

January 15, 2019

## Funding for One Health capacities in low- and middle-income countries

Author: Olga Jonas, Senior Fellow and Economic Adviser, Harvard Global Health Institute\*  
Address: 42 Church Street, Cambridge, MA 02138, USA;  
Contact: [olga\\_jonas@harvard.edu](mailto:olga_jonas@harvard.edu) or cell 202-469-2727

---

<b>Summary</b> .....	<b>ii</b>
<b>Introduction</b> .....	<b>1</b>
<b>1. Role of core public-health functions</b> .....	<b>1</b>
1.1. <i>A pure public good that saves lives and saves money</i> .....	1
1.2. <i>Support for poverty reduction</i> .....	2
<b>2. Obstacles on the pathway from assessments to results</b> .....	<b>2</b>
2.1. <i>Objective expert assessments of weak links in core public-health systems</i> .....	3
2.2. <i>Structural reasons for persistent neglect of core public-health systems</i> .....	5
2.3. <i>Health sector bias against saving money</i> .....	8
<b>3. Economic rationale for spending public funds</b> .....	<b>10</b>
3.1. <i>High returns of investment in core public-health systems</i> .....	10
3.2. <i>Risk to economic and fiscal stability</i> .....	10
<b>4. Toward universal coverage by core public-health systems</b> .....	<b>12</b>
4.1. <i>Analyses and technical assistance</i> .....	13
4.2. <i>Financing to save lives and save money</i> .....	14
4.3. <i>Critical review of recent recommendations on financing</i> .....	15
4.4. <i>Counterproductive behavioral responses to risk</i> .....	17
4.5. <i>Incentive #1: Require the World Bank to perform due diligence in the health sector</i> .....	18
4.6. <i>Incentive #2: Supplemental allocation</i> .....	18
<b>Conclusion</b> .....	<b>18</b>
<b>Annex 1. Two recent analyses of financing of preparedness (human-health focus)</b> .....	<b>20</b>
<b>Acknowledgements</b> .....	<b>21</b>
<b>References</b> .....	<b>21</b>
<b>Text Boxes, Figures, and Tables</b>	
Box 1. Example of consequences of poor governance .....	4
Box 2. Argument library: What bad things will happen if public-health systems are weak and lack capacity for One Health collaboration?.....	15
Figure 1. Poor performance of core public-health functions – and in most of the world, it’s not even known .....	3
Figure 2. Components of losses due to an outbreak .....	7
Figure 3. A pandemic could trigger a global recession as severe as the global financial crisis a decade ago -- and a massive loss of tax revenues.....	11
Table 1. Economic costs of outbreaks are often more significant than public-health impacts.....	6
Table 2. Spending on core public-health functions is extraordinarily productive .....	10
Table 3. Core public-health systems need less than 1 % of public spending on health (but get far less) .....	12

## Summary

Most infectious diseases with epidemic and pandemic potentials are of animal origin; control at the source thus requires detection in animals, before the threat extends to human populations. Core veterinary and human public-health systems that use One Health approaches are the first line of defense against contagion and antimicrobial resistance (AMR). Adequate financing for core veterinary and human public-health systems is important for their performance. Despite the remarkably low costs of core public-health systems, financing has been inadequate, and spending has not even been officially monitored.

Weak core public-health systems pose substantial macroeconomic threats, including to public finances. They tend to increase poverty and inequality as well. Attainment of universal healthcare, which is a priority in many countries, will be delayed by additional disease burdens, declining drug-effectiveness, fiscal pressures, and poverty.

Financing of One Health activities depends directly on raising the priority of core public-health functions in public expenditures. To this end, international organizations, including the IMF and the World Bank, should ensure that their regular analyses of macroeconomic risks are complete and do not omit pandemic and other microbial risks. Their consultations with governments on economic policies should address the adequacy of country capacities to mitigate all material macroeconomic risks. These and other small and feasible adjustments to incentives at the global and national levels would sustainably generate significant health and economic co-benefits, over and above a reduction in microbial risks. Core public-health systems should be the foundation of resilient and effective health sectors. With advice and technical assistance from the IMF and the World Bank, Ministers of finance can ensure that this public good is available in all countries.

---

Keywords: prevention of epidemics, pandemic risk, fiscal stability, international financial institutions, One Health economics, country systems, financing, public-health systems

## Introduction

Humanity does not have the universal coverage by core veterinary and human public-health systems that it needs to protect itself and its livestock from permanent microbial threats. Despite growing concern about the risks since the beginning of the 21<sup>st</sup> century, prospects for sustained and adequate financing for these systems are poor. Yet, these are “the most productive investments on behalf of mankind.” (1)

Part 1 of the paper briefly sets out the relevance of core public-health functions that use One Health approaches. The term “One Health approaches” refers mainly to pragmatic operational approaches that help human-health policymakers prioritize early and effective control of infectious diseases at their animal or environmental source. The case for One Health approaches is compelling for a range of microbial threats, including outbreaks with epidemic and pandemic potentials, antimicrobial resistance (AMR), and endemic zoonoses. Low-cost capacities can detect and stop these threats before they affect human health, but these capacities are sparse and uneven. In most countries, surveillance and other core public-health functions are completely absent for animal and environmental health, and they are at best weak for human health. It is not acceptable that health sector policymakers have de facto tasked several billion of the poorest people in the world to potentially serve as sentinels for animal diseases.

Part 2 then explores the reasons for the weak state of core public-health functions. Part 3 sets out some of the macroeconomic and fiscal implications of continuing neglect of core public-health functions.

Part 4 turns to the question of financing access by populations in all countries to core public-health functions. With leadership from the IMF and the World Bank, several small policy adjustments are suggested, including an opportunity for these organizations to refine their advice on macroeconomic risk-mitigation, cross-sector coordination, health sector governance, and effective use of public funds. Such adjustments are necessary to improve prospects for country and global economic and fiscal stability, and well as to benefit public health.

### 1. Role of core public-health functions

#### 1.1. A pure public good that saves lives and saves money

Imagine living in a wooden house, in a neighborhood of wooden houses that are close to each other. Some people cook using coal or wood. Clearly, every house “needs” to have a fire-detector, both to protect its residents and to provide early warning to the community. The government would organize and adequately fund a fire brigade that would put out any fires before they spread to neighboring houses and to the city beyond. The community would also support building inspections to detect faulty electrical wiring and other fire hazards.

Similarly, every country needs capacities to prevent, prepare, detect, respond to, and recover from primarily infectious diseases (including those caused by drug-resistant pathogens). These core public-health capacities provide a pure public good. The capacities include surveillance, analyses of health risks in humans, animals, and the environment, diagnostics to correctly identify pathogens and drug-resistance, formulation of effective risk-mitigation measures, preparedness

for responses to public-health emergencies, and collaboration with international authorities (WHO and OIE). Clearly, having these capacities generates substantial health and economic benefits for the country.

Everyone benefits as well when any one country has core public-health systems that reduce the infectious disease and AMR threats in that country, because the threats can easily cross borders. The mutual interest of all countries to be neither importers nor exporters of contagion has underpinned international agreements for more than a century. Under the International Health Regulations -IHR (2005), all countries have adopted a requirement for core public-health capacities. These core capacities fall into four domains: surveillance, laboratory, response, and workforce and pertain to “surveillance, reporting, notification, verification, response, and collaboration.” (2) Core public-health functions are required for public health, economic stability, and compliance with international law, but this has not been sufficient to give most of the world’s population access to these functions. One Health approaches are clearly needed to implement the IHR (2005) since many threats to human public health originate in animal populations and the environment more broadly.

## 1.2. Support for poverty reduction

Failures to prevent epidemics and contain AMR have distributional consequences. Though data are rarely collected, the poor tend to experience far greater proportionate declines in incomes from disasters like uncontrolled disease outbreaks than wealthier and more resilient populations. Such shocks can be profoundly immiserizing but are seldom documented or included in official databases. Still, lack of access to core public-health functions should be a concern for governments in low-and middle-income countries and their partners. Endemic zoonoses cause a staggering 2.4 billion human illnesses every year, mostly among the poorest populations where veterinary and human core public-health functions are low, but exposures to animals are high. (3) (4) The same core veterinary and human public-health capacities that are needed to implement IHR (2005) would serve to reduce the endemic disease burdens and the poverty, food insecurity, and malnutrition they cause. Investing in core public-health systems would benefit large poor populations and reduce inequality in low- and middle-income countries, in addition to generating the health security benefits presented below. (5)

