human public health systems" is "veterinary public health system and human public health system". These two systems are usually managed by separate public authorities or government ministries.

High cost of delays. Too often detection, diagnosis, and control of disease outbreaks[10] are attempted only with delay and after humans are infected. When public veterinary authorities are not prepared and equipped to control outbreaks, or to detect them in the first place, delays in control and eradication (when possible) are inevitable. When outbreak control fails because it is delayed, poorly designed, or poorly implemented, prevention of an epidemic (and a possible pandemic) becomes more difficult and, as contagion spreads, eventually impossible. Mitigation of an epidemic is then the only option, by preventing infections of individuals. The AIDS pandemic offers a stark reminder of the costs of delay in tackling an infectious disease. Poor coordination, inadequate communications, gaps in authority and funding, and weak oversight—these all cause slippages even in single-country efforts, and are more likely where coordination among multiple countries and international partners is required. Delays in detection and control are ultimately very costly because contagion and attendant mitigation costs grow exponentially (Figure 3).

Weak public veterinary health systems hinder early warning about disease outbreak. When

Figure 3. Illustrative relationship between the time of detection of an emerging zoonotic disease and total cost of outbreak



public veterinary systems are so weak that they do not detect the disease in animals, the left side of Figure 3 becomes invisible to public health authorities. Contagion is obscured because government did not build the requisite systems to detect and diagnose it early. Early warning and 'connecting the dots' to inform disease control measures are impossible tasks when the most important 'dots'—those that signal the onset of contagion—are hidden. Thus, governments are not delivering an essential public service, leading to lower effectiveness and efficiency of disease control (Box 2). If nothing or too little is known about zoonotic disease in livestock, little can be done to prevent human infections and wider spread. Such crucial weakness of public veterinary systems have

[10] Disease "outbreak" refers to an event before a disease becomes an epidemic. Outbreaks are generally geographically limited and affect fewer animals and humans than epidemics (in humans) and epizootics (in animals).

hindered control of H5N1 avian flu in many developing countries, where poultry disease was detected only after humans (typically children and women) fell ill. This kind of public health service delivery—only looking for a zoonotic disease in livestock after humans are infected—is both inefficient (because of the dramatically higher costs of late control) and inhumane. Humans should not serve as sentinels for surveillance of livestock disease; they should not have to fall ill and die in order for public authorities to find a livestock disease.

Box 2. Science of Delivery informs collaboration for service effectiveness and efficiency

Science of delivery for public health services points toward adjustments in approach when services are not delivered in an adequate way to safeguard population health, notably by protecting populations from impacts of contagion on health and livelihoods. The intermediate results that serve as inputs into the ultimate result of effective zoonotic outbreak control include early detection, correct diagnosis, identification and implementation of control measures, monitoring and evaluation. The graph in Figure 3 suggests how crucial these tasks are.

Assessments of systems that should perform these functions can inform investments and management changes in public veterinary and human health systems to increase their capacity for better delivery of the services. One Health approaches (see Box 7) embody these adjustments because they reflect scientific knowledge about zoonotic disease epidemiology, evidence on delays and wrong diagnoses in the absence of One Health approaches, and evidence on the health and economic consequences of unchecked infectious disease spread. For a review of evidence and quantification of the impacts of One Health approaches on the efficiency and effectiveness of delivery of disease control services, see World Bank (2012).

Links to development and transmission of health risks into other types of risk

Initial pandemic shock to labor and consumers, not to capital. A pandemic will always impact human health and reduce the labor supply, as disease spreads and may come to affect a sizeable part of the population. AIDS, for example, disproportionately affects men and women in economically active age groups. Even if few people are actually infected, the labor-supply contraction due to workers' reactions to news of spreading illness and a drop in aggregate demand due to loss of consumer and business confidence could be massive and relatively sudden because fear may travel faster than the pathogen itself (Box 3 below). In a flu pandemic, some 30-40 percent of workers may be ill within several months. This would affect all labor-dependent activities. Impacts would be felt in all regions with human populations. Not only do the vast majority of people live in developing countries (six, out of a global population of seven, billion), but many of them could be especially vulnerable, for reasons that include malnutrition and pre-existing medical conditions, low access to safety nets and medical care, low disaster preparedness at community and national levels, low knowledge, weak communication systems, crowded living and workplace conditions, dependence on incomes from activities involving face-to-face contact, and patchy human public health services.

Vulnerabilities. Already-weak public authority and business climate in fragile and conflict-affected states could be sharply eroded, worsening security and population welfare. Business continuity failures may put at risk vulnerable groups, including dependent refugee and prisoner populations. Since developing countries derive a larger part of their income from labor rather than from capital, a significant labor supply contraction could have a disproportionate negative impact

on national incomes.[11] Moreover, many developing countries depend on remittances, tourism, world capital markets, and foreign markets for their exports. The importance of these vulnerable links would differ across countries, and many developing countries could be especially susceptible to disruptions. Active promotion of whole-of-society resilience and pandemic preparedness can benefit countries by reducing not only pandemic impact, but also the costs of other disasters and major crises.

Supply of a pure global public good. Pandemic risk management is particularly relevant to developing countries because many of them are positioned to be the main supplier of pandemic prevention, which is a pure global public good (Box 3). Many developing countries that increasingly take part in global trade and travel do not yet have the veterinary and human public health capacities to arrest contagion early. This capacity gap is a source of pandemic risk. As co-

Box 3. Characteristics of global public goods of pandemic prevention and pandemic mitigation

Global public goods share two qualities. First, their benefits are nonexcludable so that once a good is available, everyone in the world can enjoy it. This is clearly the case for **pandemic prevention,** which increases the probability that contagion will be detected and arrested effectively, at the outset. This benefits all countries and thus is a 'pure' global public good. Second, consumption of global public goods is non-rivalrous because consumption by one person does not reduce the availability to others, across nations. This, too, holds without qualifications for prevention of pandemics and the resulting pandemic risk reduction. This makes it a 'pure' global public good. Operationally, the supply of global public goods often depends critically on **international collective action**. "Global public goods concern all countries, rich and poor, and they can no longer be separated from national interests. The spread of communicable diseases […] clearly illustrates the urgency of concerted global action," according to the World Bank, *Global Public Goods: A Framework for the Role of the World Bank (DC2007-0020)*, September 2007.

Pandemic mitigation occurs after a pandemic starts. Its success depends on whole-of-society preparedness to take appropriate measures. Pandemic mitigation delivers both a global public good and a national public good. Global benefits (that are nonexcludable and non-rivalrous) are generated because successful mitigation in any one country will contribute to attenuation of the systemic shock that affects all countries. This global benefit may be expected to be proportional to the size and degree of interconnectedness of the country implementing mitigation measures, for instance those that limit failure of critical infrastructure and reduce the drop in economic activity. Vaccination is a pandemic mitigation measure that may be available about 6 months after a flu pandemic starts, and only in limited quantities; vaccination would have public (national and global) benefits because it reduces population-wide disease spread in the later stages of a pandemic, regardless of borders. Vaccination also produces private benefits by preventing individual infections.

Pandemic risk reduction results from pandemic prevention (a pure global public good) and pandemic mitigation (a mix of global public, national public, and private goods). The substantial public good content of pandemic risk reduction warrants consideration of pandemic risk reduction as a global public good as well.

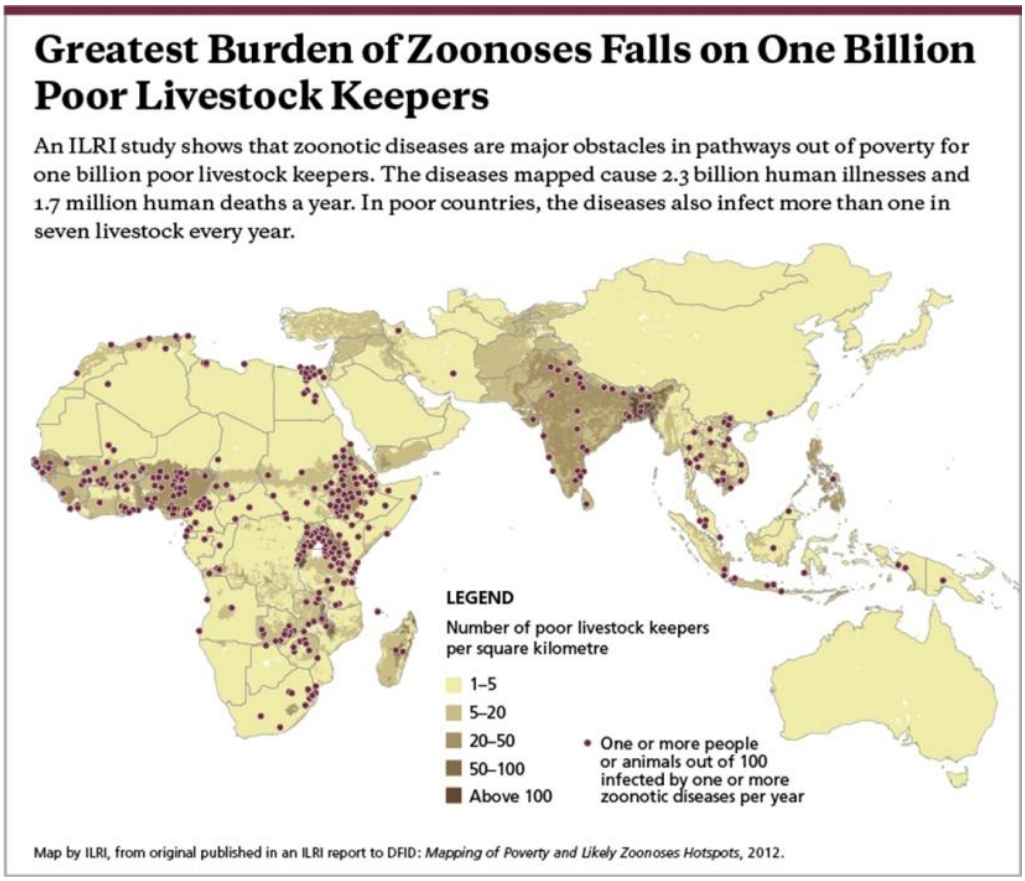
The International Task Force on Global Public Goods (2006) said that the very nature of global public goods means that demand will tend to outweigh supply "due to issues of sovereignty, differing preferences and priorities, the 'free rider' problem (the incentive to wait for another party to provide the public good, then enjoy its consumption), the 'weakest link' problem (success can be eroded by a single act of non-compliance, as in the efforts to eradicate an infectious disease), and the 'summation problem (the need to ensure compliance and sustain momentum with long term global initiatives)." Pandemic risk is high because these factors all constrain the provision of the public services required to reduce the risk, so the global public good of pandemic risk reduction is grossly undersupplied.

