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International Collective Action for Epidemic and Pandemic Preparedness

An Economic Policy Brief for the G20 Health Working Group

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SEEK development

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KEY MESSAGES AND RECOMMENDATIONS TO THE G20

» The world is highly vulnerable to massive loss of life and economic shocks from natural or man-made epidemics and pandemics. The 2003 SARS pandemic, for example, was moderate in severity and yet still caused a global economic loss of about US$ 52.2 billion (in US$ 2016). Since SARS, we have had four other outbreaks creating regional or global economic setbacks. It is certain that we will face such outbreaks again in the near future.

» Reducing this vulnerability requires action to strengthen two planks of preparedness/response:

- The national plank involves investing in national public health systems, especially their surveillance capacities, as the first line of defense; financing will largely be through domestic resources, supplemented by donor financing in the poorest countries.
- The international plank—the focus of this brief—is financing global efforts to (a) accelerate R&D of missing vaccines, drugs, and diagnostics for outbreak control, and (b) strengthen the global and regional outbreak preparedness and response system.

» To accelerate R&D, based on the existing pipeline of products, we estimated the "price tag" for developing a set of missing control tools. Over a 5-year period:

- US$ 180-740 million/year would fund the development of one vaccine candidate for each of the 10 priority emerging infectious diseases (EIDs) or 2-3 candidates for three priority diseases (the wide cost range depends on the complexity of vaccine technologies used); the Coalition for Epidemic Preparedness Innovations (CEPI) is a new platform for such vaccine development.
- US$ 860 million/year would fund the development of at least one drug for 6 priority EIDs and at least one diagnostic for 8 priority EIDs.

Recommendations to the G20: *We call on G20 nations*

» To enhance donor support for CEPI to ensure the development of vaccines, and to provide sufficient funding to the WHO R&D Blueprint for Action to Prevent Epidemics to coordinate development of drugs and diagnostics.

» To strengthen the global and regional system for outbreak control: (a) fill the funding gaps in the WHO Contingency Fund for Emergencies (which has a capitalization target of US$100 million but only received US$32.7 million thus far) and the WHO Health Emergencies and Health Systems Preparedness Programmes (which face a shortfall of US$ 225 million/year); and (b) provide additional funding for the Pandemic Emergency Facility to allow for increased prevention of pandemic risk.

» To fully support (i) their own and other countries' national preparedness efforts, including through joint external evaluations; (ii) the creation and maintenance of a regional and country-level pandemic risk and preparedness index; and (iii) a global effort to develop long-term national, regional, and global investment plans (including for influenza pandemics), to create a world secure from the threat of devastation from outbreaks.

Introduction: about this policy brief

This economic policy brief summarizes the outcomes and recommendations of a February 17, 2017 **workshop** held at the National Academy of Medicine in Washington, DC, USA, involving an **international group of 25 researchers and policymakers** (Annex 1). The workshop was co-hosted by CEPI and Duke University's Center for Policy Impact in Global Health, who also conducted background research in partnership with SEEK Development, Berlin, and the University of California San Francisco's Global Health Group. The brief, written for the **2017 G20 Health Working Group**, focuses on the role of international collective action in supporting global and regional efforts to prepare for future epidemics and pandemics.[a]

We focus on a set of neglected EIDs that the WHO defines as "**severe emerging diseases with potential to generate a public health emergency**, and for which insufficient or no preventive and curative solutions exist."[b] Outbreaks from these EIDs are relatively frequent but can cause **massive economic shocks**. Nevertheless, the most likely candidate for another major pandemic is a strain of influenza (in our recommendations, we propose an analysis of long-term national, regional, and global investment plans *to include influenza pandemics*). The brief is divided into 5 sections: (1) the costs of inaction, (2) the two key planks of outbreak preparedness/response, (3) accelerating R&D of missing control tools, (4) strengthening the global/regional system for outbreak control, and (5) conclusions and recommendations.

1. The costs of inaction

Inadequate preparedness for the next epidemic or pandemic puts the world at risk of massive loss of life and economic devastation. **Severe economic damage** occurs from the indirect effects of the outbreak: reduction in the labor force due to illness and death and behavior changes induced by fear (e.g., closure of businesses and schools, health system collapse, reduction in tourism and trade).[1] Quantifying the likely size of these losses is challenging because the epidemiological and economic research in this field is still at an early stage. Table 1 summarizes the losses from four different epidemics and pandemics.