## 2. Obstacles on the pathway from assessments to results

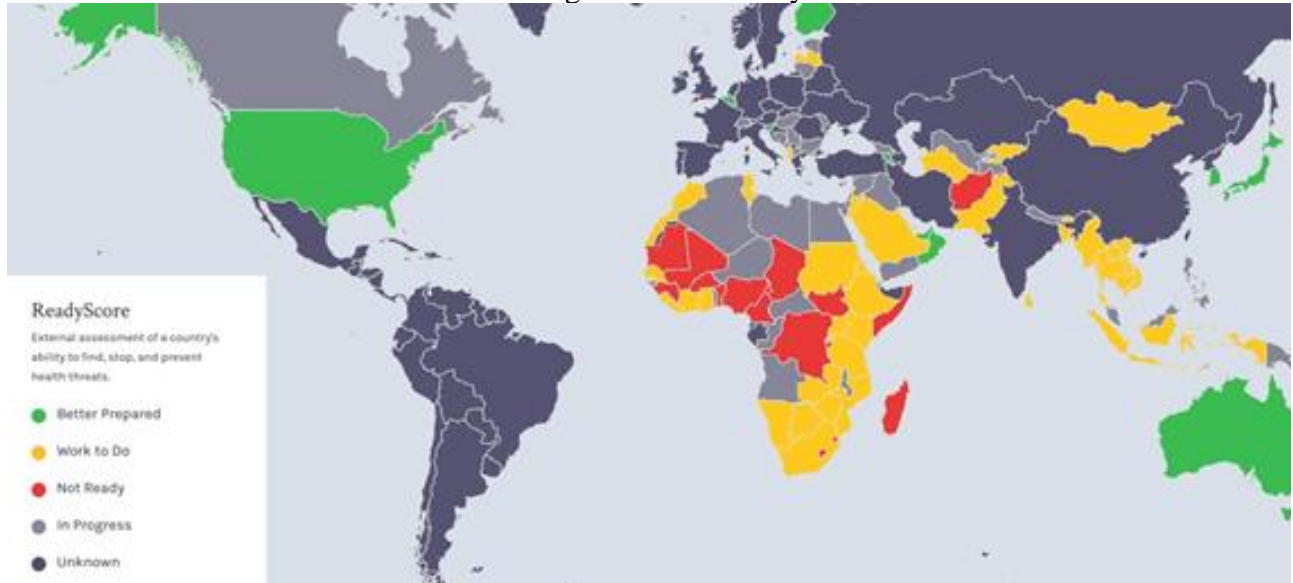
Policymakers have long understood that core public-health capacities are required. “Functioning surveillance systems are necessary for the success of global health initiatives. However, surveillance systems [...] are often non-existent and hard to create. The failure of surveillance systems in developing countries is often due to limited available resources, [...]” (6) This assessment dates from 2006, but remains true even today. Equally concerning, performance is unknown in many countries. The pattern of performance of core human public-health functions in Figure 1 is a direct result of pervasive and long-lasting neglect and underfunding by governments. Veterinary public-health systems are weaker still than human public-health-systems, making operational One Health approaches difficult.

## 2.1. Objective expert assessments of weak links in core public-health systems

Global knowledge about core public-health functions has improved recently thanks to OIE and WHO using the Performance of Veterinary Services (PVS) pathway and Joint External Evaluation (JEE), respectively, to assess country capacities, including the “bridges” between core veterinary and human public-health systems. An in-depth analysis of 55 JEE results shows that the tools measure performance well. (8) By end-2018, there were reports on core public-health capacities in 135 countries and 85 countries, respectively, for animal and human health.<sup>1</sup> Periodic re-assessments by WHO and OIE will be essential because the knowledge the assessments generate is a highly valuable global public good. As the international authorities on human and animal health, respectively, WHO and OIE are indispensable to support and coordinate implementation of international health laws and regulations.

**Figure 1. Poor performance of core public-health functions – and in most of the world, it’s not even known**

- Most countries lack an assessment of core public-health capacities, more than a decade after IHR (2005) were adopted.
- Among countries with assessments, only a few are better prepared.
- Most countries do not have financing for the necessary investments.



Source: [www.preventepidemics.org](http://www.preventepidemics.org), accessed on January 4, 2019.

<sup>1</sup> Countries with JEE reports: <http://www.who.int/ihr/procedures/mission-reports/en/>; Countries with PVS reports: <http://www.oie.int/solidarity/pvs-evaluations/status-of-missions/>.

Unfortunately, however, few investments identified on the basis of these assessments have been made. The lessons of past crises did prompt increases in assessments of weak links, preparation of plans and frameworks, and frequency of meetings and consultations. But without funding and a systematic monitoring effort, defenses against high and growing microbial threats will remain out of reach. (9) Fourteen years ago, all countries reaffirmed their mutual commitments to have core public-health capacities to protect themselves and each other, but compliance with the International Health Regulations (IHR 2005) has been anemic. The 2013-16 Ebola epidemic illustrated how easily a pattern of neglect can prevail (Box 1) even when capacity assessments exist and the required investments are known and low-cost.

**Box 1. Example of consequences of poor governance**

During the response to H5N1 avian flu after 2006, the World Bank, the European Commission, WHO, FAO, USAID, and other official partners supported assessments of outbreak preparedness in more than 30 countries in sub-Saharan Africa. Country authorities then prepared, prioritized, and costed Integrated National Action Plans, to close the most dangerous gaps. Ultimately most of these action plans were set aside, and few actions were taken.

The action plans aimed at adequate capacities for outbreak detection and control also in Guinea, Liberia, and Sierra Leone. The combined cost in the three countries would be \$26 million. Since the plans were phased over three years, the countries would need an average of \$9 million per year. Neither the governments, nor the World Bank or another partner helped to finance these urgently-needed investments in core public-health capacities for disease outbreak detection and control.

The governments and their partners knew about the gaps in outbreak-control performance because they had paid for the assessments. The cost was very small compared to the large expected benefits and health sector budgets. In 2008-2013, when implementation of the Integrated National Action Plans was to occur, the three countries together spent \$500 million of public funds annually on health, of which \$260 million was financed by donors and \$240 million by their governments' budgets. Spending \$9 million annually on the urgently-needed public-health systems would have taken up just 1.8% of total public financing for health. Poor governance (failure to spend funds productively and to comply with IHR (2005)) then caused the Ebola crisis, which cost \$6.4 billion (Table 1 below), or enough to fund 700 years' worth of the preventative requirements.

Clearly, the \$9 million annual expenditures called for in the Integrated National Action Plans should have been made. Even if performance of outbreak control improved only partially (because some of the \$9 million would have been wasted or diverted to healthcare, for example), the expected benefits were so large that the capacities should have been financed as a priority, ahead of other, less productive, activities. It is tragic that the preventable crisis hit healthcare facilities and personnel so hard that additional non-Ebola illness and death tolls exceeded the direct health impacts of Ebola. The progress brought by the \$500 million annual spending on healthcare dissipated because the countries did not have safeguards to protect their scarce healthcare assets.

Global health leaders have known about the inevitable cost of weak core public-health functions, but they have not acted on this knowledge. According to World Bank President Jim Yong Kim: "We all knew that in these three countries [Guinea, Liberia, and Sierra Leone], and in many others in the developing world, the health systems were extremely weak and could not effectively contain an infectious disease outbreak [...] Now we are witnessing the results of our acceptance of the status quo." (10) As a recent authoritative analysis argued, there is "an urgent need to move

beyond assessment and planning to measurable progress at the national level—supporting countries to build capacity in four main domains: surveillance, laboratory, response, and workforce.” (11)

## 2.2. Structural reasons for persistent neglect of core public-health systems

The chronic lapses in the provision of core public-health functions in most of the world may be traced to systemic roots. Core public-health systems have been a marginal concern in global organizations in human health (WHO) and development (World Bank and others). This has not only put effective collective action out of reach, but it has also left countries that need to improve their systems without guidance and support. Uneven engagement by the relevant international authorities has contributed to neglect. But funding for core public-health systems has been grossly inadequate for decades for a range of other reasons as well, including relatively small public-health impacts of many outbreaks; dispersion of the risks and externalities; and low risk awareness among economic policy-makers. Competing demands and poor coordination of financing in the human health sector, and neglect of animal and environmental health have also been important.

Ministers of finance or commerce could be more concerned about microbial risks than health ministers. Consider the examples in Table 1. The economic costs of the outbreaks of MERS in 2015 and SARS in 2003 were \$44 million per case and \$5 million per case, respectively. The public-health impacts were relatively small, however. The 2013-16 Ebola epidemic also had only modest impact on mortality and morbidity impacts compared to the ongoing disease burdens in the affected countries, even when the excess deaths from other diseases (caused by collapsing healthcare systems) are included. (14) The comprehensive cost of the Ebola epidemic (including mortality and morbidity, as well as response costs and economic impacts) was \$53 billion. (15) But because Ebola directly and indirectly caused less death and illness than the many other ongoing disease burdens in the region, the spending on the response (\$3.6 billion) seemed generous to the stakeholders in other health programs who may not understand that control of contagion prevents far greater costs. Such misperceptions of excessive attention to outbreaks can then help justify a de-funding of preparedness. For example, after the 2009 H1N1 pandemic influenza emergency, the World Bank abandoned its five-year momentum in funding preparedness in 60 countries - despite the adoption, by a ministerial conference in 2010, of a joint World Bank-UN strategy on “sustaining momentum” in preparedness and One Health approaches. (16) (17) The ultimate costs of the resulting cycles of panic and neglect are, of course, much greater than sustaining adequate investments in preparedness between outbreak responses.



Table 1. Economic costs of outbreaks are often more significant than public-health impacts				
Examples of outbreaks	Type of impact	Magnitude of impact (US\$ billion)	Number of cases	Cost/ case, US\$ 000
<b>Small public-health impact (because response contained outbreak)</b>				
SARS in 37 countries (2003)	Economic cost	40-54 a/	8,096	4,941
Ebola in West Africa (2013-16)	Economic cost	6.4 b/	28,652	223
Ebola in West Africa (2013-16)	Comprehensive cost	53 c/		1,850
MERS in Rep. of Korea (2015)	Economic cost	8.2 d/	186	44,300
<b>Large public-health and economic impact (because response much-delayed)</b>				
AIDS	Response cost only	563 e/	76 m	7,395
<b>Catastrophic public-health and economic impacts (pandemics)</b>				
Flu pandemic (or similar disease)	Economic cost (ongoing, annual expected value)	80 f/	~30% of population	~37
Flu pandemic (or similar disease)	Comprehensive cost (annual)	570 f/		~265
Notes and sources				
a/ Lee, J.W. & McKibbin, W. (2004). Estimating the Global Economic Costs of SARS. National Academies Press.				
b/ World Bank (2016). –West Africa Ebola Crisis Impact Update: economic cost of \$2.8b. CDC (2017). Cost of the Ebola Epidemic. Factsheet: response cost of \$3.6 b.				
c/ Huber, C., Finelli, L. & Stevens, W. (2018). The Economic and Social Burden of the 2014 Ebola Outbreak in West Africa. The Journal of Infectious Diseases.				
d/ Cho K. & Yoo J. (2015). Estimation of economic loss from the Korean outbreak of MERS-CoV. Korean Economic Research Institute (KERI) Insight, Seoul.				
e/ Institute for Health Metrics and Evaluation (2018). Financing Global Health 2017; UNAIDS (2018). Factsheet.				
f/ Severe and moderately severe flu pandemic, with annual probabilities of 1.6% & 2.0%, respectively. Fan, V., Jamison, D. & Summers, L. (2016). The Inclusive Cost of Pandemic Influenza Risk. NBER Working Paper No. 22137. Based on severe-case scenario of the World Bank, with economic impact of 4.8% of GDP. A novel flu strain is considered most likely, but other pathogens cannot be excluded. They will most likely originate in animals (like novel flu strains). Thus, “similar disease” refers e.g. to a coronavirus with similar transmissibility and severity as a severe flu. See also (28) and (37).				