[11] Many countries have high unemployment, and the unemployed may be disproportionately vulnerable to disease in a pandemic. In that case, the impact on production would be lower than implied by overall infection (attack) rates. The impact might be mitigated by the ability of firms (and public services) to readily replace ill workers with healthy ones, including those who have recovered from illness. Such responses would require advance preparations.

benefits, these capacities would produce national public goods, the lack of which is an obstacle to development and poverty reduction. Investing in these capacities would substantially strengthen critical parts of the national and international systems for prevention of pandemics and thus increase the supply of the global public good of pandemic risk reduction. The benefits would accrue to all people and all firms in all countries.

Animal disease worsens poverty. Those most affected by animal-borne diseases (called zoonoses) are the poor, often the poorest, livestock keepers in developing countries (Figure 4), with some 2.3 billion infections in humans occurring year after year. Many of these diseases are so-called diseases of poverty, which are misdiagnosed, underdiagnosed, and rarely treated. Too often the fevers accompanying zoonotic diseases may be diagnosed as malaria, for instance, resulting in

Figure 4. The impact of animal-borne diseases



inappropriate treatment.[12] These diseases deepen poverty because it is the poor who tend to live in close quarters, sometimes in the same room, with livestock. Taking care of poultry, cattle, and other animals is often the responsibility of children and of women, who are thus particularly vulnerable. Poor households derive a relatively large share of their incomes from poultry (see example in Figure 5) so animal disease will reduce their incomes the most. Livestock, including poultry, is one of the poor's most important assets. It embodies an accumulation of savings, and animals can be sold quickly to generate cash for family emergencies, such as a need for medical care. Livestock therefore provides a safety net, functioning as a self-insurance mechanism against idiosyncratic risks. Animal disease reduces the value of these assets and insurance mechanisms,

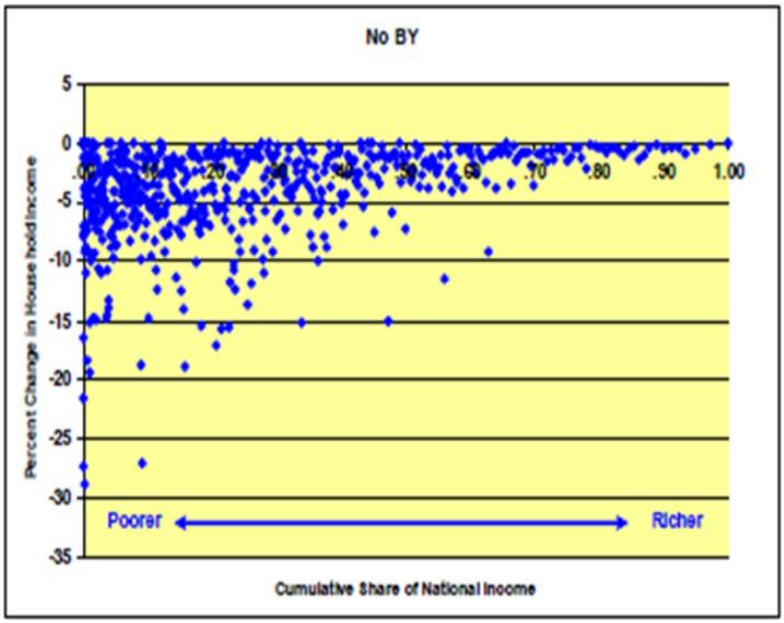
[12] Okello, A.L. *et al.* (2011).

harming the welfare and increasing the vulnerability of the poor. Animal disease also works like a tax on a key source of protein and nutrition, with deleterious consequences for child development, in particular.

Hotspots. The data in Figure 4 can serve as a proxy indicator of where the origins of the next pandemic could be. The existing zoonotic disease outbreaks shown on the map are an outcome of geography, animal and human densities, and veterinary and human public health capacities. They are clearly evident in areas where poverty is pervasive, in low-income and middle-income countries in Africa, Middle East, and South and East Asia.[13] The World Organization for Animal Health (OIE) has systematically assessed veterinary services capacity in more than a hundred and twenty five countries. Each essential veterinary public health function (critical competency) receives a score between 1 and 5 in the assessment, with 5 corresponding to full compliance with international standards on quality of veterinary services. At this time, only 19 countries have agreed to full public disclosure of their assessments.[14] Greater disclosure would help increase awareness of the global public of the status of veterinary systems and its links to hotspots of pandemic risk. The World Health Organization (WHO) is assisting in carrying out assessments of country compliance with International Health Regulations (IHR). Though these assessments are not yet publicly disclosed, human public health systems are likely weakest in the countries with zoonotic disease outbreaks.

Co-benefits. Reduction of livestock disease prevalence would help reduce greenhouse gas emissions, contributing to the global public good of mitigating climate change. There would also be important national co-benefits, including national public goods in many developing countries. Reduction of zoonotic disease risks is thus both an intermediate goal (a means to reduce pandemic risk) and an important national objective in its own right. Though countries that engage in trade in livestock products are already required to have good veterinary systems, much trade is informal and enforcement may be uneven. Strengthening of veterinary systems would increase formal trade opportunities, with resulting higher incomes for producers, and reduce

Figure 5. The poorest households would suffer larger income declines than wealthier households with a ban on backyard poultry sales



Source: FAO case study in Vietnam

[13] See the study by Grace, D. *et al* (2012) and a report on this study by Gilbert, N. (2012). The study did not include data for countries in the Americas, where zoonotic disease outbreaks occur as well. See also Jones et al. (2008).

[14] The countries with Performance of Veterinary Services (PVS) assessments disclosed on the OIE website are Belize, Bolivia, Botswana, Brazil, Central African Republic, Chile, Guinea, Guinea-Bissau, Haiti, Israel, Namibia, Nigeria, Panama, Paraguay, Swaziland, Syria, Uruguay, and Vietnam (available at: http://www.oie.int/en/support-to-oie-members/pvs-evaluations/oie-pvs-evaluation-reports/). An additional 65 PVS assessments have been disclosed to donors and partners.

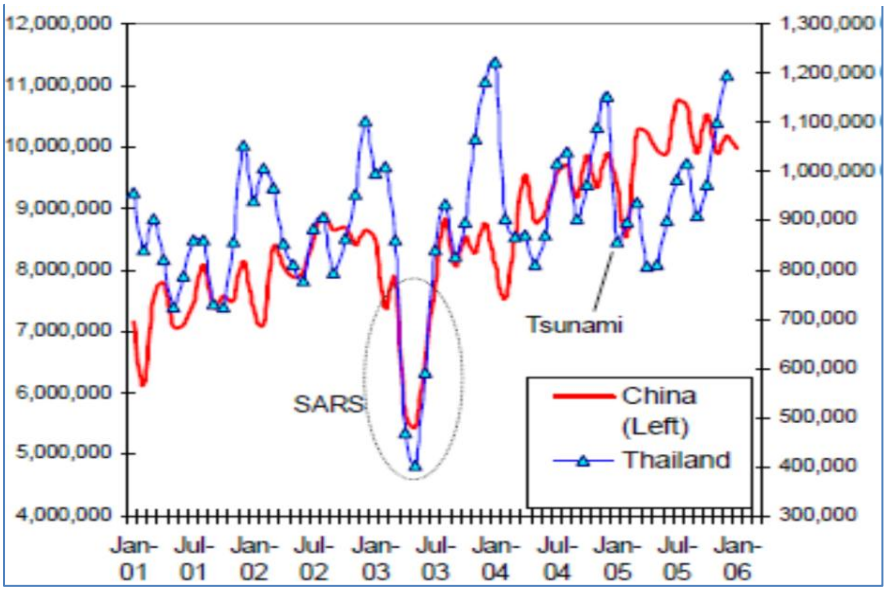
the risks associated with informal trade. More broadly, improved public veterinary and human health systems would better control other human and livestock diseases, including the 2.3 billion zoonotic infections that burden poor people every year (Figure 4). This is because the disease surveillance, laboratory, diagnostic and other capacities that are capable of thwarting a novel coronavirus, avian flu, or antimicrobial resistance—all of which pose a pandemic threat—will also reduce other locally-relevant health threats such as cholera, rabies, foot and mouth disease, leptospirosis or brucellosis, to name a few. Reduction of zoonotic disease risks would thus go hand-in-hand with reduction of other disease risks. National benefits would depend on the structure of livestock production and related activities; they would include poverty elimination, shared prosperity, reduced disease burden on the poor, nutrition, food security, food safety, reduced vulnerability, and higher incomes and trade. Strengthening of human public health capacities would bring yet other health benefits. For instance, success in promotion of hygiene would reduce human health risks due to both zoonotic and non-zoonotic factors.

Economic impacts

Systemic economic shock. If a disease is not controlled at its animal source and a sudden-onset pandemic occurs, people in all countries may experience both a contagion of disease and a sharp, possibly catastrophic, economic downturn associated with shifts in demand, supply shocks, and economic and social disruptions. Because countries are connected by, and depend on, travel, trade and capital movements, the shocks would propagate across interconnected economic and financial systems worldwide, possibly ahead of the contagion itself. These risks were evident in the SARS outbreak in 2003 (Figure 6) and should be anticipated, based on connectedness characteristics of each country (some will be more vulnerable than others). The evolution of a pandemic in any one country or community is largely unpredictable, not least because disease surveillance data become available with delay and only partially, and this is generally more so in countries with weak health information systems. For slow-onset pandemics like AIDS, which developed over decades, these economic impacts would be much smaller, however.

A range of possible outcomes. Three cases can illustrate some of the possible outcomes in a rapid-onset pandemic: a mild case (as in the 1968 flu pandemic, cost of 0.7 percent of GDP), a moderate case (as in the 1958 flu pandemic, cost of 3.1 percent of GDP), and a severe case (as in the case of the 1918 pandemic, cost of

Figure 6. Initial response to SARS: sudden collapses in tourist arrivals



4.8 percent of GDP).[15] Planning for a severe case is better than no planning at all since it is generally easier to scale a response down rather than up. Box 4 presents the nature of some of the impacts that policymakers and businesses may decide to anticipate.

Box 4. Possible demand and supply shocks associated with a flu pandemic

Avoidance reactions and social distancing measures	A. In an initial reaction to news of contagion, people tend to spontaneously try to reduce person-to-person contact, to avoid being infected. This can give rise to rapid and significant negative demand shocks and supply disruptions. Avoidance reactions, based on fear, can occur even if the outbreak subsides instead of escalating into an epidemic. Services sectors such as tourism, retail trade, transport, and entertainment can be hardest hit (Figure 5 shows the speed and extent of impact on tourism). Public health measures for *social distancing*, such as a temporary shut-down of non-essential activities, school closures, and market closures, as well as border screening or quarantines would be important to prevent illness, but they could have economic costs as well. The combined cost may account for more half of the total economic impact.
Direct and indirect costs of disease	B. The direct and indirect costs associated with human illness and death would arise from actual contagion. A minor part would be direct costs, such as for medication and hospitalization. Indirect costs, which would be far greater than direct costs, would include production losses as a result of the death and illness of workers and other absenteeism, for instance by workers staying home when their family members are ill. Absenteeism and illness of some 30-40 percent of the labor force within as little as 6 months would result in a severe supply shock. This could disrupt labor-intensive sectors the most (such as public order, transport, education, health care, retail commerce in food and non-food goods), and networked industries (such as banking, utilities, and communications). Production losses in agriculture, where a harvesting season may be impaired, may reduce food supplies for many months.
Offsetting and cascading effects	C. The above effects may offset each other. For example, avoidance behaviors may indeed reduce the rate of infection and thus reduce disease costs and supply shocks. Or the effects may combine to produce cascading impacts. For instance, absenteeism among police would reduce security and may enable looting of remaining food supplies in urban areas; disruptions of domestic and/or foreign banking services would disrupt the flow of workers' remittances; transport failures would hinder commutes to work and so further reduce the labor supply. While communities, countries, and the global economy could experience systemic shocks, there would be less severe impacts in sectors, communities, and countries with preparedness and business continuity plans that had been informed by assessments of vulnerabilities across sectors.