Table 1. Health and economic impacts of the 1918 Spanish flu and of recent epidemics and pandemics

Epidemic or pandemic	Estimated economic loss (adjusted to US$ 2016)	Estimated deaths[c]
Spanish flu (1918)	GDP loss of 3% in Australia, 15% in Canada, 17% in the UK, 11% in the US;[2] another flu epidemic as severe as Spanish flu could cost $US 3.5 trillion in global economic loss[3]	50,000,000[4]
SARS (2003)	Global economic loss of US$ 52.2 billion[5]	774[6]
Ebola (2013)	US$ 2.8 billion in Guinea, Liberia, and Sierra Leone[1]	10,600[1]
Zika (2015-2016)	Estimated expected loss to Latin America and Caribbean region of US$ 3.5 billion[7]	20[8]

[a] ***Epidemics*** are infectious disease outbreaks that cause illness and death across a community or region. ***Pandemics***, which are less frequent than epidemics, are outbreaks occurring over a wider geographic area across international boundaries; their likelihood has risen over the last century due to environmental, ecological, and social factors.

[b] The list comprises arenaviral haemorrhagic fevers (including Lassa fever), Crimean Congo Haemorrhagic Fever, Filoviral diseases (including Ebola and Marburg), MERS-CoV, other highly pathogenic coronaviral diseases (e.g., SARS), Nipah and related henipaviral diseases, Rift Valley Fever, Severe Fever with Thrombocytopenia Syndrome (SFTS), Zika, and Chikungunya.

[c] In addition to mortality, epidemics and pandemics cause significant morbidity and disability.

A limitation in assessing the economic costs of outbreaks is that they only capture the impact on income. Fan, Jamison, and Summers recently addressed this limitation by estimating the "inclusive" cost of pandemics: the sum of the cost in lost income *and* a dollar valuation of the cost of early death.[9] They found that for Ebola and SARS, the true ("inclusive") costs are 2-3 times income loss. For extremely serious pandemics such as the Spanish flu, the inclusive costs are over 5 times income loss.

Fan and colleagues estimate that when all costs are considered, **global economic losses** from a severe pandemic are expected to be **US$ 570 billion each year or 0.7% of global income—a threat similar to that of global warming**, which is expected to cost 0.2-2% of global income annually.[10] To put this further into perspective, natural disasters cause an expected annual economic loss of US$ 250-350 billion globally[11] and in 2015 terrorism caused an estimated global economic loss of US$ 89.6 billion.[12]

2. The two key planks of outbreak preparedness/response

Reducing the world's vulnerability to economic shocks and health threats from outbreaks requires action to strengthen two planks of preparedness and response.

The **first plank (national level)** is to prioritize investment in developing public health capabilities as a first line of defense, especially surveillance capacities (including animal surveillance, since most EIDs originate in animals). [13] Strengthening the foundations ("building blocks") of national health systems—such as the health workforce, financial management, and health information systems—is crucial for early detection and rapid control of outbreaks. National capabilities should be assessed through rigorous external assessments; the WHO's Joint External Evaluation (JEE) tool was developed specifically for this purpose.[14]

Financing for this first plank will largely be through domestic resources, but this must be supplemented by donor financing to low-income, high-risk countries. Upgrading such national capabilities constitutes the largest portion of the overall funding required for outbreak preparedness and response. The World Bank's International Working Group on Financing Preparedness, chaired by Peter Sands, is estimating the "price tag" to strengthen national health care systems for outbreak preparedness and the role of donor financing in such systems strengthening.

The **second plank (international level),** the focus of this brief, is financing global efforts to (i) *accelerate R&D of vaccines, drugs, and diagnostics for outbreak control* and (ii) *strengthen the global and regional outbreak preparedness and response system*. Studies suggest that such activities are critically underfunded.[15]

3. Accelerating R&D of missing control tools

To increase the world's resilience and capacity to prevent, detect, and quickly extinguish outbreaks, we need **medical countermeasures—specifically vaccines, therapeutics, and diagnostics—**that are currently missing.

Pandemic and epidemic vaccines

Investments in vaccine development against EIDs are necessary for preventing potential outbreaks of disease from becoming humanitarian crises. **CEPI**, which launched at the 2017 World Economic Forum

with an initial **donor investment of US$ 540 million out of an initial target of US$ 1 billion over five years**, is a new coalition for developing vaccines against EIDs as well as platforms for rapid development of vaccines against outbreaks of unknown origin. Consolidating and enhancing donor support for CEPI would be an efficient way to channel resources aimed at improving global outbreak preparedness and response.