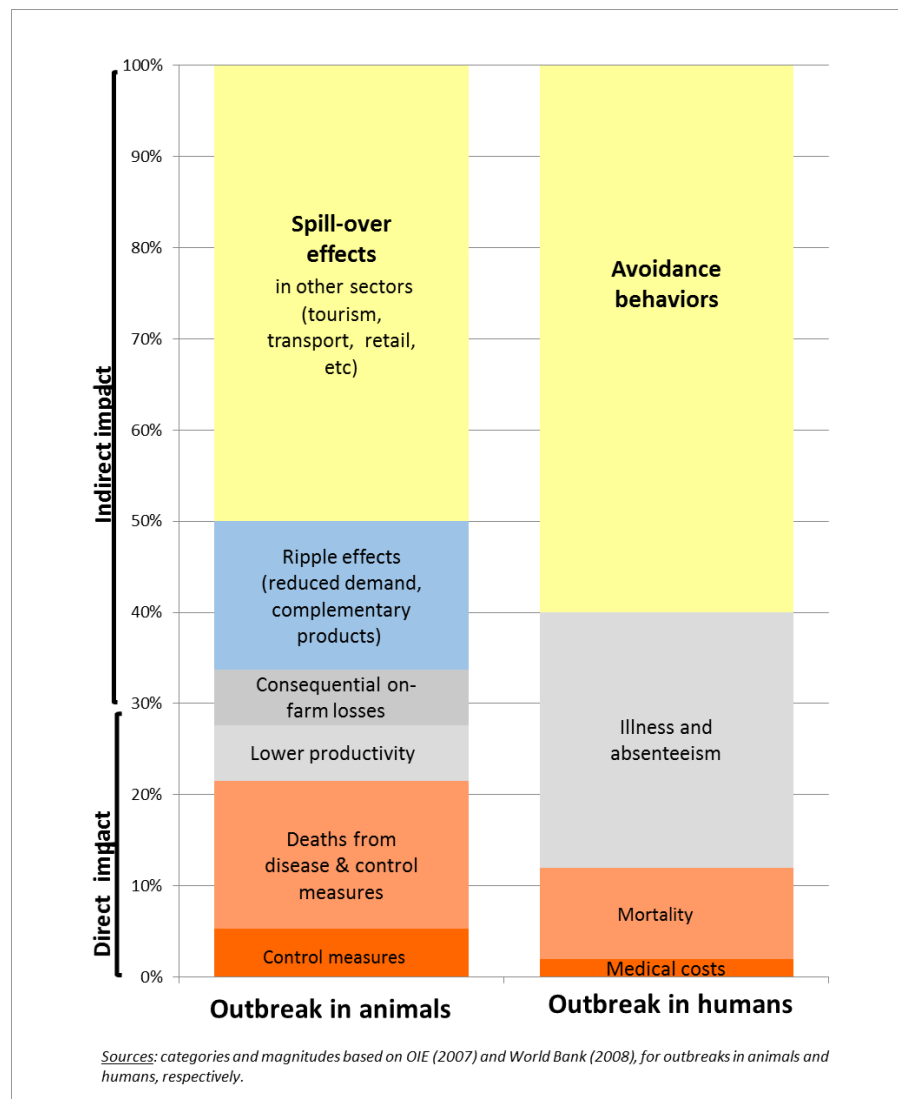
Although the costs of uncontrolled infectious disease outbreaks and AMR are high and the public threat is substantial, the costs have not been tracked by public authorities. Low risk-awareness is a consequence of weak documentation and lack of accessible official data. The World Bank’s Open Data enables access to data relevant to economic development. But among the more than 4,000 indicators, none pertain to core public-health systems, animal health, economic impacts of public-health emergencies, and the livestock sector. These gaps effectively hinder risk awareness and relevant analytical work. Official invisibility of the threats then leads to undue surprises, which aggravate costly fear-based behavioral reactions to outbreaks as well as the human tendency to substantially underestimate low-probability events. (25) Active promotion of more complete official data, risk-awareness, and mechanisms for deliberative thinking about these risks are all warranted. (26)

Another reason for chronic underfunding of core public-health systems is that the risks are dispersed, with large externalities that cascade beyond the source of the contagion. (27) (28) The economic impacts of outbreaks can propagate widely, so that the so-called indirect impacts are typically 4 or 5 times (or more) greater than the direct costs of illness, death, and disease control measures. Impacts due to fear-based human behaviors and interconnectedness of markets predominate in outbreaks (Figure 2). In contrast, official communications tend to focus on the numbers of infected and dead people, which leaves an incomplete record of the event, and one that is biased toward the smaller part of the impact.

Attention to pandemic and AMR risks among economists is very low.

Macroeconomists have relegated these macroeconomic risks to health economists, who are mainly concerned with analyses of that justify expenditures on particular healthcare interventions, however. Regular reports on country risks are prepared for all countries by the IMF, the World Bank, and others concerned about macroeconomic stability and development. Such reports seldom mention microbial risks. Since these risks would have been material in analyses of medium-term and short-term macroeconomic prospects, these omissions have officially

Figure 2. Components of losses due to an outbreak  
Proportions vary by disease and timeliness of control measures



communicated a misleading assessment that microbial risks are zero. (31) Severe macroeconomic shocks that will result from inadequate outbreak responses and that could have been anticipated, then come as a surprise. The economy contracted by 22% in 2015 in Sierra Leone and by 8% in Liberia during the Ebola crisis; prior World Bank and IMF advice on mitigation of such shocks

would have been valuable. The economic devastation outlasted the epidemiological impact due to “severe shocks to investment, production, and consumption. Economic recovery will be slow” (19). Omission of these risks from all highly influential official reports of international organizations is unfortunate, especially since many governments rely on these reports (and related IMF and the World Bank technical assistance and advice) to carry out their own assessments of risks to their macroeconomic and fiscal prospects. Cascading of microbial risks to other sectors and communities requires an analysis that aggregates the dispersed risks in order to justify spending on risk mitigation, notably by ensuring that core public-health functions are delivered. (28)

Microbial risks are underestimated because the country of origin of the contagion may not fully consider impacts beyond its borders. For example, a recent study showed how the U.S. economy would be affected even if an epidemic never reached the U.S.; an outbreak limited to nine countries in Southeast Asia would result in losses to U.S. exporters of over \$40 billion in export revenues, putting more than 1 million U.S. jobs at risk. (32) Such blind spots will lead to global underinvestment in prevention and preparedness.

### 2.3. Health sector bias against saving money

Reduction of risks of epidemics and AMR have been marginal concerns within the human health sector – although, paradoxically, this sector has had the lead responsibility for reducing these risks. Core public-health systems have been underfunded because powerful healthcare stakeholders tend to dominate policymaking and budget decisions. Their influence worsens governance and effectiveness of public spending on health by shifting scarce resources away from the capacities needed for prevention of disease. (33)

Core public-health systems have very high economic returns and avert substantial illness and deaths: the expected economic benefits, on an annual basis, are \$80 billion (Table 1 above) and the costs of investment, operations, and maintenance would be \$3.4 billion annually, giving a benefit : cost ratio of 24 : 1. For each \$1 spent, the expected benefit is \$24, which is far greater than for other public services. Preventing noncommunicable diseases, for example, is also a productive use of public funds (but it is not a public good in the conventional sense). The expected benefit is \$25 billion annually if \$8 billion annually is spent on the most effective preventive interventions. The benefit : cost ratio is 3:1, showing that preventing noncommunicable diseases brings large expected benefits. (34) For each \$1 spent, the benefit is, however, eight times less than for spending on core public-health systems.

If governments and their funding partners aimed to maximize health and economic benefits (to save the most lives and to save the most money), core veterinary and human public-health systems would be fully funded first, as a priority, before funds are allocated to other programs. Such prioritization within the health sector (and within the overall government budget and in donor

budgets) is required to help prevent disease burdens, contain healthcare demand, and limit severe fiscal pressures in the future.<sup>2</sup>

Myopic behaviors and populist pressures have persistently moved resources away from core public-health systems into healthcare. At the World Bank, for example, health-sector managers with considerable budget authority explained dramatic reductions, since 2011, of support to preparedness by suggesting that “the benefits of prevention of epidemics are invisible,” so there is no demand for investments, and that core public-health systems “cannot compete for funding because they do not have an attractive jingle.” This is akin to saying that the benefits of spending on fire prevention and fire brigades are invisible because, at the end of the day, there would be little fire damage. Clearly, health-sector policymakers have knowingly decided against financing highly-productive investments and thus channeled financing to projects with lower returns (but visible results). While pursuit of visibility rather than sustainable results is common for charities, it is not in the World Bank’s core mandate, which is to finance more productive investments as a priority, ahead of less productive ones.<sup>(35)</sup> A senior manager confirmed in 2012, as health-sector managers begun to prioritize promotion of universal healthcare, that the World Bank would “not do anything [to support preparedness] until there is another crisis.”