Factors affecting systemic vulnerability

Globalization. Globalization–the growing international movement of goods, services, and people–has complex links with pandemic risk. Local and national public health authorities are increasingly tasked with coordinating internationally, but this is often a challenge. Globalization has outstripped the capacities of public health systems in many countries. Not only is there a booming trade in livestock and livestock products, but human mobility is dramatically greater than a hundred years ago as more people than ever travel domestically and internationally. More people visit countries and regions with poor public health systems and travel between these countries and high-income

[15]The 1918 flu pandemic was atypically severe compared to the other three flu pandemics in the last 100 years. See World Bank (2008) for details on the assumptions behind the three cases cited here. Others have proposed economic costs of up to 10 percent of GDP in a severe case. However, pandemics of still greater severity may occur. No economic impact modeling appears to have been done for a flu pandemic with higher (e.g., 4 percent or 8 percent) case fatality ratios (deaths as a proportion of those infected). In such catastrophic scenarios health impacts would be unambiguously worse; however, the economic impacts need not be proportionately greater.

countries that have far stronger governance of veterinary and human public health. A pathogen originating in a poultry flock or a goat herd in a remote village in Africa or Asia can reach major cities on all continents within 36 hours. If the country of origin can detect such threats, diagnose them correctly, and control the disease, contagion is far less likely to cross borders and spread globally. Robust veterinary and human public health systems in the "country of origin" of a pathogen would greatly enhance security in "destination countries" because only such systems would make it less likely that dangerous pathogens board international flights (with human passengers) and ships or trucks (with livestock trade) in the first place.[16]

Knowledge and communications about threats. Other aspects of globalization have been working to reduce pandemic risk. Advances in biological and related sciences in recent decades have yielded a dramatically better scientific understanding of pathogens, including how they can be detected and diagnosed early enough to enable effective disease control. Some of this research was supported by a network of advanced laboratories around the world (many of them part of the US military) that are working on zoonotic and other pathogens. Work on bioterrorism agents, of which 80 percent are of animal origin, covers many pandemic-potential pathogens. Information and communications advances enable prompt and extensive collaboration among scientists and laboratories, as well as better surveillance. They have also helped improve governments' compliance with mandatory notification of diseases and emerging events to the relevant international organizations, such as WHO for human diseases and OIE for animal diseases. Fast growth in access to global media, the internet and cell phones now allow people to access and share information on disease outbreaks, complementing official information and lessening the chances of a government successfully hiding disease outbreaks from their people and from other countries. In 2012 the UN System Influenza Coordinator has begun disseminating key information related to pandemic threats and health threats at the animal-human-environment interface by email as well as posting it online at www.un-influenza.org. Blogs and networks such as ProMed Mail, Flu Trackers, Google Flu Trends, diseasemap.org, the Facebook group "One Health Approaches", Crawford Kilian's blog "H5N1", and others have emerged since around 2004, in response to concern over H5N1 avian flu, and have come to effectively and rapidly share disease intelligence and other knowledge with the public, officials, and scientists.

Interconnectedness. Modernization may make economies more vulnerable to pandemic impacts because of dependence on long supply chains, just-in-time deliveries, and a growing part of the economy consisting of networked industries. A failure of a weak link in such an interconnected system can create a gap with serious repercussions on households and firms that depend on that service for their operations. Similarly, urban areas, where more than half of the world's population now lives, are vulnerable: their food, water, transport, power and other essential goods and services are only available thanks to complex arrangements where each stage depends on several providers each delivering their part. These arrangements are vulnerable if they are not able to withstand extended 30-40 percent labor absenteeism and other disruptions. A pandemic may expose gaps in interconnected systems where 'last mile' investments had not been made in

[16] Extensive security systems are in place globally to thwart persons with explosives and weapons from boarding flights, to reduce the risk to crew, passengers, the aircraft, and other costs. This risk could entail up to 400 tragic deaths but is reduced thanks to significant expenditure on the security system. This risk reduction experience could be used to assess the adequacy of efforts to lower the likelihood that a person with a dangerous pathogen boards the same aircraft, and the contagion possibly quickly reaches megacities and ultimately endangers billions of people, as well as the global economy. Whereas passenger screening as such may be relatively ineffective and costly, the case for ensuring robust public health systems in all countries where travelers originate may become even stronger.

business continuity planning. In contrast, traditional rural communities may be self-sufficient for at least several weeks and thus better able to cope than city dwellers.

Poverty and gender. The poor would tend to be disproportionately vulnerable to impact. Their weaker physical condition and health may make them more prone to medical complications. Their incomes would suffer during economic decline and disruptions, and they would be last in line during any food, health care, or other shortages. The proportion of populations living in poverty could rise substantially, making the attainment of the poverty elimination and shared prosperity goals less likely in most, if not all, developing countries. Though the gender impact of the disease itself is unknowable in advance, women tend to be caretakers of ill dependents. They may therefore bear multiple burdens, especially in developing countries where access to health care is limited and health care systems have little or no capacity to cope with sudden surges of illness. Refugee populations in camps in developing countries (estimated to be more than 15 million) and prison inmates (more than 10 million) would be vulnerable to starvation in the absence of adequate contingency plans for food delivery.

Ex post mitigation depends on systemic resilience to pandemic impact

Risk assessments and response plans. When a pandemic begins, good pandemic risk management entails activating whole-of-society contingency plans to mitigate impacts on health, economies, and communities. Most developed countries address pandemic risk and some share their assessments with the public. The UK government, for instance, has been making its national risk assessment public, finding that pandemics are a substantial risk, which is higher than terrorism risk, for instance. Such methodical risk assessments are valuable not only to identify risks and ways of reducing them, but also to encourage preparedness. Whole-of society response plans that are integrated with national disaster risk management systems should have pre-defined response options for critical sectors. Periodic simulation exercises and reviews of exposures and response plans at firm, sector, community, sub-national, and national levels will improve resilience and reduce pandemic impact. Governments should also periodically estimate public liabilities in case of a pandemic and address them as part of their overall contingent liability management.

Cross-border coordination of pandemic response plans. Countries can also benefit from coordination of their contingency plans internationally as warranted, for instance with neighboring countries, with countries in the same economic union or community, and with main trading partners. For example, ASEAN has begun supporting joint analysis by the member countries of interdependencies and vulnerability to pandemic risks.

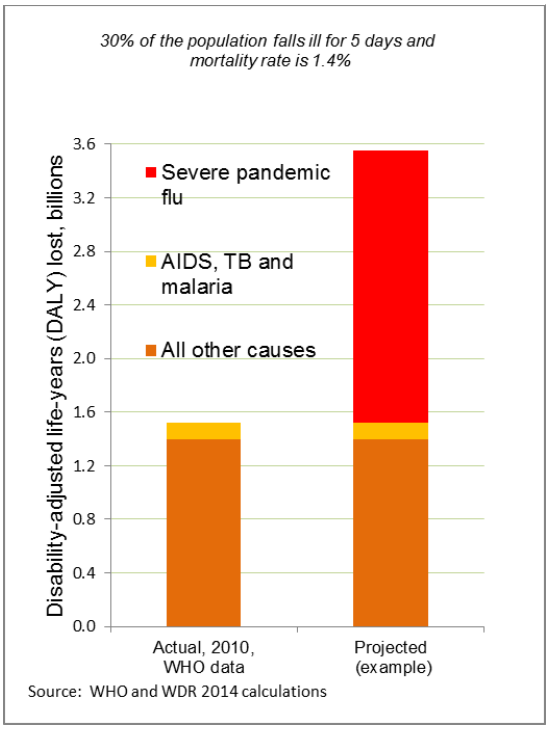
Accountable leadership. In 2012 the presidents of the US and Mexico and the Canadian prime minister launched, at the White House, a revised North American pandemic plan. Such high-level attention to whole-of-society preparedness sends an important signal. Government leadership between crises (and not just during crises) would make a country better prepared and thus more resilient. Similarly, preparedness in firms and public and private organizations will tend to occur only if there is concerted senior management commitment and directives from the CEO or the Board. Leadership is needed because incentives for preparedness are very weak. For other disasters with large externalities—and hence a need for public sector intervention that is prompt and effective—there are legal codes and regulations, or incentives in insurance contracts to encourage preparedness. For instance, some cities mandate regular fire drills, a building with fire extinguishers and sprinklers gets an insurance premium discount, and governments inspect

buildings and otherwise enforce codes to reduce fire risk. No government would survive long if it dismantled its fire department only because it has been a while since the last fire (indeed, those responsible for such a decision could be liable for criminal prosecution). Diffuse accountability in governments and international organizations, however, makes possible analogous recklessness: a gross neglect of pandemic preparedness and disease control and prevention. Inadequate funding for prevention and preparedness when there is not (yet) an emergency increases the likelihood of contagion spreading and thus increases risks. Both prudent leadership and governance that introduces accountability toward the young and future generations are needed to offset this common tendency.[17]

Individual resilience. Individuals would need knowledge to be less pandemic prone. This would include knowledge of hygiene and familiarity with their community and national disaster response plans. Where national and community disaster preparedness is weak, households with access to supplies of food and water would be able to cope better than those without such access.

Limited scope for risk pooling and ex-post mitigation. Risk pooling among individuals or among countries is difficult because once a severe flu pandemic is underway, all would quickly face similar risks, with worldwide economic disruptions within a few weeks. Within communities health risks could be pooled *ex post* as the uninfected and the recovered care for the ill. On the other hand, members of large households, such as families, are at greater risk of infection than individuals living alone. Contagion of disease differs from other hazards in that risks rise when people draw together, for instance, to help each other as in the altruistic responses observed in the aftermath of earthquakes and other calamities. In a pandemic, instead of helping each other, they could spread disease among themselves and aggravate contagion. Contingency plans should provide for the staffing of essential services by those who recover from the disease since they would be immune to further infection. The scope for insurance (other than self-insurance) is limited. Households can in principle mitigate risk through life insurance and medical insurance, where available. Firms may have business continuity insurance. But insurers will be hard-hit when many individuals and firms

Figure 7. Disease burden could more than double



[17]The health sector is not in a position to effectively lead on pandemic prevention and preparedness. Health sector resources are heavily concentrated on treatment of existing diseases. Key concerns of health policy makers are about ensuring access and quality of care, financing of costs, and securing human resources and facilities, and incomes, for health care service providers. By low investment in the prevention of future diseases, health sector policy-makers heavily discount the future welfare of the young. Health sector approaches (to the trade-off between diseases of today vs. diseases of tomorrow) diverge markedly from policy advice on climate change, where low-to-moderate discount rates are commonly applied to future impacts. Myopia and a low weight of the welfare of future generations will lead to higher costs, because low spending on prevention will cause some preventable pandemics and other disease not being prevented. Use of a high discount rate in the sector may thus result in a substantially larger-than-optimal, and costly, health care sector over time. Quantification of this impact in different countries may be a fruitful area for research and could serve to reduce systemic bias against prevention.

present claims simultaneously, and so they may not be able to honor all claims. Vaccination may (or may not) be available in time to reduce individual and population-wide risks to health. A pandemic would compromise the attainment of universal health coverage (UHC) goals, as recently adopted by the United Nations, and progress toward the goals would be set back by the sheer increase of the burden of disease. A severe flu pandemic could more than double the total global burden of disease (Figure 7).