CEPI has developed a cost model to estimate the costs of developing vaccines for 10 out of the 11 EIDs that the WHO has prioritized for further R&D.[d] CEPI estimates that it would cost **US$ 180-740 million/year over the next 5 years** to fund development of at least one vaccine candidate for each of these 10 EIDs (through phase 2a of development) or 2-3 candidates for three priority diseases. The wide range of costs depends on the complexity of vaccine technologies used.[e]

Pandemic and epidemic drugs and diagnostics

Drug treatments and diagnostic tests are another cornerstone in outbreak control. As with vaccines, evidence on what it would cost to develop drugs and diagnostics is scarce. A research team at Duke's Center for Policy Impact in Global Health, SEEK Development, and the University of California San Francisco conducted an analysis to estimate the annual cost to develop drugs and diagnostics for 12 priority EIDs through to the end of the development process (i.e., including Phase 3 and regulatory trials).[f] The study found that it would cost **US$ 860 million/year over the next 5 years**. Assuming standard attrition rates for the development of EID products, this investment would be expected to deliver new drugs for 6 EIDs and new diagnostics for 8 EIDs at the end of the 5-year period.

The **WHO R&D Blueprint for Action to Prevent Epidemic**s is the mechanism for coordinating and prioritizing the development of drugs and diagnostics for EIDs.[16] G20 countries should provide sufficient funds to WHO to ensure that this critical coordination function is adequately financed.

4. Strengthening the global and regional system for outbreak control

Crucial components of the global and regional system for outbreak control include: *surge response capacity* (including the ability to urgently deploy human resources, set up information systems, and deliver medical supplies); providing *technical guidance to countries* in the event of an outbreak; and establishing a coordinated, inter-linked global, regional, and national **surveillance system**.

These activities are the remit of several essential WHO financing envelopes that all face major funding shortfalls that must be urgently filled. The first is the **Contingency Fund for Emergencies**, which finances surge outbreak response for up to 3 months (until resources from other financing mechanisms begin to flow). The fund has a capitalization target of US$ 100 million of flexible voluntary contributions, which

[d] The 10 diseases included in the CEPI study were Nipah, SARS, Marburg, Lassa fever, Ebola, Rift Valley Fever, Crimean Congo Haemorrhagic Fever, Chikungunya, Zika, and MERS. For SFTS, the researchers did not have sufficient data to model the costs.

[e] These costs do not cover the important additional costs of supporting platforms for the rapid development of vaccines for any new, emerging pathogen. Nor do they address the challenges of adapting regulatory frameworks to facilitate rapid vaccine development during a pandemic event.

[f] These comprised the 10 EIDs that CEPI included in its vaccine costing model plus SFTS and West Nile Virus.

needs to be replenished with about US$ 25-50 million per year depending on the extent of the outbreak in any given year.[17] However, as of 26 January, 2017, only US$ 32.7 million had been received.[18] The others are the **WHO Health Emergencies and Health Systems Preparedness Programmes**, which face an annual shortfall of US$ 225 million in funding their epidemic and pandemic prevention and control activities.[19]

Previous health emergencies have highlighted that it can take time to organize global collective action and provide financing to the national and local level.[20] In such situations, a global mechanism should offer a rapid injection of liquidity to affected countries. The **World Bank's Pandemic Emergency Financing Facility** (PEF) is a proposed global insurance mechanism for pandemic emergencies.[21] It aims to provide surge funding for response efforts to help respond to rare, high-burden disease outbreaks, preventing them from becoming more deadly and costly pandemics. The PEF currently proposes a coverage of US$ 500 million for the insurance window; increasing the current coverage will require additional donor commitments.[g]

5. Conclusions and recommendations

G20 leadership is urgently needed to prevent economic shocks and massive loss of life from disease outbreaks. Five recommendations emerged from our workshop. *We call on all G20 nations*

(i) To **accelerate development of new technologies to control outbreaks**, donors should expand their financing for CEPI and should support the WHO R&D Blueprint for Action to Prevent Epidemics.

(ii) To **strengthen the global and regional system for outbreak control**, funding gaps in the WHO Contingency Fund for Emergencies and the WHO Health Emergencies Programme should be urgently filled. The G20 should also consider increasing its support for the PEF.