Embedding of core capacities for IHR (2005) in health systems has been recommended only recently. <sup>(36)</sup> Core capacities were also not in the World Bank’s large 20-year program of analyses of health-systems financing. The marginal status of core public-health systems within health systems work is surprising and has facilitated reversals in support to preparedness. For example, materials encouraging country preparedness were deleted by health-sector management from the World Bank’s communications and strategies in 2011. The responsible official explained that “we do not want to scare people” to justify the purge, including destruction of educational videos on avian influenza and human pandemic influenza preparedness and responses in developing countries. Mentions of One Health approaches were omitted in topic briefs, reports to IDA donors, and strategy statements in 2011-14 so as not to detract from advocacy for universal healthcare.

Repeated disappearance of core public-health systems from the work and advocacy programs of leading institutions matters because it sends signals to others and reduces risk awareness. Episodes of neglect could be forestalled by stronger oversight and accountable leadership, but such changes are uncertain at best -- and would take time to have effect. Small adjustments to governance of programming and financing will be therefore required. When oversight of health-sector leaders in international organizations (and in governments) is weak, there is a strong case for establishing rules that foster deliberative thinking and transparency.

---

<sup>2</sup> The priority of core public-health systems is further increased in countries where healthcare quality is low or where resources are chronically diminished by waste and corruption. Reducing such inefficiencies is clearly important, but progress may be slow because “corruption is pervasive within healthcare to the extent it has become normalised.” (12) (13)

### 3. Economic rationale for spending public funds

#### 3.1. High returns of investment in core public-health systems

The expected rate of return on public spending on core veterinary and human public-health systems is high even under pessimistic assumptions about their success in reducing risks (Table 2). For example, spending on core public-health systems and other measures for AMR containment may turn out to be only 10 per cent effective (so most AMR would still spread). Even so, core public-health systems and AMR control would bring an enormous benefit, equivalent to an annual return of 47%. If only half of all pandemics were averted, the annual rate of return would be 57%. Such results are better than the returns earned by World Bank-financed projects and by Warren Buffett, the most successful investor in recent decades; only his two best investments were as productive as spending on public-health functions.

Productivity of country-level spending on core public-health systems will be similar to the global simulated results (41) (42). When expected benefits are larger, by a wide margin, than the costs, the investment case is strong.

**Table 2. Spending on core public-health functions is extraordinarily productive**

Range of plausible scenarios		Expected annual rate of return (percent)
Success in preventing pandemics a/	20% (only 1 in 5 pandemics prevented)	25
	50% (only half of pandemics prevented)	57
	100% (all pandemics prevented)	86
Success in containing antimicrobial resistance (AMR) b/	10% containment achieved in high-AMR impact case	47
	75% containment achieved in high-AMR impact case	88
Memo	Warren Buffett's 5 greatest investments of all time (actual) c/	21, 22, 24, 41 and 52
	World Bank-financing - median of actual economic rates of return of projects ending in 2005-7 d/	24
Sources: a/ (37); b/(38); c/ Fortune magazine, October 2014; d/ (39).		

#### 3.2. Risk to economic and fiscal stability

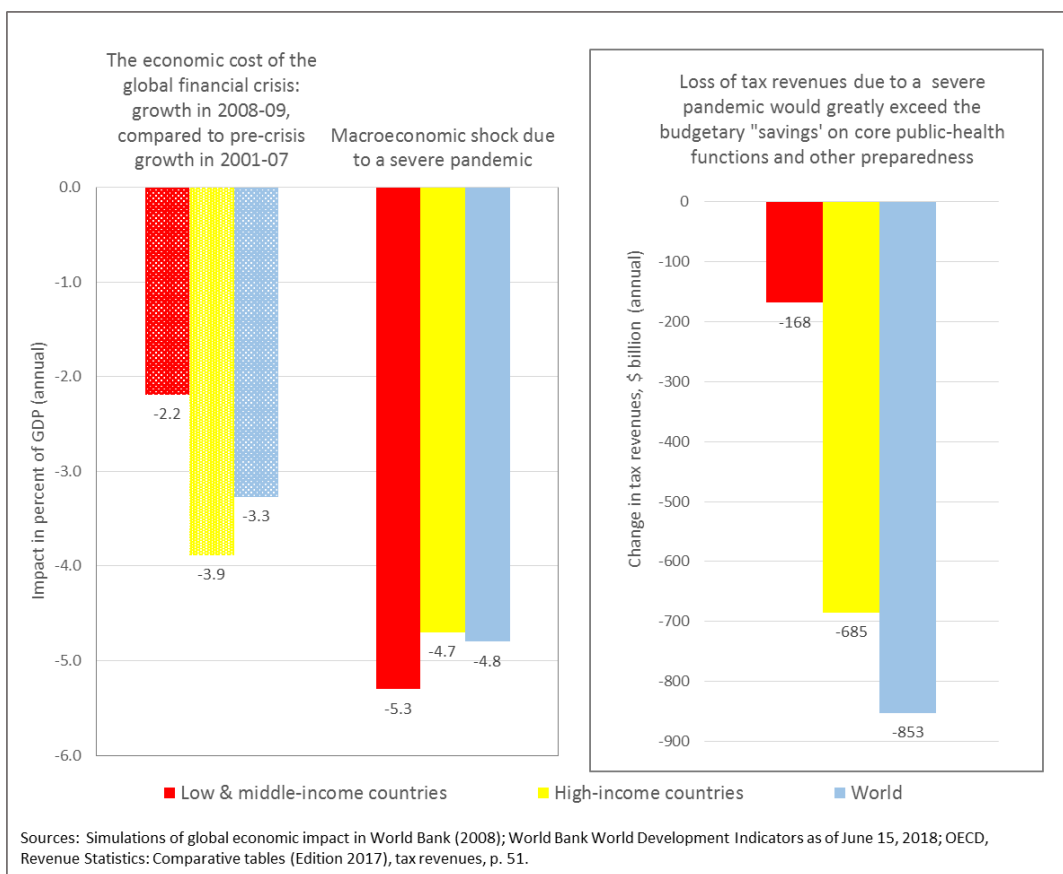
Weak core public-health systems pose a direct threat to tax revenues and fiscal balances. This substantial risk, which is a shared concern of ministers of finance of all countries, arises because outbreaks with epidemic or pandemic potential will trigger rapid and sharp declines in economic activity. Failures to contain AMR will also have macroeconomic impacts. More economic damage will follow if weaknesses in core public-health functions allow the contagion to grow into an epidemic or a pandemic (a world-wide epidemic). If a country has weak core public-health systems, the probability is high that over a decade at least one costly outbreak will occur and not be contained. (31) The onset of the outbreak can be due to importation of a pathogen from

elsewhere in the region or from another continent. The economic shock can originate anywhere and propagate faster than the disease itself as businesses and consumers react to the threat and uncertainty. A country can suffer negative economic impacts before anyone in the country falls ill.

In World Bank simulations of a severe influenza pandemic (or another highly transmissible disease), the decline in economic activity (4.8 %) would be worse than during the global financial crisis that started in 2008 (Figure 3); about two-thirds of the impact could be due to behavioral changes of the healthy, notably as consumers and businesses spontaneously react to information about responses to the threat by the public-health authorities and others.

A decline in tax revenues should be anticipated as economic activity falls. Lapses in tax compliance would reduce tax revenues further; this effect is not reflected in the scenario in Figure 3, however, where tax revenues decline by 4.8 %, in line with the contraction of the economy. Tax revenue shortfalls would be \$685 billion and \$168 billion in high-income countries and low- and middle-income developing countries, respectively (based on 2016 tax revenue data). These shortfalls would far exceed the “savings” from underfunding preparedness. The global tax revenue shortfall of \$853 billion annually is larger than the funding requirement of core public-health systems and preparedness for 190 years.

**Figure 3. A pandemic could trigger a global recession as severe as the global financial crisis a decade ago -- and a massive loss of tax revenues**



The annual requirement for preparedness is \$4.5 billion, which includes \$3.4 billion for core veterinary and human public-health systems in 139 low- and middle-income developing countries (37) and \$1.1 billion for research and development for vaccines and other global preparedness measures (43). In mild and moderate impact scenarios (with economic declines of 1% and 2%, respectively), tax revenue shortfalls would exceed the cumulative costs of core public-health systems and preparedness measures for 40 and 80 years, respectively. Because of the high risks and economic interconnectedness, ministers of finance in high-income countries are interested in robust public-health systems in low- and middle-income countries.

Public finances are also vulnerable to simultaneous pressures to increase government expenditures, including for healthcare, security, food distribution, disease control, a fiscal stimulus to mitigate the recession, and measures to help stabilize asset prices. Core public-health systems are thus directly material to fiscal stability of all countries. For the world’s ministries of finance, spending on these systems is a fundamental necessity.

Health projects financed by external donors – \$55 billion annually– will not have sustainable benefits in the absence of core public-health capacities. More broadly, underinvestment in core public-health capacities has devastating consequences for livelihoods of the poor and their communities, which will make achievement of the Sustainable Development Goals for 2030 and universal healthcare more difficult and costly, and in some countries impossible. Grossly inadequate spending on core veterinary and human public-health capacities, over a long period, is difficult to understand because the budgetary cost would be very modest: an average of \$0.54 per capita annually, which is less than 1% of public expenditure in the health sector (**Error! Reference source not found.**).

Table 3. Core public-health systems need less than 1 % of public spending on health (but get far less) <i>Governments have not provided financing for core functions</i>				
Countries:	Low-income	Middle-income	Low- and middle-income	
2017, US\$ billions				
Government spending on health	18	301	318	
Development assistance for health	24	31	55	
Total public spending on health	41	332	373	
Annual cost of core public-health systems a/			3.4	0.9% of public spending on health in low- and middle-income countries or US\$0.54 per capita per year
Population, billions	0.7	5.6	6.3	

a/ World Bank (2012) estimate for 139 countries, of financing required for investment, operations, and maintenance of veterinary and human public-health systems. Actual financing was estimated to be \$500 m/year in 2012, or about 15% of the requirement (46).