Preparedness. Whole-of-society preparedness is the best way to reduce pandemic impacts and help households, firms, communities, and governments cope (Box 5). This should involve periodic contingency planning and simulation exercises, covering all relevant hazards and engaging all key sectors. These plans, even if they are only rudimentary, will help communities, firms, and countries respond better than they could without such plans. Some measures involve vaccinating vulnerable populations and changing behaviors to reduce disease transmission, but many other response measures are the same for a pandemic as for other complex disasters and economic crises. Notably, non-pharmaceutical measures for reducing damaging impacts on communities and economies, such as response plans to maintain essential services and social distancing, are likely to be the only means to mitigate a flu pandemic for about six months, even in wealthy countries. Thereafter the vaccines may become available, in limited quantities and likely only in higher-income countries. Non-pharmaceutical measures are effective if they are adequately prepared and managed. Communication of knowledge merits particular attention because of its large impact on people's behaviors. Truthful, compete, and promptly disclosed information about contagion is important, because uncertainty, fear, and rumors will worsen economic impacts, especially if officials, people or firms panic based on faulty communication. Such plans for responses and risk communications may be usefully coordinated among countries (e.g., within a region) and globally. While WHO is well-placed to coordinate on human health matters and disease risk communications, global coordination mechanisms are not yet as well-defined for other sectors than span borders, such as transport, telecom, financial services, and tourism. Contingency planning is a low-cost activity, but one that requires leadership and political commitment. Still, it is often neglected. Most governments, organization, firms, and households are thus under-prepared.

Box 5. A whole-of-society approach is key to joint working of multiple interests

Adopting the whole-of-society approach to sustain and mainstream pandemic preparedness and integrate it into the disaster risk reduction efforts should be on our priority list. It is people-centered: where governments open up the process and remove boundaries, where people participate to identify and satisfy their needs and where people are well informed and motivated to proactively reduce the risks to their lives and livelihoods. The whole-of-society approach will stimulate the joint working of multiple interests in pursuit of a common goal –ensuring the health and economic security for our children and future generations.

– UN System Influenza Coordinator David Nabarro, 2013

High cost of some ex-post mitigation measures, compared to prevention. Faced with a potential catastrophe, high-income country governments acquire large stockpiles of antiviral medications (though these may be of limited utility) and preorder pandemic vaccines. Pandemic vaccine research and development attract substantial government funding; for instance, in 2012 the US administration awarded $25 billion to three pharmaceutical companies. Such expenditures for *ex post* mitigation are justified from a national standpoint, but they point to a misallocation of resources from a global perspective. Because there is very little spending on early warning and disease control systems in developing countries, these systems are weak. As a result, pandemic risk

is high. Thus, governments with resources seek to protect their own populations by spending large amounts on *ex post* measures such as vaccines and antivirals. At best, these measures can provide only partial protection, however, and only with delay. Vaccines are unlikely to be available in the first six months of a flu pandemic and are not yet available for AIDS many years into the pandemic; flu vaccines may be in short supply later on in the pandemic and possibly have only low efficacy. Health security and economic security for the world, including for high-income countries, would increase if pandemics were prevented through control of contagion at the source of the threat. Prevention would render *ex post* measures less necessary, resulting in substantial savings. An expenditure of $3.4 billion annually would be required in developing countries for the world to acquire a robust pandemic prevention capability.[18]

Role of the international community

Risk management starts with awareness and goals. The most important contribution of the global community is to establish governance, risk management principles, and an effective expression of demand for the global public good of reduction of pandemic risk. While the need for pandemic risk reduction is dire as the risk is at least $30 billion per year, the apparent demand for reducing this figure is weak because of large externalities and gaps in governance. The international community needs to adopt a long term view, wherein recurrent emergencies, though infrequent, are understood to be manifestations of a substantial permanent threat to all. This threat warrants a systemic response that is adequately prepared and sustainably financed. Effective management of pandemic risk will require setting international goals for risk reduction, assessing performance of country veterinary and human public health systems relative to established performance standards, and financing strengthening of the parts of the systems that are not operating to international standards. This will reduce pandemic risk through prevention. To further reduce the risk through pandemic mitigation, the global community should encourage whole-of-society preparedness in all countries since badly managed responses to a pandemic in any one country may negatively impact other countries.

Pathogens without borders. No country's government can by itself manage pandemic risk. National authority generally stops at the border. Every country will find it in its own interest to prepare to mitigate a pandemic, but no country, or even a group of countries, can prevent a pandemic if the initial outbreaks are outside their borders. Only an international authority, anchored in an intergovernmental agreement, can consider pandemic risks adequately and coordinate a workable global system that detects pathogens early, diagnoses them correctly, and promptly thwarts their spread to prevent a pandemic. This characteristic of infectious diseases has long motivated international human public health cooperation, starting with conferences on commerce and quarantine more than a hundred years ago and now reflected in the WHO's International Health Regulations (2005). Determination to control rinderpest, which decimated cattle herds for centuries, gave rise to the establishment of the World Organization for Animal Health (OIE) in 1924.[19] Implementation of disease prevention and control across borders falls short, however, in part because of the weak capacity of countries to comply with the surveillance and reporting requirements. There are no enforcement provisions. And there are no mechanisms

[18] World Bank (2012).

[19] As OIE was established before the UN, it is not a UN agency. The founding of WHO came twenty years after OIE's. Since 2010, WHO and OIE, together with Food and Agriculture Organization of the UN (FAO) use One Health approaches to cooperate under a formal tripartite agreement on prevention and control of zoonotic diseases and other health risks at the animal-human-environment interface.

that would systematically assist weak performers to raise their performance to international standards. Since there are no such financial and institutional mechanisms, weak performance persists in many countries. This reduces human and animal health security, economic security, and social stability everywhere, including in countries with robust systems.

A coherent global system. Stopping contagion at its source is in the interest of all countries – and the capacities needed to succeed in this effort should be funded and managed accordingly, as a joint responsibility for essential public infrastructure. The initial disease outbreak may occur in any country, and that country and all other countries have an interest in the outbreak being contained as soon as possible and at the least cost, at the source. Such collective action can succeed only with robust veterinary and human public health systems that collaborate effectively in all countries and that together operate as a coherent global system. Building and operating a coherent global system will require resources and technical assistance over the long term. Global institutions such as the international technical agencies (WHO, OIE) are needed to ensure technical coherence, while the World Bank, which operates globally as well, would be in a position to support the necessary investments and financing arrangements, raise risk awareness, and facilitate information sharing on the nature, causes, and consequences of the pandemic risk.

Rules for inter-country cooperation. Because in most cases contagion starts locally, country systems are the first line of defense and need to have capacity to respond well. But international cooperation should facilitate other functions such as reporting, information sharing, and technical and other assistance. One problem, for example, is *de facto* penalties for timely reporting of livestock disease because other countries can retaliate through trade restrictions. Another example is the fragile framework for sharing of virus samples, which was exposed during the most intense period of the H5N1 avian flu crisis and in the early stages of the MERS outbreak in 2012-13 in Saudi Arabia. Sharing samples with international laboratories is important to analyze the pathogen, which in turn helps to assess the risk of contagion, and to develop pharmaceuticals to prevent and treat infections. Indonesia did not share H5N1 avian flu virus samples with WHO laboratories, arguing that they had inadequate access to the benefits that could arise from research on the samples, including vaccines. In effect, while a dangerous pathogen with pandemic potential is an immense global liability, from another perspective, it can become a country's asset. Long negotiations to reduce ambiguities of sample sharing led to a framework to share viruses and access vaccines and other benefits, concluded in 2011.[20] Incentives to carry out adequate surveillance and share relevant information are weakened in many countries by the competing demands of other pressing development problems. The international policy framework could thus include positive incentives for compliance with reporting requirements, in addition to the existing negative ones (notably livestock trade restrictions). The issue of burden sharing to finance country system investments and operations can likely be readily resolved since such costs ($3.4 billion annually) are modest relative to the large benefits ($37 billion annually).[21]

[20] See WHO (2011). http://www.who.int/influenza/pip/Framework_History_2011.pdf

[21] World Bank (2012). This benefit estimate includes the pandemic risk (annual expected value of $30 billion) and the average annual value of $7 billion due to the costs of major zoonotic disease outbreaks during the 12 year period 1997-2009 ($80 billion). These outbreaks did not become pandemics. Such outbreaks can be expected in the future as well, in the absence of adequate prevention. Additional important co-benefits, not yet estimated, include those that would accrue to populations suffering from endemic zoonotic diseases, especially the poor (see Figure 4 above) and those already noted on pages 8-10 of this paper. Pandemic risk reduction alone is already a very large benefit that, by itself, more than justifies the $3.4 billion annual cost of robust veterinary and human public health systems in developing countries. Clearly, the systems should be built if the decision were to be made on the basis of rate of return and cost-

Weak links are 'last-mile' investment opportunities. Countries with low national veterinary and human public health capacities are the weak links in the global system that should deliver pandemic prevention. Such countries expose their people and the people in all other countries to risk. The functions that need to be assured include early detection, prompt and complete reporting by communities to the national authorities and in turn to the international authorities, sharing of samples and diagnoses, determination of control measures, and rapid response including implementation of control measures (in animals, this includes culling). Farmer cooperation with detection, reporting, and control measures for animal diseases crucially depends on compensation payments that are prompt and adequate. Because these activities all deliver a substantial global public good of pandemic risk reduction (in addition to national public goods), the international community has a strong interest in the capacity of each and every national system delivering the 'last mile' in pandemic prevention services. The returns on such investments are very high since an interconnected system such as that required for disease prevention and control is only as strong as its weakest link. Accordingly, the building and operations of the required systems (animal and human public health and cooperation between them) in the countries that now have inadequate capacity will need to be funded primarily by international sources on a long-term basis.[22]

International community role in preparedness and coping assistance. International cooperation can provide knowledge and tools to help firms and countries cope once a pandemic develops. Responses to a pandemic in internationally networked sectors, such as finance, transport, and communications would benefit from *ex ante* international coordination by industry associations and relevant public authorities. The extent to which such plans exist is uncertain. There are, however, arrangements for coordination in the health sector and among select government authorities, especially among high-income countries. Since pandemic vaccines will likely be only available late and in limited quantities, the international community may consider establishing plans *ex ante* to donate vaccines to least-developed countries to facilitate their preparedness planning. When the 2009 H1N1 flu pandemic was underway, donations were arranged to vaccinate 10 percent of the least developed countries' populations. But donors made these arrangements once it was apparent that the pandemic was mild and vaccine shortages were thus unlikely. The vaccine donation program experience could nevertheless inform a future arrangement.