(iii) To **support their own and other countries' national preparedness efforts**, including committing to the JEE process.

(iv) **To support the creation and maintenance of a regional and country-level pandemic risk and preparedness index**, which could be used—where macroeconomic consequences are likely to be large—in IMF article IV consultations. Possible venues for creating/maintaining such an index include the WHO in partnership with the Inter Academy Partnership, a global network of academies of science, medicine, and engineering.

(v) To support a global effort to **develop long-term national, regional, and global investment plans** to create a world secure from the threat of devastation from outbreaks.

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[g] In addition, the PEF has a US$ 50-100 million replenishable cash window.

References

1. World Bank (2016). 2014-2015 West Africa Ebola Crisis: Impact Update. At: http://pubdocs.worldbank.org/en/297531463677588074/Ebola-Economic-Impact-and-Lessons-Paper-short-version.pdf
2. Madhav N, Oppenheim B, Gallivan M, et al. Pandemics: risk, impacts, and mitigation. Disease Control Priorities, 3rd Edition, 2017 (in press).
3. Burns A, van der Mensbrugghe D, Timmer H. Evaluating the economic consequences of avian influenza. World Bank, Washington, DC; 2008
4. Taubenberger JK, Morens DM. 1918 influenza: the mother of all pandemics. *Emerg Infect Dis.* 2006;12:15-22.
5. Lee J-W, McKibbin W J (2004) Estimating the Global Economic Costs of SARS In: Knobler S, Mahmoud A, Lemon S et al. (editors) Institute of Medicine (US) Forum on Microbial Threats Washington (DC): National Academies Press (US).
6. CDC (2004). Fact Sheet: Basic Information about SARS. At: https://www.cdc.gov/sars/about/fs-sars.pdf
7. World Bank (2016). The short-term economic costs of Zika in Latin America and the Caribbean (LCR). Washington, DC: World Bank Group.
8. PAHO (2017). Zika cases and congenital syndrome associated with Zika virus reported by countries and territories in the Americas, 2015 - 2017 Cumulative cases. Data as of 16 February, 2017, 2pm EST. At http://bit.ly/2kuXvZG.
9. Fan, V. Y., Jamison, D. T., & Summers, L. H. (2016). The inclusive cost of pandemic influenza risk (No. w22137). National Bureau of Economic Research.) At: http://www.nber.org/papers/w22137
10. Intergovernmental Panel on Climate Change (2014). Climate change 2014: impacts, adaptation, and vulnerability. At http://www.ipcc.ch/report/ar5/wg2/.
11. UNISDR (2015). Making Development Sustainable: The Future of Disaster Risk Management. Global Assessment Report on Disaster Risk Reduction. Geneva, Switzerland: UNISDR.
12. Institute for Economics and Peace (2016). Global Terrorism Index 2016: Measuring and Understanding the Impact of Terrorism. Sydney, Australia: IEP.
13. Sands PS, Mundaca-Shah, Dzau VJ. The neglected dimension of global security—a framework for countering infectious-disease crises. *New Engl J Med* 2016;374:1281-87
14. WHO. (2016). Joint external evaluation tool: International Health Regulations (2005). At: http://apps.who.int/iris/handle/10665/204368
15. Schäferhoff M, Fewer S, Kraus J, et al. How much donor financing for health is channeled to global versus country-specific aid functions? *Lancet* 2015;386:2436-2441.
16. WHO (2017). R&D Blueprint for Action to Prevent Epidemics. At: http://www.who.int/csr/research-and-development/blueprint/en/
17. WHO (2017), personal communication
18. WHO (2017). Contingency fund for emergencies income and allocations. At: http://www.who.int/about/who_reform/emergency-capacities/contingency-fund/contribution/en/
19. WHO (2016). Progress report on the development of the WHO Health Emergencies Programme, 30 March 2016. At: http://www.who.int/about/who_reform/emergency-capacities/who-health-emergencies-programme-progress-report-march-2016.pdf?ua=1
20. WHO (2013). Emergency Response Framework (ERF). At: http://www.who.int/hac/about/erf_.pdf
21. World Bank (2016).Pandemic Emergency Facility: Frequently Asked Questions. At: http://www.worldbank.org/en/topic/pandemics/brief/pandemic-emergency-facility-frequently-asked-questions

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