Sources: World Bank (37); Institute for Health Metrics and Evaluation database (22) accessed on June 15, 2018.

#### 4. Toward universal coverage by core public-health systems

The rationale for adopting One Health approaches to prevention and preparedness may be robust, both in countries and globally, but gross underfunding has persisted for decades. The microbial

threat warrants bringing to bear the most effective instruments available. International organizations responsible for fostering economic stability and development can better serve their members individually by nudging them toward core public-health functions (including One Health coordination) as they provide policy advice and technical assistance. (47) Policymakers in ministries of finance need to know the magnitude that these risks pose to their economies and fiscal prospects. Microbial risks (i.e., the expected annual value of economic impact of pandemics and AMR) are about as large as those of major financial crises and climate change, for example. In peacetime, few economic shocks are as consequential as those caused by inadequate core public-health systems. By helping to reduce risks for each member country, the international organizations could also minimize the prevalence of weak links and thus serve the global community as a whole.

The dire consequences of low-probability, high-impact disease outbreaks may have been seen as an arcane health topic (and perhaps an inconvenient truth) by finance and development specialists. Top catastrophic risks to the world economy and an existential risk to humanity (48) warrant concerted and serious policy approaches, for which suggestions are set out below.

#### **4.1. Analyses and technical assistance**

Finance ministers may wish to consider that exponential growth of microbial threats can confound the normal response processes of governments, international organizations, and businesses, so responses tend to lag more and more behind rapidly growing problems. An exponential spread that is enabled by an inadequate response can become costly societal and economic crisis. The risks are rising with growing global mobility, trade, connectivity, prosperity, urbanization, expanding livestock and human populations, and greater exposures of humans to animal pathogens. Risk awareness regularly plummets after outbreaks, and government attention and resources shift to other agendas.

The IMF, the World Bank, the OECD and others regularly prepare influential reports for their members on country economic risks and prospects. Conducting macroeconomic risk assessments that do not omit material economic risks will strengthen the analysis and advice on risk mitigation. These multisectoral institutions are uniquely well-placed to encourage One Health coordination in governments (49) and implementation of risk-mitigation measures recommended by the global health authorities (OIE and WHO), notably the necessity of adequate and stable financing of core public-health systems. Assessments by the IMF and the World Bank of the adequacy of each country's measures to reduce risks to economies and fiscal balances will be critical and would be fully aligned with their mandates to promote economic prosperity, stability, and development. Such attention will help ensure adequate financing for core public-health systems, benefiting country as well as the rest of the world.

Continuing to leave responsibility for this agenda only to sectoral experts is unlikely to start producing results that differ from those that this approach has had to date. Health policymakers have been aware of the high vulnerability of many developing countries, and prepared detailed costed action plans to remedy the worst gaps. But the issues have not been considered in countries' regular policy dialogue with the IMF and the World Bank about macroeconomic risks and public expenditure priorities; this has left core public-health functions underfinanced and the high economic and fiscal risks invisible. Advice from sectoral experts has seldom translated into



action; for example, “health surveillance is the ongoing systematic collection, analysis and interpretation of health data essential [...] to prevent and control disease. ...Relatively small investments can be very effective in reducing death, disease, and disability. Surveillance can make the health system more effective and efficient, and better able to control devastating epidemics.” (50) Such advice is necessary but it has not been sufficient to build the capacities that all countries need and their populations deserve.

International organizations need to support all their member countries in acquiring core public-health systems and adopting One Health collaboration. The IMF and the World Bank can make a significant contribution by integrating this agenda into their analyses and policy advice on economic stability and public finances. The World Bank has experience with promoting One Health approaches in its \$1.3 billion response to avian and human pandemic influenzas in 2005-13 and its new One Health operational framework (51).

#### 4.2. Financing to save lives and save money

The IMF, the World Bank and others should improve official data on expenditures on core public-health systems and their financing. This information has been surprisingly nonexistent, although such spending is a key indicator of a top global catastrophic risk and of compliance with the IHR (2005), a binding international treaty. All countries should be able to know the risks they face, which requires access to authoritative assessments and data on risk-reduction efforts in all other countries.

Reporting to the IMF by all governments on their expenditures to (and to the OECD on aid flows) has long been mandatory, with considerable sub-sectoral detail. The reporting formats should be reviewed to make expenditures on core public-health functions (both for human and animal health) visible in official statistics. A dedicated line would generate vital information for risk-management, serve to encourage prevention, and signal the interest of the international community in reducing top economic and existential risks. A non-governmental organization, the Institute for Health Metrics and Evaluation (IHME) published some data for the first time in 2018, based on very partial surveys and unofficial classifications. (22) The IMF, the OECD, and the World Bank (through its public expenditure reviews) have the mandates and statistical expertise to ensure quality reporting. Defense against microbial threats is a permanent challenge for all governments and not a special program that is time-bound or optional. It is risky to rely on NGOs to produce data on government spending on mitigating a top economic risk. A revision of the classification for official reporting is worthwhile.

Though the international organizations can advise on adequacy of spending, the decisions are made by governments. Domestic support will depend on risk awareness and prioritization of productive expenditures for national development and public health. In practice, arguments centered on the consequences of continued neglect could be more effective than explaining the benefits of increased spending. Suggestions for developing arguments are in Box 2.

<b>Box 2. Argument library: What bad things will happen if public-health systems are weak and lack capacity for One Health collaboration?</b>			
<b>Harm economic stability and growth</b>	<b>Delayed or no universal healthcare</b>	<b>Undermine security and social stability</b>	<b>Worsen relations with region and global community</b>
<p>Small spending will prevent or limit extremely high future losses from:</p> <ul style="list-style-type: none"> <li>– mounting toll of death, illness &amp; strain on healthcare; response activities costly, if not prepared;</li> <li>– high economic costs due to loss of consumer &amp; business confidence; costs disproportionate to the size of an outbreak;</li> <li>– fear &amp; uncertainty trigger avoidance behaviors, absenteeism; reduced travel, hospitality, entertainment &amp; shopping.</li> <li>– Investors take account of epidemic risks in their decisions, especially in highly vulnerable sectors (e.g., tourism, hospitality), undermining government’s promotion.</li> </ul>	<p>Disease spread &amp; surge of demand for healthcare will reduce access, cost lives &amp; more money, so attaining UHC can become impossible.</p> <p>Without core public-health systems:</p> <ul style="list-style-type: none"> <li>– antimicrobial resistance will spread undetected;</li> <li>– mismanaged responses to recurrent outbreaks (meningitis, yellow fever, cholera, etc.), degradation of health systems; high costs to health, budget, communities;</li> <li>– faster &amp; more disease spread due to inability to change the “shape of the curve” of contagion.</li> </ul>	<p>Without core public-health systems:</p> <ul style="list-style-type: none"> <li>– vulnerability to bioterrorism &amp; other biosecurity threats;</li> <li>– potential loss of key security personnel &amp; disruption of capacity to perform security activities;</li> <li>– mismanaged outbreak responses sharply increase vulnerability to societal disruptions, political upheaval, breakdown of law &amp; order.</li> </ul>	<p>Unwarranted closing of borders to people &amp; trade.</p> <p>Reputation of “disease exporter” could impair relations in trade &amp; other domains.</p> <p>After 2013-6 Ebola crisis, world community sees respect for the International Health Regulations as key to health security.</p> <p>International funding for core public-health systems is available, upon country request.</p>

Based on IWG (2017), Appendix D on Change Management and Investment Case. Heading based on advice to the public-health agency, from the chairman of the parliamentary budget committee: “Instead of telling us about the good things will happen if we give you the money, tell us what bad things will happen if we don’t give you the money.”

### 4.3. Critical review of recent recommendations on financing

Experts have examined financing for core public-health functions. Two examples of major efforts are summarized in Annex 1, offering broadly appropriate recommendations. They may not be sufficient to improve financing prospects, however, for the reasons below.

In both studies, the proponents of preparedness are responsible for making the case for core-public-health systems, which can entail 10 steps. This approach puts core public-health systems on the same level in the competition for budget resources as other health programs. These other programs seldom meet the tests of being productive investments or providing a pure public good. As noted above, spending on prevention of noncommunicable diseases, which may be among the most productive health programs, is eight times less productive than core public-health functions.

The starting position should be, instead, to fund core public-health systems first and completely in order to obtain the highest health and economic benefits also from the programs that are funded next, as second and lower priorities.

Similarly, integration into health-sector budgeting is problematic. Clearly, core public-health functions must coordinate and collaborate with veterinary public health, clinicians, and others. Core public-health systems have been integrated (and thus invisible and underfunded, if they existed at all) in health systems for decades. Good governance requires that spending on core public-health functions should be clearly identifiable in the budget, to inform the finance ministry and parliamentary budget committees, and to facilitate accountability of health policymakers. Neither study deals with One Health approaches adequately, or the roles of biodiversity, food safety, livestock productivity, and food exports. These are areas where core public-health systems generate co-benefits. The omissions are thus unfortunate, since public-health systems are a small minority within health and agriculture departments, and thus need allies.