Global risk-management tools

Advocacy for risk reduction. Risk awareness is a necessary first step toward better risk management. International organizations should systematically monitor global risks, report on them, and relentlessly make the case for prevention and for preparedness. Some organizations do so for some risks, but most do not, and instead concentrate on traditional appeals for resources to mitigate failures of prevention (including financing for preventable disease care). The global community already contributes science and knowledge. It could do more to raise awareness about the global public good of pandemic risk reduction. With the rapid unwinding of the international response to the H5N1 avian flu, global communications about pandemic risks have nearly vanished, although the risk has persisted and may have increased.[23] Other pathogens with

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effectiveness. The annual rate of return ranges from 50% to 123% per annum, far above other public investments, with very conservative assumptions about the expected frequency of pandemics (see World Bank, 2012)

[22] See World Bank, Public Health Policy Note. *Connecting Sectors and Systems for Health Results*, December 2012.

[23] A number of countries in Africa and Asia continue to struggle to control H5N1 avian flu and experience sporadic human infections. Global risks may be aggravated since the disease appears to have become enzootic in parts of a

pandemic potential are certain to emerge or re-emerge. Global institutions that play a role in preventing pandemics and supporting emergency response activities should continue systematically their efforts to raise risk awareness and engage in communications and reporting about their programs in order to avoid perceptions of reduced risk globally, maintain advocacy for global preparedness, and prevent a slowdown of progress in strengthening systems for prevention of contagion in developing countries. Progress in this area is essential not only to reduce risks but also to safeguard sustainable attainment of global poverty elimination and shared prosperity goals. Public health is a key driver of progress toward both goals.

Global delivery of advocacy services. The UN and international agencies have a number of means at their disposal to help advocate for better management of pandemic risk. For instance, there is an annual AIDS Day, with wide communications outreach and high-level advocacy activities. A more effective and coherent approach would be an annual Pandemic Prevention and Response Day, with messages about the urgency of mitigating the high costs of an existing pandemic (i.e., AIDS) complemented and amplified by "never again" messages that highlight the imperative of preventing the next pandemic, whether it is "the next AIDS", influenza, coronavirus, or other pathogen. Media and civil society should be core constituents of such efforts, to enhance impact and responsiveness to specific needs of the poor. Likewise, the lifetime risk for children to experience a pandemic is much higher than for adults and the elderly. For instance, for a 5-year old, the lifetime odds of experiencing a pandemic are ten times higher than for a 65-year old simply because the 5-year old is expected to live ten times longer.[24] While calls to action to give children healthy starts should be heeded, the active advocacy campaigns could usefully include, for balance, calls to action to prevent the same children from facing pandemic risks and its devastating consequences.

Comprehensive financing framework. Pandemic prevention requires permanent infrastructure of robust national veterinary and human public health systems that adequately address health risks at the interfaces between animals, humans, and environment. Relevant international authorities should periodically assess the performance of the national systems and help countries determine the investments needed to bring performance to recognized international standards. Such work has started already, using the WHO's International Health Regulations (IHR 2005) and OIE's Performance of Veterinary Services (PVS) pathway, for human and animal health, respectively. To perform well (both for national needs and as part of a coherent global system), the parts of the global system that are in developing countries will require financing from the international community. Such financing will need to be on a mandatory, adequate, and stable basis. A good case can be made that the bulk of such funding should come from development assistance budgets because it mainly provides a global public good that benefits the whole world. There is also a strong case for contributions that are proportional to country national incomes since the economic impacts of a pandemic would likely be approximately proportional to national incomes as well. Thus the strengthening of veterinary and human public health systems in developing countries would be financed mainly by developed countries, in line with the benefits that developed countries obtain from prevention of economic losses in a pandemic. Such an arrangement will

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number of countries, including in Bangladesh, Cambodia, China, Egypt, India, Indonesia, Nepal, and Vietnam. When a disease is enzootic, reducing the risks of outbreaks becomes a costly protracted challenge.

[24] To illustrate, assume that the probability of occurrence of a pandemic is 1 percent in any year, and that these probabilities are independent and constant. In that case, the probability of at least one pandemic occurring during any 5-year period is 5 percent. During a 80-year period, the probability of at least one pandemic occurring is 51 percent. Moreover, the probability of two or more pandemics occurring during these is not zero.

require intergovernmental action to agree on governance of the global system and its financing. Another option is to adopt the single-best-effort model, whereby one or more globally leading countries provide nearly all the financing.[25] Still another option would be a small dedicated tax to generate some of the required resources, with the tax chosen in a way to reduce the disease externalities and encourage improved veterinary standards.[26]

Incentives to compliance, risk sharing, UN system preparedness. Intergovernmental action would also be useful to limit country ability to impose unjustified restrictions on movement of livestock and trade on disease grounds, which has been open to abuse and penalized prompt reporting of some disease outbreaks. A global financing framework could usefully include risk sharing mechanisms for payment of compensation for culling carried out to control promptly reported animal disease outbreaks, such as pooled multicountry contingency funds. International risk management tools such as contingency plans and funding would also be needed to ensure food and other safety nets for refugee populations. The global community and especially the poorest developing countries would benefit if UN agencies and programs such as the World Food Program and UN peacekeeping forces sustained adequate preparedness to deliver services during a pandemic. The international community should encourage whole-of-society preparedness for complex disasters as part of disaster risk management. It should also continue to work to encourage availability of contingent financing, conditioned on adequate disaster risk management programs, including for pandemics.

Select lessons from coping with pandemics

Delays caused by weak public health systems are costly. The ongoing AIDS pandemic is a reminder of the human and economic costs that result from inadequate public health systems. The virus was infecting more and more people, undetected, for several decades in regions with poor public human health and veterinary services. A twenty-year gap between formal documentation of fatal human cases and diagnosis followed (Box 6). By this time the disease was already widespread. Requirements to mitigate the pandemic are now $16-22 billion per year for the foreseeable future, with a likely prospect of many more years of coping and mitigation, despite the commitment of substantial resources and improvements in health care delivery.[27]

Global emergency mobilization is possible. The response to H5N1 avian flu from 2005 onwards, which was the largest global public health emergency program to date, demonstrated that the international community can mobilize reasonably quickly to tackle a global disease threat. The highly pathogenic H5N1 avian flu virus had emerged in Asia, with extraordinarily high lethality for a flu virus. As the virus spread to birds and poultry in more than 60 countries in 2005-6, the World Health Organization (WHO), the World Organization for Animal Health (OIE), other international organizations, governments and scientists were acutely aware of the prospect that a virus mutation could lead to sustained and efficient human-to-human transmission and thus to a

[25] See Barrett, Scott (2007) *Why Cooperate? The Incentive to Supply Global Public Goods.* In the response to avian and pandemic influenza in 2005-10, 36 donors contributed $2.6 billion as grant financing. Three donors contributed 88 percent of this total: United States ($1.6 billion), Japan ($381 million) and the European Commission ($322 million). This avian flu response thus had characteristics of 'single best effort.' The World Bank provided $1.3 billion, largely as loans and credits.

[26] World Bank (2010).

[27] Kim et al (2013).

pandemic, which could be severe. The international community mobilized $4 billion from 36 donors to assist more than 100 developing countries.

Box 6. A very late pandemic warning

Genetic research indicates that HIV originated in animals in west-central Africa during the early twentieth century. AIDS was first recognized by the Centers for Disease Control and Prevention (CDC) in 1981. It took more than twenty years between the first documented cases in the late 1950s and diagnosis (1981). This long delay contributed to the disease spreading to more than 34 million infected people by 2010. The delay was partly due to the interval of up to ten years between infection and symptoms; this hampered detection, as did the fact that this is a slow-onset pandemic. But poor public health capacities were also a key factor in the delay in detection and diagnosis. The public health systems failed to deliver the core service (control of infectious disease) that populations rightly expect to receive from them.

Only robust systems for veterinary public health and human public health can provide an early warning of disease emergence, and allow rapid and effective disease control and response at the source of the contagion. This is the only way to improve the chances of avoiding a costly pandemic like AIDS in the future. The world's need to minimize the risks of another pandemic occurring at all is one of the main lessons from AIDS.

A joint approach was essential to reduce a complex multisectoral threat. Together with WHO, OIE, FAO and the UN, the World Bank helped frame a new multisectoral approach that brought to bear international expertise in human health, animal health, analytical and technical support, disaster preparedness, and development communications to underpin comprehensive, country-led responses. The World Bank, which is active in all the sectors (unlike any one of the international technical agencies) supported coordination among the sectors at both the international and country levels. It was also the largest financier of country responses, committing $1.3 billion for 72 emergency projects in 60 countries.

Political support and leadership sustained momentum. Five global ministerial conferences in 2006-10 monitored the response and encouraged countries to control H5N1 avian flu and prepare for a possible pandemic. The United States and the European Commission provided political leadership for the international response, which also had support from most countries and the UN. Implementation performance was impressive, reflecting high political commitment from both developing countries and donors. Service delivery and disbursement rates exceeded those in other major emergency responses (for example, the Indian Ocean tsunami disaster). Crucially, the human health and veterinary services in more than 60 developing countries worked together to address the threat, sometimes for the first time ever. Representation at the ministerial conferences was also from both ministries of agriculture and of human health. Coordination among international, regional and national programs was tested and performed well, thanks to the impetus of high-profile emergency and substantial dedicated resources for coordination. Early on, the UN Secretary General appointed a senior UN System Influenza Coordinator (UNSIC) who effectively supported intergovernmental action and coordination across the disciplines and international organizations involved.[28] The World Bank was responsible for monitoring financing and reporting on gaps and overlaps in the global program, in addition to providing financing, advice and coordination services for country programs.

[28] These included WHO, OIE, FAO, UNDP, ILO, UNICEF, World Tourism Organization, other UN agencies, regional banks and organizations and the IMF.

Results were fragile and incomplete when emergency ended. While most developing countries did succeed in controlling H5N1 avian flu, in part thanks to assistance from the international community, the H5N1 virus is still circulating. In 2012-13, two other pathogens with pandemic potential were detected in humans (but most likely spread to humans from livestock): a novel coronavirus that causes severe disease named Middle East respiratory syndrome (MERS) and H7N9 avian flu in China. Either pathogen could mutate to transmit readily from person to person, resulting in contagion that could spread fast because these are respiratory diseases. These pathogens could also not mutate (like H5N1 to date) and thus not acquire characteristics that could cause a pandemic, or they could disappear and so cease being an active source of pandemic risk. Even so, other pathogens are certain to emerge or re-emerge. The capacities to address this threat and prevent pandemics that were created to respond to the H5N1 avian flu are increasingly not being maintained, so that they will degrade.