If core public-health functions are invisible, then the term “core” is meaningless. Expenditures on core public-health functions should be reported on a separate line in the economic classifications of government expenditures in the Government Finance Statistics of the IMF, in the OECD’s data on development assistance, and in World Bank data. A separate line in regular reporting on public expenditures would improve the current state of affairs, where public authorities individually and collectively do not know the spending on mitigation of a top global catastrophic and existential threat. Neither study identified healthcare resources to reallocate to public-health systems or reductions in future healthcare costs due to such a reallocation. Such dialogue within the health sector is needed to inform health leaders who view effectiveness as an agenda of “public-health Luddites.” (52)

Core public-health systems are essential public infrastructure that requires adequate, stable, predictable funding of operations, and maintenance permanently. Volatility of funding reduces operational effectiveness and efficiency. Earmarked taxes can stabilize funding and can be an appropriate funding source. Dedicated parafiscal funds or other earmarking mechanisms often fund functions like road maintenance, which also requires stable and adequate funding. Earmarked taxes to finance core public-health functions have been proposed on exports of meat or processed meat products. (53) Another source of stable financing for core public-health systems could be lotteries, which have become a major source of government and charity funding globally, especially where governments are unable or unwilling to raise and collect taxes but nevertheless are obligated to provide public goods. Their use may be controversial in some cultural settings because “with state hooked on the [lottery] money, [politicians] have no choice but to continue to bombard their citizens, especially the more vulnerable ones, with a message at odds with the ethic of work, sacrifice, and moral responsibility that sustains democratic life.” (54) Continued underfunding of core public-health functions is highly detrimental as well, however.

Insurance is unlikely to be an effective and viable source of financing, and certainly not for governments or public entities which bear the main responsibility for core public-health functions. The Pandemic Emergency Financing Facility (PEF), established by the World Bank in 2016, lacks a rationale. It has design and operational flaws. It purchases expensive commercial insurance with public funds, including contributions from the World Bank’s concessional fund, IDA, which has \$75 billion in the current three-year period. IDA can and should self-insure for even very

large disasters (substantial resources can be reprogrammed to rapidly finance emergency outbreak responses). In addition to the lack of a rationale for insurance, the premiums for the insurance on offer are very high. IDA is paying the equivalent annual cost of financing of 14% while both IDA (and the World Bank) and many countries can readily borrow at less than 2%, which means that the PEF has been bankrupt and not sustainable from its inception. IDA can provide emergency financing, including through contingent components. Contingent components have been strongly encouraged since 2008. Effectiveness of World Bank (including IDA) financing for epidemic and pandemic risk reduction would improve substantially by focusing, instead, on adequate financing for core public-health systems.

Financing for emergency responses should be sought from low-cost sources first and from high-cost sources only when necessary. Thus, by order of cost, the first choice is to tap budget reserves and contingencies (including special funds for paying compensation to farmers for culled poultry); the next choice would be to increase borrowing (including use of the above-mentioned contingent components in projects financed by the World Bank and other financiers or using the balances in a contingent loans or pre-arranged credit lines). The World Bank also offers rapid budget support for emergencies, the development policy loan (credit/grant) with a deferred drawdown option (Catastrophe DDO). Purchasing insurance for disease outbreaks is rarely possible and invariably would be very costly, so the use of such a tool by public institutions would not constitute prudent financial management.

#### **4.4. Counterproductive behavioral responses to risk**

Human behavioral responses to low-probability catastrophic losses have been found to be counterproductive. Leaders and policymakers are also susceptible and thus may unfortunately dismiss even the best investment case, stakeholder mobilization, and change management efforts for securing adequate funding. “Specifically, we cannot assume that the massive destructiveness of a future event will lead us to appreciate and appropriately respond to the threat. The low probability of such events [at any time] leads us to treat the event as below our threshold level of concern [...]. The potential consequences, whether in trillions of dollars or tens of millions of endangered lives, fail to convey the emotional meaning necessary to motivate effective protective actions.” (55) Since we know about this inherent behavioral propensity, it make sense to treat core public-health functions as fundamentally different from other government programs, especially where such programs deliver mainly private benefits such as, for example, curative healthcare.

The second step suggested by behavioral research is that “we must employ slow and careful thinking coupled with short-term incentives to create policies, procedures, laws, and institutions that will nudge or even require us to behave in ways that accord with our considered values for protecting human lives and property.”(55) Just as there are reasons for the requirement of house insurance before banks provide a loan, mandatory use of seatbelts, and enforcement of building codes, there is a strong case for adopting procedures and rules that will nudge policymakers away from taking excessive risks with lives, economic and societal wellbeing, and the continuing existence of humanity. To this end, the following two practical proposals would serve to encourage adequate core public-health functions in low- and middle-income countries. Both can be adopted at the World Bank, which has the advantage of having a universal membership, substantial financial capacity and operational experience, and established burden-sharing of its

concessional fund (the International Development Association, IDA). But others (including governments, bilateral donors, and other multilateral funds) can adopt these incentives as well.

#### **4.5. Incentive #1: Require the World Bank to perform due diligence in the health sector**

The proposed first incentive is based on the recognition that core public-health capacities are “different” from other health spending. They are different because of their productivity (very high economic returns), effectiveness in improving public health both directly and by improving effectiveness of other healthcare spending, protecting healthcare personnel and services, and modest cost. These factors point to funding core public-health systems first, ahead of all other public spending on health. Other factors have clearly dominated because core public-health systems have been grossly underfunded. A new requirement of due diligence is warranted. (56) Thus, before funding any health project, the World Bank would be required to ascertain that core public-health systems are satisfactory (relying on the authoritative assessments of WHO and OIE). Where the core systems are not satisfactory, the World Bank would be required to assist the country to develop an action plan to improve the performance of these systems. The World Bank would also be required to finance any residual gap to implement this action plan (either as part of a larger project in the health, agriculture, public sector governance, or other sectors, or as a standalone project). By financing the core functions first, the World Bank would be de-risking the health sector in the country (thus making financing of health by others more productive) as well as helping the country generate large economic and public-health benefits. Implementation would require approval of the approach by the Board.

#### **4.6. Incentive #2: Supplemental allocation**

IDA resources are allocated to countries on the basis of performance on an annual policy and institutional assessment. The World Bank can then use these funds to support projects in any sector, in response to demand from the government. For regional projects, however, two-thirds of the funds are additional, so that the country has to use its IDA allocation for one third of the project cost. This subsidy to regional projects has been very effective, so the number of regional projects has increased over the last 20 years when this incentive has been implemented. The same incentive should be extended to all projects building capacity for core public-health functions. (57) Similar to regional projects, core public-health system projects have significant cross-border impacts and the international community has a strong interest in all countries having the capacity to comply with IHR (2005). Implementation of such an incentive needs to be agreed between IDA donors and World Bank management.

## **Conclusion**

Microbial threats are permanent and as such require a sustained, continuous response. One Health collaboration is essential for core public-health systems to perform, but it will not materialize if either or both of the veterinary and human public-health systems are weak. Neglect of One Health approaches in any one country increases the existential risk to humanity as well as risks to economies, fiscal stability, functioning of society, and public health in all other countries. Because of high interconnectedness of economies through trade, capital, and travel, these risks confront not only each country but also the world. Economic rationales – effectiveness and efficiency – have seldom informed public spending in the health sector.

The IMF, the World Bank and other organizations charged with promoting economic prosperity and stability, fiscal sustainability, and economic development can better serve their member countries by considering a complete set of relevant economic risks in their regular consultations with governments. With support and guidance from WHO and OIE, they can assess adequacy of risk-mitigation, including by One Health collaboration across sectors. A review of reporting formats and official data coverage should enable tracking of government spending on core public-health systems.

Complementing statistical efforts, analyses, and technical assistance, two simple rules for World Bank assistance would promote adequate and sustained funding. The proposals draw on research on behavioral responses to risk and the long-standing failures to ensure universal coverage by core public-health functions. First, a formal assessment that progress toward core public-health functions is satisfactory to the World Bank, before any financing to the affected sector is provided. Second, a supplemental allocation of concessional funds, as is already the practice for regional projects, for all projects supporting core public-health functions. In both options, the World Bank should be required to provide a formal assessment of progress toward core public-health functions. Other funders may wish to consider adopting these or similar rules.

Annex 1. Two recent analyses of financing of preparedness (human-health focus)	
Recommendations from the International Working Group on Financing Preparedness (2017) <sup>a/</sup>	US National Academy of Medicine, Center for Policy Impact in Global Health (Duke University) & CEPI Workshop (2017) <sup>b/</sup>
<p>#1 -Adopt recommendations #2-10.</p> <p>#2 –All countries to have JEE &amp; PVS by end-2019.</p> <p>#3 –Action plan ready within 9 months of JEE &amp; PVS.</p> <p>#4 –Government to prepare financing request &amp; compelling investment case, to get political support.</p> <p>#5- Government to make detailed financing plan, integrated in national budget. Win political support because proponents make case, use integrated change management strategy &amp; coordinate all stakeholders.</p> <p>#6 –Government to review scope for incremental domestic funds from improved tax design &amp; collection or introduction of earmarked taxes.</p> <p>#7 –Donors to finance (i) investment (operating costs to be financed domestically wherever possible); (ii) regional initiatives; (iii) capacities in fragile states.</p> <p>#8 –Government to involve private sector through awareness-building, participation in response planning. Regulate activities that raise outbreak risks (require risk mitigation).</p> <p>#9 –IMF &amp; World Bank to facilitate inclusion of disease outbreak risks in macroeconomic assessments &amp; development of measures of risk &amp; vulnerability, such as indices.</p> <p>#10–World Bank to add preparedness as a criterion in its annual Country Policy &amp; Institutional Assessment, which guides allocation of concessional funds among countries; add analysis of outbreak risks to country core diagnostic reports.</p> <p>Bottom line: “Investing in global health security is an imperative.”</p>	<p>Call for scaled up financing of international collective action for epidemic &amp; pandemic preparedness.</p> <p>Two planks:</p> <ul style="list-style-type: none"> <li>- Public-health capacity, including animal &amp; human disease surveillance. Financing for this plank will be largely through domestic resources.</li> <li>- Accelerate R&amp;D for vaccines, drugs &amp; diagnostics; strengthen regional &amp; global response systems, including surge capacity, technical assistance &amp; surveillance.</li> </ul> <p>Ministers of health of all countries should:</p> <ol style="list-style-type: none"> <li>1. Accelerate pharmaceutical R&amp;D, including by more financing of CEPI.</li> <li>2. Add funding to the WHO contingency fund, the WHO emergencies program, and the World Bank’s PEF.</li> <li>3. Support their own &amp; other countries’ preparedness efforts.</li> <li>4. Create &amp; maintain regional &amp; country-level pandemic risk indices.</li> <li>5. Mount new global effort to develop country, regional, &amp; global investment plans to create a secure world.</li> </ol>
<p>Sources:</p> <p>a/IWG (2018) – (43) Reference to a next version of insurance-based Pandemic Emergency Financing Facility (PEF) has been omitted. The PEF is a pilot scheme so considering a next version is premature. The PEF also appears to lack a rationale, effectiveness, and efficiency.</p> <p>b/ Yamey, G. et al (2017) -- (58)</p>	

## Acknowledgements

I am grateful to Milan Brahmhatt, Jesse Bump, Richard Cash, Andrew Farlow, Odd Hanssen, Andrew Kitua, Christopher Lee, Amanda McClelland, Mike Osterholm, Yoshini Naomi Rupasinghe, Richard Seifman, Felix Stein, and [the OIE Scientific and Technical Review's referees and editors] for their helpful comments and suggestions. All errors and statements without specific references are my responsibility.

## References

- (1) Summers, L. (2014) – Comments at World Bank Panel Discussion. “Toward Universal Health Coverage for 2030.” Washington, DC, April 11, 2014. [Available at https://cdnapisec.kaltura.com/index.php/extwidget/openGraph/wid/1\\_zx4w3paq](https://cdnapisec.kaltura.com/index.php/extwidget/openGraph/wid/1_zx4w3paq)
- (2) WHO (2016). -- International Health Regulations (2005). 3rd edition, Annex 1. Core capacity requirements for surveillance and response. [Available at https://www.who.int/ihr/publications/9789241580496/en/](https://www.who.int/ihr/publications/9789241580496/en/)
- (3) Grace, D., Mutua, F., Ochungo, P., Kruska, R., Jones, K., Brierley, L., Lapar L., Said, M., Herrero, M., Phuc, P.M, Thao, N.B., & Ogutu, F. (2012). – Mapping of poverty and likely zoonoses hotspots. Zoonoses Project 4. Report to the UK Department for International Development. Nairobi, Kenya: ILRI. Available at <https://hdl.handle.net/10568/21161>
- (4) The Economist (2014). –On the zoonose. January 18, 2014. [Available at https://www.economist.com/international/2014/01/18/on-the-zoonose](https://www.economist.com/international/2014/01/18/on-the-zoonose).
- (5) Grace D. (2014). – The business case for One Health, Onderstepoort. Journal of Veterinary Research 81(2), Art. #725. [dx.doi.org/10.4102/ojvr.v81i2.725](https://doi.org/10.4102/ojvr.v81i2.725) (accessed on September 15, 2018).
- (6) Nsubuga P., White M.E., Thacker S.B., et al. (2006). –Public Health Surveillance: A Tool for Targeting and Monitoring Interventions. In: Jamison D.T., Breman, J.G., Measham, A.R., et al., editors. Disease Control Priorities in Developing Countries. 2nd edition. The World Bank; 2006. Chapter 53. Available from: Available at <https://www.ncbi.nlm.nih.gov/books/NBK11770/> Co-published by Oxford University Press, New York (accessed on September 15, 2018).
- (7) PreventEpidemics.org website (accessed on January 4, 2019).
- (8) Gupta, V., Kraemer, J.D., Katz, R., Jha, A.K., Kery, V.B., Sane, J., Ollgren, J. & Salminen, M.O. (2018). – Analysis of results from the Joint External Evaluation: examining its strength and assessing for trends among participating countries. Journal of Global Health. Vol. 8 No. 2. doi: 10.7189/jogh.08.020416 (accessed on September 15, 2018).
- (9) Jonas, O., Katz, R., Yansen, S. & Geddes, K. & Jha, A. (2018). – Call for independent monitoring of disease outbreak preparedness. British Medical Journal, BMJ 2018; 361 doi: [Available at https://doi.org/10.1136/bmj.k2269](https://doi.org/10.1136/bmj.k2269) (Published 24 May 2018).
- (10) Kim. J.Y. President, World Bank Group & Zuma N.D. Chairperson of the African Union (2014). –How to Stop Ebola-and the Next Outbreak. Huffington Post, August 14, 2014 (accessed on September 15, 2018).
- (11) Glassman, A., Datema, B. & McClelland, A. (2018). -- Financing Outbreak Preparedness: Where Are We and What Next? Center for Global Development, November 9, 2018. Available at <https://www.cgdev.org/blog/financing-outbreak-preparedness-where-are-we-and-what-next>. (accessed on December 20, 2018).
- (12) WHO (2010). – Health systems financing: the path to universal coverage. World health report 2010. [Available at http://www.who.int/whr/2010/en/](http://www.who.int/whr/2010/en/) (accessed on September 15, 2018).
- (13) Transparency International UK (2016). – Diagnosing Corruption in Healthcare. [Available at https://www.transparency.org.uk/publications/diagnosing-corruption-in-healthcare/](https://www.transparency.org.uk/publications/diagnosing-corruption-in-healthcare/)



- (14) Parpia, A.S., Ndeffo-Mbah, M.L., Wenzel, N.S., Galvani, A.P. (2016). – Effects of Response to 2014–2015 Ebola Outbreak on Deaths from Malaria, HIV/AIDS, and Tuberculosis, West Africa. *Emerging Infectious Diseases*. 2016;22(3):433-441. Available at <https://dx.doi.org/10.3201/eid2203.150977> (accessed on September 15, 2018).
- (15) Huber, C., Finelli, L. & Stevens, W. (2018). – The Economic and Social Burden of the 2014 Ebola Outbreak in West Africa. *The Journal of Infectious Diseases* 2018;0000:S1–7. Available at <https://academic.oup.com/jid/advance-article/doi/10.1093/infdis/jiy213/5129071> (accessed on September 15, 2018).
- (16) World Bank (2010). – Animal and Pandemic Influenza: A Framework for Sustaining Momentum. Fifth Global Progress Report. New York and Washington, DC: UNSIC and World Bank. Available at <https://openknowledge.worldbank.org/handle/10986/18202> (accessed on September 15, 2018).
- (17) Independent Evaluation Group (2014). – Responding to Global Public Bads: Learning from Evaluation of the World Bank Experience with Avian Influenza, 2006-2013. IEG. World Bank. Washington, DC: Available at [https://ieg.worldbankgroup.org/Data/reports/avian\\_flu1.pdf](https://ieg.worldbankgroup.org/Data/reports/avian_flu1.pdf) (accessed on September 15, 2018).
- (18) Lee, J.W. & McKibbin, W. (2004). – Estimating the Global Economic Costs of SARS. Learning from SARS: Preparing for the Next Disease Outbreak: Workshop Summary. Washington, D.C.: National Academies Press (accessed on September 15, 2018).
- (19) World Bank (2016). – West Africa Ebola Crisis Impact Update. May 16, 2016. Available at <http://pubdocs.worldbank.org/en/297531463677588074/Ebola-Economic-Impact-and-Lessons-Paper-short-version.pdf> (accessed on September 15, 2018).
- (20) CDC (2017). – Cost of the Ebola Epidemic. Factsheet. Available at <https://www.cdc.gov/vhf/ebola/pdf/cost-response.pdf> (accessed on September 15, 2018).
- (21) Cho K. & Yoo J. (2015). – Estimation of economic loss from the Korean outbreak of MERS-CoV. Korean Economic Research Institute (KERI) Insight, Seoul.
- (22) Institute for Health Metrics and Evaluation (2018). – Financing Global Health 2017. Available at <http://www.healthdata.org/policy-report/financing-global-health-2017> (accessed on September 15, 2018).
- (23) UNAIDS (2018). – Factsheet. Available at <http://www.unaids.org/en/resources/fact-sheet> (accessed on September 15, 2018).
- (24) Fan, V., Jamison, D. & Summers, L. (2016). – The Inclusive Cost of Pandemic Influenza Risk. NBER Working Paper No. 22137. March 2016. JEL No. H51,I15,I18 (accessed on September 15, 2018).
- (25) Kahneman, D. (2011). – Thinking, fast and slow. New York: Farrar, Straus, and Giroux.
- (26) Kunreuther, H. & Useem, M. (2018). – Mastering catastrophic risk: how companies are coping with disruption. Issue Brief. Wharton Risk Management and Decision Processes Center. University of Pennsylvania. Available at [https://riskcenter.wharton.upenn.edu/wp-content/uploads/2018/06/Mastering-Catastrophic-Risk\\_Kunreuther-and-Useem\\_summary\\_2018.pdf](https://riskcenter.wharton.upenn.edu/wp-content/uploads/2018/06/Mastering-Catastrophic-Risk_Kunreuther-and-Useem_summary_2018.pdf) (accessed on September 15, 2018).
- (27) Smith, K.M., Machalaba, C.C., Seifman, R., Feferholtz, Y., Karesh, W.B. (2019). Infectious disease and economics: The case for considering multi-sectoral impacts. *One Health*. Volume 7. Available at <https://doi.org/10.1016/j.onehlt.2018.100080> (accessed on January 11, 2019).
- (28) Jonas, O. (2013). – Pandemic Risk. Background paper for the 2014 World Development Report. World Bank. Available at <https://openknowledge.worldbank.org/handle/10986/16343> (accessed on September 15, 2018).
- (29) World Organization for Animal Health (OIE) (2007). – Prevention and control of animal diseases worldwide. Economic analysis – Prevention versus outbreak costs. Final Report, Part I, submitted by: Civic Consulting - Agra CEAS Consulting. 66-89. [www.oie.int/solidarity/global-studies/global-animal-health-initiative/](http://www.oie.int/solidarity/global-studies/global-animal-health-initiative/) (accessed on September 15, 2018).