Stalled transition as 'pandemic fatigue' set in, undermining sustainability of risk reduction. The initial momentum of the response to H5N1 avian flu was quickly followed, starting in 2008, by sharply diminished funding for veterinary and human public health systems, waning political support, pandemic fatigue in the media, and pandemic amnesia in governments and organizations. In the face of dissipating support, finding a way to sustain at least some of the gains in pandemic prevention was warranted. The international community therefore adopted a strategy to promote One Health approaches, at the ministerial conference in 2008. These approaches were tested during the H5N1 avian flu response, focusing on collaboration between strengthened veterinary and human public health services. The strategy was prepared by WHO, OIE, FAO, UNSIC, UNICEF and the World Bank. Though the ministerial conference in 2010 urged implementation of this strategy to build systems that are capable of delivering veterinary public health and human public health, there is limited funding for the required country and international efforts. Pandemic preparedness, which was the other strand of the H5N1 avian flu response, became the "Towards a Safer World" (TASW) initiative, which is anchored by UNSIC. The initiative promotes whole-of-society preparedness for complex disasters (including pandemics) and integration of whole-of-society preparedness within disaster risk management. But TASW, too, receives only scant encouragement and support to date.

Examples of successful precedents. The international community has thwarted pathogens in the past. Notably, two devastating scourges have been eradicated: smallpox in 1979 and rinderpest in 2011. Smallpox killed as many as 500 million people in the twentieth century alone. Rinderpest (cattle plague), with its high fatality rate, decimated herds and economies for centuries. Intergovernmental cooperation, science-based disease control strategies, mass vaccination, and surveillance were among the elements behind these successful campaigns. Contagion risk was reduced to zero. The benefits are lasting and already outweigh the control costs many times over. Good international coordination and strong public health agencies made control of SARS possible in 2003. The contagion initially occurred because of failures of disclosing information, but after 8,000 people were affected and 10 percent killed, the chain of transmission was broken and contagion stopped.

Factors underlying mismanagement of pandemic risk

Myopia. Pandemic risk is undermanaged for several reasons. First, it is rarely thought about because few people like to think about death and about their family, friends and communities being the source of infection risk. Each occurrence tends to be treated as a one-off surprise, as

news with an outbreak narrative. Pandemic amnesia and collective myopia in governments and international organizations are pervasive. As the French writer Albert Camus said: "Everybody knows that pestilences have a way of recurring in the world; yet somehow we find it hard to believe in ones that crash down on our heads from a blue sky."[29] Recent reports on risk financing and disaster risk management policies do not mention pandemic risks explicitly, focusing mainly on other natural hazards that have lower expected annual values of losses than a severe pandemic. Without active consideration of the risk in public discourse and policy-making, even tacit knowledge about pandemics eventually diminishes. Leaders in private and official circles may ignore pandemic risks, because they consider that nothing will (probably) happen on their watch, that alarming approaches will make them unpopular, and that tackling existing, visible, problems will provide greater exposure and better prospects. And the public will not know about the benefits it is receiving from a prevented disaster, such as a pandemic. The consequence is that such attitudes heavily discount the welfare of the young and of future generations and preparedness and prevention remain inadequate for today's and future generations.

Collective amnesia. Societies have a tendency to erase pandemics from memory. Bristow (2012) has suggested that since the European and American medical professionals were powerless in the face of the 1918 flu pandemic, they then omitted the episode from their professional discourse. It was incompatible with their new self-image that stressed scientific and medical progress and modernity. Many history textbooks with twenty pages on World War I have barely one paragraph on the 1918 flu pandemic, though it killed six times more people than the war and its impact was determined by human actions, not merely by virus mutations. Also, war memorials are a far more common sight in villages, towns, and cities, than public memorials for the victims of pandemics. Since pandemics were (and with scientific progress will increasingly be) at least in part due to a failure of governments to deliver basic public health services to protect populations, forgetting these failures may make their recurrence more likely.

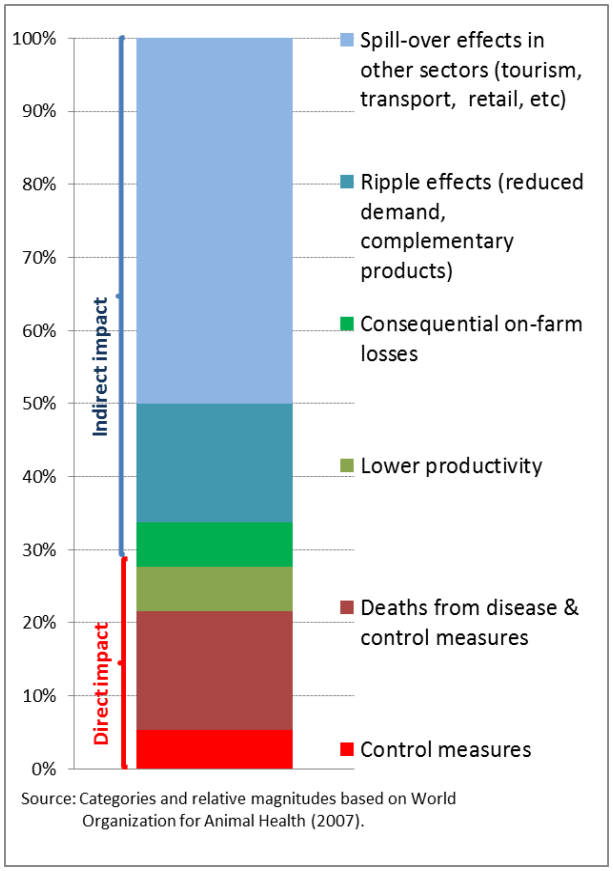
Health sector bias toward present diseases. The second reason for poor management of pandemic risk is the uneasy fit of preparedness and prevention in the human health sector. Reflexively, governments and other institutions classify pandemics as a human health issue. Pandemics are, however, a very low priority for the health care sector, which is mainly concerned with existing health burdens. Prevention of future disease gets relatively little attention, which is also apparent from the ongoing high prevalence of preventable diseases. Medications and equipment to treat existing illness are far better developed, better financed, and more profitable than preventive measures (such as vaccines, public health systems, veterinary services, and risk awareness efforts).[30] Physicians, trained to treat and save the lives of patients who are already ill, dominate leadership, management, and policy-making. Compounding this bias against preventing future disease burdens, consideration of pandemic risk is sidelined by the ongoing certainties of existing disease. For instance, one preparedness measure within the health sector is to build in a degree of redundancy and flexibility in the health care system (spare hospital beds and reserve lists of nurses, for instance), to at least partly accommodate a surge of additional patients. But such contingent surge capacities are not feasible in many developing countries where health care systems cannot cope with already existing demand. Budgets for such contingent capacities and for preparedness more broadly are also the first to be cut even in high-income countries. The health sector has little incentive and scant means and authority to anticipate pandemic impacts on society and the economy, and to ensure preparedness in all sectors to mitigate such impacts.

[29] Camus, Albert (1948). *The Plague*.
[30] These may include simple measures, such as closing the mouth when sneezing or coughing and washing hands.

Large externalities. The third reason for mismanagement is the multisectorality and diffuseness of the impact of contagion. Figure 8 shows a schematic composition of the costs of an animal disease outbreak. The cost to the farmer and the veterinary services may typically account for about 30 percent of the total impact. Since farmers suffer only a small part of the damage, they will tend to assume what are unduly large risks from a societal perspective. For instance, without considering externalities, the cost of an avian flu outbreak to the farmer and the veterinary services is $3 per chicken. But including impacts on the community and on neighboring communities and beyond, the value of the loss is more than $10 per chicken – and it would be higher still if pandemic risk were included. Farmers' incentives to prevent diseases and to seek veterinary services to this end are limited by their own losses. The other vulnerable sectors (such those where demand is sensitive to disease risk perceptions—tourism, restaurants, and entertainment, and commerce more broadly) may be underestimating their own risks from animal disease outbreaks because they are not familiar with the farms and their disease risks. Since they have little or no concerns about animal diseases, they do not convey demand for reduction of this risk to the government. Thus, budgets of public veterinary and human health services will continue to be underfunded relative to the societal benefits they generate.

Aggregate benefit unknown or poorly recognized. The beneficiaries of disease prevention and control tend to be widely dispersed and not organized. Most will not even realize that they benefited from prevention of disease. The result is that the full extent of the demand for infectious disease prevention and control will not be effectively expressed. This holds for human infectious diseases—and it is even more so for animal diseases. These 'market failures' require government to aggregate the risks and bring public human health and veterinary system performance to a level that minimizes the overall expected losses to society (net of the cost of the systems). The problem of externalities also hampers management of risks that extend beyond a country's borders. The country of origin of the contagion would not normally consider impacts beyond its borders, leading to an underestimation of risks by the authorities of that country. With many countries thinking along similar lines, the result is a global underestimation of risk and underfunding of prevention.

Figure 8. Most of the cost impact is indirect, though also fully attributable to the animal disease outbreak



Source: Categories and relative magnitudes based on World Organization for Animal Health (2007).

Professional and institutional divides. Not only are risks assessed too low because of externalities (due to impacts in multiple sectors and across borders), but there are also divisions among the institutions and professions that are responsible for public animal health and public human health and are charged with reducing the risk of contagion so as to protect human and animal populations.

This is the fourth, and perhaps the most intractable, reason for mismanagement of health risks at the animal-human-environment interface. Necessary communications and collaboration do not occur readily in an emergency or routinely between emergencies, mainly because in too many countries veterinary services are far weaker and less well funded than human health departments. Authority, mandates, and scope for collaboration are sometimes ill-defined, and there is competition for budgets between the two ministries involved. Without explicit and sustained attention to the interactions between the functions of public veterinary and human health services, and adequate resourcing of the coordination between them, disease control failures are a certain prospect in both developed and developing countries. Each of the two sectors may consider that it is on its own adequately handling "its part" of the risk, but without close coordination with the other sector, this is not the case. Poor communications and cooperation between veterinary and human health services create risks of delays in diagnosis and disease control, which become highly costly when contagion spreads. One Health approaches are needed to remedy these gaps (Box 7).

Box 7. One Health approaches

One Health means "the collaborative efforts of multiple disciplines working locally, nationally and globally to attain optimal health for people, animals and our environment"

– American Veterinary Medical Association, 2008

Recognized and practiced long before it was given the name, systematic collaboration between veterinary and human public health professionals and agencies was a fundamental aspect of medical training. The German physician and pathologist Rudolf Virchow (who coined the term "zoonosis") emphasized the importance of collaboration between human and veterinary medicine. But in the 20th century, ever greater specialization in both animal and human health professions has let the idea slip from curricula and professional practice.