- (30) Burns, A., van der Mensbrugge, D. & Timmer, H. (2008). – Evaluating the Economic Consequences of Avian Influenza. World Bank. [www.worldbank.org/pandemics](http://www.worldbank.org/pandemics) (accessed on September 15, 2018).
- (31) Sands, P., El Turabi, A., Saynisch, P. & Dzau, V. (2016). – Assessment of economic vulnerability to infectious disease crises. *Lancet*, Volume 388, No. 10058, p2443–2448, 12 November 2016, DOI: Available at [https://doi.org/10.1016/S0140-6736\(16\)30594-3](https://doi.org/10.1016/S0140-6736(16)30594-3) (accessed on September 15, 2018).
- (32) Bamberg, Z., Cassell, C., Bunnell, R., et al. (2018). – Impact of a hypothetical infectious disease outbreak on US exports and export-based jobs. *Health Security*. 2018;16(1). DOI: 10.1089/hs.2017.0052 (accessed on September 15, 2018).
- (33) Shelton, J.D. (2018). – At last! Universal health coverage that prioritizes health impact: the latest edition of Disease Control Priorities (DCP3). *Global Health: Science and Practice*. June 2018; 6(2):232-236. Available at <https://doi.org/10.9745/GHSP-D-18-00193> (accessed on September 15, 2018).
- (34) WHO (2011). - From Burden to “Best Buys”: Reducing the Economic Impact of Non-Communicable Diseases in Low- and Middle-Income Countries. The Global Economic Burden of Non-communicable Diseases. Prepared by the World Economic Forum and the Harvard School of Public Health (2011) and includes WHO (2011). Scaling up action against noncommunicable diseases: How much will it cost? Available at <http://www.who.int/nmh/publications> (accessed on September 15, 2018).
- (35) International Bank for Reconstruction and Development (1945). ~Articles of Agreement, as amended effective June 27, 2012. Article I, Purposes (of the World Bank). Available at <http://pubdocs.worldbank.org/en/666651532371886085/sdr-bond-2016-ibrd-articles-of-agreement-english.pdf> (accessed on September 15, 2018).
- (36) Kluge H., Martín-Moreno J.M., Emiroglu N., et al. (2018). – Strengthening global health security by embedding the International Health Regulations requirements into national health systems. *BMJ Global Health*, January 20, 2018; 3:e000656 (accessed on September 15, 2018).
- (37) World Bank (2012). -- People, Pathogens, and Our Planet: Volume Two – The Economics of One Health. Available at <https://openknowledge.worldbank.org/handle/10986/2844> (accessed on September 15, 2018).
- (38) World Bank (2016). – Drug-resistant Infections-A Threat to Our Economic Future. Discussion Draft. September 2016. Available at <http://pubdocs.worldbank.org/en/689381474641399486/1701381-AMR-Lab-Report-Web.pdf> (accessed on September 15, 2018).
- (39) Independent Evaluation Group (2010). -- Cost-Benefit Analysis in World Bank Project. IEG. World Bank. Washington, D.C (accessed on September 15, 2018).
- (40) Gandel, S. (2014). - Warren Buffett's 6 best investments of all time. *Fortune Magazine*, October 2014. Available at <http://fortune.com/2014/10/31/warren-buffett-best-investments/> (accessed on September 15, 2018).
- (41) World Bank (2014). – Implementation Completion and Results Report on the Vietnam Avian and Human Influenza and Human Pandemic Preparedness Project Financing. Report number: ICR3330. December 2014. Available at <http://projects.worldbank.org/P101608/vn-avian-human-influenza-control-prep?lang=en&tab=overview> (accessed on September 15, 2018).
- (42) World Bank (2016). – Project Appraisal Document for a Regional Disease Surveillance Systems Enhancement Program in West Africa (REDISSE). Annex 5A: Economic and Financial Analysis. Report number: PAD1752. June 6, 2016. Available at <http://projects.worldbank.org/P154807?lang=en> (accessed on September 15, 2018).
- (43) International Working Group on Financing Preparedness (2017). -- From Panic and Neglect to Investing in Health Security: Financing Pandemic Preparedness at a National Level, December 2017. Available at [www.worldbank.org/en/topic/pandemics/publication/from-panic-neglect-to-investing-in-health-security-financing-pandemic-preparedness-at-a-national-level](http://www.worldbank.org/en/topic/pandemics/publication/from-panic-neglect-to-investing-in-health-security-financing-pandemic-preparedness-at-a-national-level) (accessed on September 15, 2018).
- (44) World Bank (2018). World Development Indicators. World Bank Open Data. Available at <https://data.worldbank.org/> (accessed on September 15, 2018).

- (45) OECD (2017), Revenue Statistics 2017, OECD Publishing, Paris, Table 3.2. [Available at https://doi.org/10.1787/9789264283183-en](https://doi.org/10.1787/9789264283183-en) (accessed on September 15, 2018).
- (46) Jonas, O. (2014). – Pandemic Risk. Global Health Threats of the 21<sup>st</sup> Century. Finance & Development, December 2014. International Monetary Fund (IMF). [Available at http://www.imf.org/external/pubs/ft/fandd/2014/12/jonas.htm](http://www.imf.org/external/pubs/ft/fandd/2014/12/jonas.htm) (accessed on September 15, 2018).
- (47) Otker-Robe, I. (2014). – Global Risks and Collective Action Failures: What Can the International Community Do? IMF Working Paper WP/14/195. International Monetary Fund (accessed on September 15, 2018).
- (48) Millett, P. and Snyder-Beattie, A. (2017). – Existential Risk and Cost-Effective Biosecurity. Health Security, Volume 15, Number 4, 2017. DOI: 10.1089/hs.2017.0028 (accessed on September 15, 2018).
- (49) Seifman, R. (2018). –“One Health”: Have the Finance Minister Make It a Priority. Journal of Health Care Finance. Vol. 45, No. 1, Summer 2018. Available at <http://www.healthfinancejournal.com/index.php/johcf/article/view/158/162> (accessed on September 15, 2018).
- (50) WHO and World Bank (2006).–Surveillance. at a glance. Available at <https://openknowledge.worldbank.org/handle/10986/9616> (accessed on September 15, 2018).
- (51) World Bank (2018). – Operational Framework for Strengthening Human, Animal, and Environmental Public Health Systems at Their Interface. With EcoHealth Alliance. Washington, DC. [Available at http://documents.worldbank.org/curated/en/961101524657708673/pdf/122980-REVISED-PUBLIC-World-Bank-One-Health-Framework-2018.pdf](http://documents.worldbank.org/curated/en/961101524657708673/pdf/122980-REVISED-PUBLIC-World-Bank-One-Health-Framework-2018.pdf) (accessed on September 15, 2018).
- (52) Farmer, P. & Kim, J.Y. (2017). – Bending the Arc. Harvard University screening, November 28, 2017, 53:00 of the Q&A Session. [Available at https://www.youtube.com/watch?v=oSjFK7iLRSU&feature=youtu.be](https://www.youtube.com/watch?v=oSjFK7iLRSU&feature=youtu.be) (accessed on September 15, 2018).
- (53) World Bank (2010). – People, Pathogens, and Our Planet: Volume One - Towards a One Health Approach for Controlling Zoonotic Diseases. Available at <https://openknowledge.worldbank.org/handle/10986/2844> (accessed on September 15, 2018).
- (54) Sandel, M. J. (2013). - The Moral Economy of Speculation: Gambling, Finance, and the Common Good. Tanner Lectures on Human Values. University of Utah. [Available at https://scholar.harvard.edu/sandel/publications/moral-economy-speculation-gambling-finance-and-common-good](https://scholar.harvard.edu/sandel/publications/moral-economy-speculation-gambling-finance-and-common-good) (accessed on September 15, 2018).
- (55) Kunreuther, H., Slovic, P. & Olson, K. (2014). – Fast and Slow Thinking in the Face of Catastrophic Risk. Risk Management and Decision Processes Center, The Wharton School, University of Pennsylvania. Working Paper # 2014-06. Available at <https://ssrn.com/abstract=2488653> or [Available at http://dx.doi.org/10.2139/ssrn.2488653](http://dx.doi.org/10.2139/ssrn.2488653). (accessed on September 15, 2018).
- (56) Seifman R., Kornblat S., Standley C., Sorrell E., Fischer J., Katz R. (2015) – Think big, World Bank: Time for a public health safeguard. The Lancet Global Health, 3 (4), pp. 186-187. [Available at https://www.thelancet.com/journals/langlo/article/PIIS2214-109X\(15\)70012-4/fulltext](https://www.thelancet.com/journals/langlo/article/PIIS2214-109X(15)70012-4/fulltext) (accessed on September 15, 2018).
- (57) Glassman, A., Jonas, O. & Post, L. (2016). – Will IDA18 Usher In Banking against the Superbugs? Center for Global Development blog. June 28, 2016. [Available at https://www.cgdev.org/blog/will-ida18-usher-banking-against-superbugs](https://www.cgdev.org/blog/will-ida18-usher-banking-against-superbugs) (accessed on September 15, 2018).
- (58) Yamey, G., Schäferhoff, M., Aars, O.C., Bloom, B., Carroll, D., Chawla, M., Dzau, V., Echalar, R., Gill, I.S., Godal, T., Gupta, S., Jamison, D., Kelley, P., Kristensen, F., Mundaca-Shah, C., Oppenheim, B., Pavlin, J., Salvado, R., Sands, P., Schmunis, R., Soucat, A., Summers, L.H., El Turabi, A., Waldman, R. & Whiting, E. (2017). Financing of international collective action for epidemic and pandemic preparedness, Lancet Global Health 2017. May 18, 2017. [Available at http://dx.doi.org/10.1016/S2214-109X\(17\)30203-6](http://dx.doi.org/10.1016/S2214-109X(17)30203-6) (accessed on September 15, 2018).
-