One Health is not all of health, but rather the intersections, or overlaps, between animal, human, and environmental health. The approach gives deliberate attention to the interfaces between the domains and to bridges between the public veterinary and public human health services because the likely weak links (that lead to disease control failures) are at the interface, where too often 'nobody is responsible.' Equally important is concern with strengthening the systems responsible for core functions, on which the delivery of public health services depends, since weak systems will not collaborate well.

Not only is disease control more effective when animal and human public health capacities are robust and work together, but One Health approaches will often be more efficient. They will achieve results at lower cost when some equipment, personnel, databases, and other inputs are shared. See World Bank (2012) on cost savings up to 30-40 percent in developing countries and 26 percent in the Canadian Science Centre for Human and Animal Health in Winnipeg.

One Health is a framework for enhanced collaboration in areas of common interests (intersections), with initial concentration on zoonotic diseases that will reduce risk, improve public health globally and support poverty alleviation and economic growth in developing countries. This concept involves a better way to deal with risks at the animal-human-environment interface.

– World Bank's operational definition, presented to the Hanoi ministerial conference, 2010

There are major gaps in preparedness that have widened in recent years as budgets have tightened. However, we could work together to fill these gaps through the long-term application of a One Health approach with its focus on mitigating health risks, including pandemics, at the interfaces between animals and humans in different ecosystems. This focus on linkages is an increasing feature of policy dialogues everywhere - including intergovernmental efforts underway now to establish priorities for development and disaster risk reduction after 2015. The well-being of individuals, households, societies, governments, nations, and cultures depends on good care of health at interfaces.

– UN System Influenza Coordinator David Nabarro, 2013

An example of opportunity for One Health approaches. Surveillance of flu viruses in swine is an example of how sectoral divides, which are a social and administrative construct, increase risks at the animal-human interface. Some types of swine flu are not reportable diseases and often do not make animals ill enough to appreciably affect production. One of the flu strains infecting swine may change and infect humans, spread from person to person, and cause a pandemic. But because there is relatively little surveillance for low pathogenic flu in swine, human public health authorities may not have access to potentially relevant animal flu information. Scientists repeatedly warn about new flu virus strains found in one-off studies of swine herds, and they repeatedly appeal for more flu surveillance in swine.[31] Cost of surveillance and the arguments of elected politicians from swine-producing regions against additional burdens on farmers will usually prevail over the more abstract arguments of public health, especially when such an issue is tackled country-by-country without the benefit of encouragement from an international standard.

Multisectoral coordination of communications. Coordination among sectors and institutions in whole-of-society pandemic response plans and responses is essential because of the wide range of impacts that a pandemic would bring. Mitigation of costs to firms and households is only possible on the basis of credible and truthful information. Good risk communications will reduce substantial costs due to unwarranted avoidance behaviors. Poor coordination before, during, and after a response leads to mixed messages and confusion, which can in turn lead to a loss of trust among the public for this and future outbreaks. Poor communications based on inadequate knowledge may have yet other effects on behaviors in response to disease outbreaks, such as individual and mob violence. Coordination among the agencies and firms involved in the outbreak response should be planned in advance because good coordination will not occur spontaneously in an emergency, especially if communications officers do not maintain a minimum of knowledge of the topic during peacetime, between outbreaks. Poor coordination can give rise to significant risks, which in a pandemic can have global implications. The relevant international organizations can act as sources of credible and authoritative knowledge, but they need to provide it quickly as required by the emergency circumstances. For instance, although WHO corrected the labeling of the 2009 H1N1 flu to omit the term ‘swine’, the error persisted among some human health professionals and in the popular press. The initial lapse in communications, caused by poor intersectoral coordination, gave rise to substantial real costs (Box 8).

Cost-effective, incentive-compatible policies to reduce pandemic risk

Resignation to recurrent emergencies costs lives and money, which can be saved by proactive defenses. The international community faces a choice: continue to rely on emergency responses, with their high-impact/low-sustainability tradeoff and their huge human and economic losses, or commit to supporting systemic prevention efforts that will reduce pandemic risks and deliver substantial long-term health and economic benefits. All countries benefit if each undertakes adequate whole-of-society preparedness measures to increase resilience and capacity to respond to disasters and thus limit spillovers of negative impacts to other countries. Because greater preparedness and resilience will reduce the costs of humanitarian interventions following adverse shocks, the UN’s International Inter-Agency Standing Committee (IASC), which includes UN organizations, non-UN humanitarian partners, and the World Bank, have begun work to increase funding for preparedness. This is an important milestone since funding for preparedness activities

[31] See, for instance, Butler (2012).

has been historically inadequate and constituted only a very small part of official development assistance. Over time, not prioritizing financing for prevention and preparedness has helped ensure that more aid was needed to respond to larger disasters. Chronic underfunding of pandemic prevention and preparedness has even more serious implications because with rapid global spread of disease contagion, the aggregate stakes are far greater than for other natural hazards, which tend to be confined to relatively small geographical areas and affect a fraction of a country.

Box 8. Coordinating approaches and communications is important

In an emergency, things can go very wrong because of poor risk communications. For instance, the Egyptian government killed all 300,000 of the country's pigs in May 2009 without adequately compensating the owners, in a reported attempt to control the 2009 H1N1 pandemic flu, while WHO and other health authorities had publicly announced that they had stopped using the erroneous term "swine flu" and that culling of the pigs would do nothing to diminish the H1N1 flu threat. The incorrect perception that some of the infection risk originates in swine resulted in substantial hardship for the poor, marginalized community that raises pigs in Egypt. Moreover, there were additional costs: the trash that the pigs once consumed accumulated in massive piles.

Other governments also based their responses on the 'swine' flu misnomer. More than twenty countries imposed restrictions on pork imports from Mexico and the US. In the US alone, losses in the pork sector exceeded $1 billion in April-October 2009, although there was apparently no flu infection risk from pork and related products.

For zoonotic diseases, both human and veterinary health authorities need to be involved in naming and characterizing the disease to ensure that information is accurate and that they correctly convey risks to the public.

The challenge now is how to bring intertwined fields of human, animal and ecosystems health to work together in synergy to achieve the ultimate goal of building resilient communities to all types of hazards and disasters, particularly in the face of resource scarcity. Preparing for unpredictable threats that cross borders and affect the safety of all people, should be based on trust and mutual respect. Bridging gaps in information and differences in approach between these sectors is an urgent first task.

– UN System Influenza Coordinator David Nabarro, 2013

Governance to raise risk awareness and assign responsibilities. The first essential step is for governments to recognize that knowledge about pandemic risk is too low and that even with 1 percent probability, pandemic risk is some $30 billion every year. Next, systematic, continuous management of the risk should be an explicit task for international organizations and national governments, starting with periodic monitoring and reporting of the risk by national and international institutions, rather than responding only when the mass media report an outbreak. Moreover, systematic analysis of pandemic risks by global economic and financial institutions would likely generate media coverage, which would help people and firms better manage their risks. The stop-go pattern of capacity development and disease control that comes with repeated emergency responses is inefficient and ultimately too risky and should be replaced by sustained attention to the risks and systems to reduce them, so as to reduce risks globally—especially for the poor in developing countries.

Sustained prevention efforts. While multisectoral disaster preparedness based on shared knowledge and strong political commitment is important for all countries individually and collectively, it is globally less efficient than prevention. The least-cost approach is preventing a pandemic from developing in the first place. To this end, public health and veterinary systems in each country need to be capable of detecting contagion early, diagnosing it accurately, implementing effective disease control measures, and fully collaborating with the relevant international authorities at each stage. But such systems will only succeed in preventing pandemics if they are financed and managed as essential permanent infrastructures, rather than temporarily

funded only in emergencies. Sustained attention to, and funding for, the core public health and veterinary systems and their operation is the key tool for managing pandemic risk. Periodic assessment of the performance of these systems by international authorities (WHO and OIE) and peer reviews are two promising mechanisms to ensure that the global public good of disease control is, indeed, delivered.

Country systems as core building blocks. The International Health Regulations (2005) of WHO and assessments of the Performance of Veterinary Services (PVS) of the OIE already provide a good basis for building these systems and for monitoring their performance regularly, including the bridges between them that are needed for One Health approaches to disease prevention and control. At present most developing countries have very weak veterinary and human health systems and some have next to none. Likewise, international cooperation among the national systems is still weak in theory and even more so in practice. Weak country systems are not capable of cooperating internationally or at the interface between animal health and human health. Therefore, to build an effective global system to thwart pathogens, the main focus needs to be on strengthening of country public human health and veterinary systems, the links between them, and the relevant subnational and community components.

A global goal to guide agencies and country authorities. To make progress, the international community would be well-served to adopt pandemic risk reduction as a global goal. Based on this, concrete targets for strengthening of veterinary and public health systems, and their collaboration, should be set globally. For instance, the goal could be that at least half of all countries have systems complying with international standards by 2030 and that all countries would have them by 2050. Within this framework, intermediate targets would underpin each country setting its own objectives and together with OIE and WHO, reviewing their progress. The international authorities should obtain adequate resources to carry out assessments and to monitor progress in the strengthening of systems, and to put in place regular reporting on the results of their assessments of progress in pandemic risk reduction to the UN Security Council (annually) and the General Assembly (every five years).

Modest costs, substantial benefits. The spending required in all developing countries to build and operate systems for timely and effective disease control would be up to $2.9-$3.4 billion per year, depending on disease risk. This would not only address risks at the interface between animal and human health, but would also better equip the public veterinary and human health services to tackle nonzoonotic disease threats. The expected benefit of One Health systems to the global community is at least $37 billion per year, the bulk of which is due to reduced pandemic risk. Such an expenditure on prevention ($3.4 billion annually) thus pays off.[32] If all financing were sourced in OECD countries, it amounts to just $3.40 per capita. The expected rate of economic return is in excess of 100 percent per annum, making One Health investments an extraordinarily attractive proposition for the international community.

Governance and funding gaps. At present, there is no governance in place to encourage such investments. Following the response to H5N1 avian flu and H1N1 pandemic flu, when assistance to developing countries peaked at $1 billion per year, funding for pandemic prevention and preparedness dropped to less than $450 million annually. Moreover, further declines are anticipated because the bulk of the financing has been from development aid budgets, which are under pressure. In addition, there is no mechanism to compel the countries with the weakest

[32] World Bank (2012).

systems to make the investments required, nor is there a way for the international community to provide adequate, predictable, and long-term assistance to strengthen these weakest links of the global system. Results-based financing that countries obtain through mechanisms such as the World Bank's program-for-results (PforR) instrument would be particularly suitable to improve governance of public health capacities, including the necessary collaboration between veterinary and human public health. Results-based financing would encourage countries to make systemic improvements that would be regularly monitored and assessed by the relevant international authorities.

International institutions needed to address a global issue. Neither OIE nor WHO and other UN agencies have the mandates or experience in financing large-scale long-term multisectoral investment programs such as those required for robust public veterinary and human health systems that employ One Health approaches. They could, however, provide technical assistance as well as inter-country linkages for information-sharing and for ensuring connectivity with existing global notification systems. They can also be a valuable source of analysis and emergency support. The World Bank, as an institution with a global reach and experience in supporting investments in country programs for public health, agriculture, and other sectors, could be tasked by the international community to coordinate mobilization of adequate resources and development and implementation of appropriate financing instruments. A virtual or actual fund would need to be established to mobilize and allocate resources so as to achieve over time the greatest systemic benefits in terms of pandemic risk reduction. Based on the OIE and WHO assessments of country system performance and needs, the World Bank could work with countries to prioritize and implement investments. Country-level investments may be complemented by regional or global capacities, to make efficient use of resources. For instance, pooling funds for emergency disease control and compensation or establishing a contingent emergency lending facility for this purpose would likely be more efficient and equitable globally than individual country contingency funds.[33]

Vulnerability in networked industries. There is an unmet need for pandemic preparedness by major globally-networked industries. Major firms and regulatory authorities in the financial sector have carried out pandemic response simulation exercises, and there are ongoing consultations on plans for possible responses. Work has also been done for the international tourism sector. This is not the case in other internationally interconnected sectors, however. The World Bank Group, with its multisectoral character, nearly universal membership, and engagement with both the private and public sectors, may be well-placed to encourage preparedness for responses in transport, communications, food, agriculture, energy, and other sectors with substantial cross-border scope. Political and business leaders will need to engage in this area (Box 9).

Assistance to countries coping with a pandemic. The World Bank could also prepare to help countries cope once a pandemic is underway. While the progression and severity of a pandemic is unknowable in advance, less developed and more open economies may be more vulnerable if they depend on far-flung suppliers and markets, or, as is the case for many small developing countries, rely on tourism and remittances from abroad. Where such vulnerabilities are significant, countries should not only include multisectoral pandemic response planning in their overall disaster risk

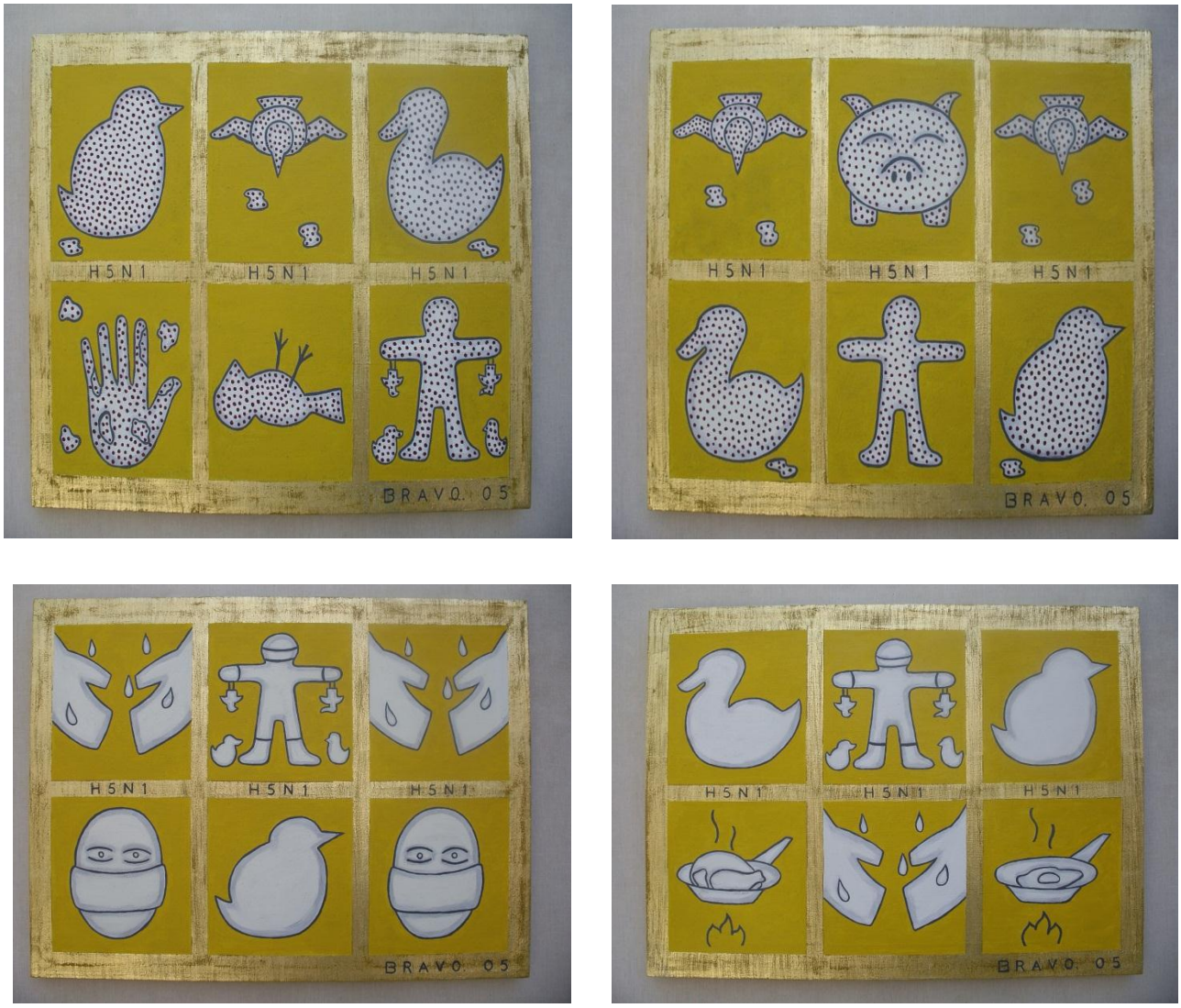
[33] The Caribbean Catastrophe Risk Insurance Facility, established in 2007, is a possible model for such risk-pooling among countries. The CCRIF operates as an independent legal entity controlled by a Board of Directors made of representatives of member countries, donors, and technical experts. After playing a facilitating role during the establishment of the Facility, the World Bank provides technical assistance and fiduciary control of the funding provided by donors and held in a trust fund.

management, but also consider making advance arrangements for contingent external financing to enable a rapid and adequate response. The facilities of the International Monetary Fund (IMF) would be particularly relevant in this regard and may be sufficient. In case of need for more funding, an instrument that could prove helpful is the Cat DDO (development policy loan with a deferred draw-down option for catastrophic risk) offered by the World Bank. Advance arrangements would be all the more warranted because low and middle-income countries may well be confronted with reduced access to external financing in a severe pandemic, both because of financial sector disruptions and because financial institutions and investors tend to react to heightened uncertainty by a 'flight to quality.'

Box 9. Leaders to emphasize collaboration

To reduce health risks, including pandemics, arising at the animal-human-ecosystem interface, communications among countries and synergy among different groups of actors have to be encouraged. This is essential to prepare for pandemics and other unpredictable cross-border threats. All partners should develop a systematic One Health approach to prepare for, and respond to, these threats. Political and business leaders should emphasize whole-of -society and multisectoral collaboration for all critical sectors that might be affected by the threats or that can help to mitigate their impact.

– UN System Influenza Coordinator David Nabarro, 2013



Gerardo Bravo Garcia, *Avian Flu Series*, 2006, Oil & Gold Leaf on Canvas. Courtesy of the World Bank Art Program.

Select key points

- The most severe of the four flu pandemics in the last 100 years killed 50 -100 million people in 1918-19, out of a global population of less than 2 billion. Pandemic risk is a top global catastrophic risk and is rising. Developing countries, with most of the world's population and labor-intensive economies, are vulnerable.
- Pandemic risk combines a low probability (1-3 percent annually) with high impact (over $3 trillion in a severe case). The annual risk is at least $30 billion, but people, firms, and governments grossly underestimate it. No country is safe. In an interconnected world, a pathogen from a remote village can reach major cities on all continents in 36 hours.
- While the hazard is natural (a pathogen), pandemic occurrence and impact would also depend on human action. Weak policies and institutions will enable a man-made disaster in a pandemic. Many impacts on economies and communities, as well as on health, are preventable. Measures to protect health are only one part of the required response.
- Pandemic risk is mismanaged because of low risk awareness, myopia, diffuse accountability, multisectorality, externalities, and, crucially, no governance and funding of the supply of a global public good. Prevention effort is low, though the risk is high; thus the welfare of the young and future generations are heavily discounted. The poor are likely most vulnerable.
- Pandemic prevention through control of contagion at its animal source has extraordinarily high economic returns and is the best approach. To succeed, pandemic prevention should be emphasized by leaders, set as a goal of governments and organizations, who need to deliver active advocacy.
- Being prepared to cope and mitigate impacts *ex post* also has high returns. Policies and budgets should therefore systematically anticipate pandemics and assess the risks; most *whole-of-society preparedness* measures are the same as for other major complex disasters.
- Weak veterinary public health and human public health systems in developing countries are a key driver of pandemic risk. The systems should detect pathogens early, diagnose them correctly, and control contagion before it spreads within the country and beyond. Much of the risk originates in livestock, which is under human control; wildlife may also infect livestock.

Select key points (continued)

- Controlling contagion at its animal source, so it does not spread and become a pandemic in humans, requires ***One Health*** approaches with systematic collaboration between capable veterinary and human public health authorities. The World Bank's 2012 public health policy note, *Connecting Sectors and Systems for Health Results*, recommends this approach, which served well in the response to avian flu.
- Investments of $3.4 billion annually would bring developing countries' capacities up to international standards. The expected benefit is at least $37 billion annually from avoided pandemics and other major outbreaks. Major co-benefits will be generated, because capacities that can control one zoonotic disease or reduce antimicrobial resistance (AMR) will also thwart other diseases in animals, humans, or both. Co-benefits will be both national and global. Robust systems for pandemic prevention will also render repeated and costly emergency responses less necessary.
- The international community needs to manage and finance a connected system of defenses against a pandemic as essential permanent infrastructure. Assessments of country systems by OIE and WHO warrant strong follow-up so all countries can operate systems that meet international standards, for the benefit of the whole world. Robust assessment tools will be available in 2014.
- Defenses against pathogens are only as strong as the weakest link. Contagion can start anywhere, and spread fast across borders. Stopping it early is in the interest of all countries individually and collectively. Strengthening the weak links is a joint responsibility that needs financing from international sources.
- A goal for 50 percent of all countries having systems that meet international standards by 2030 (followed by a goal of 100 percent coverage in 2050) would improve health, economic, and social security, especially for developing countries, those who are young today, and future generations. Without an agreed goal, and attendant oversight and monitoring, governments and partners cannot work together to reduce pandemic risk and the risk will remain high.
- Reduction of pandemic risk requires engagement from numerous partners, anchored by the UN, WHO and OIE. The World Bank could contribute its global convening capacity and multisectoral character; its experience coordinating across sectors in countries; its financing; its experience providing solutions for operations of global and country systems; its capacity to deploy solutions in financing and resource mobilization, as well as its track record of support for emergency responses.
- A single severe flu pandemic will not only kill tens of millions, sicken billions, and cost trillions of dollars, but it will also quickly unravel progress toward the 2030 international goals of eliminating poverty and boosting shared prosperity. It will increase poverty and replace shared prosperity with shared misery as it bankrupts health coverage schemes, governments, firms, and households.

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