Swiss Re

Pandemics in a changing climate – Evolving risk and the global response

A report prepared by students of Johns Hopkins University, School of Advanced International Studies

About the project

This report was authored by students of the Johns Hopkins University School of Advanced International Studies (SAIS) as part of a practicum project in the Energy, Resources and Environment Program. The practicum requires student teams to partner with key organizations to address critical international environmental policy challenges. Here, students collaborated with Swiss Re to examine the implications of climate change on global pandemic risk, and to analyze the potential of the World Bank-led Pandemic Emergency Facility to provide the basis for a long-term market for pandemic insurance. Swiss Re Risk Research provided financial support to Johns Hopkins SAIS to enable the students' work on this project.

Johns Hopkins University
School of Advanced International Studies
Energy, Resources and Environment Student Practicum

Authors
Rachel Estrada
Andrew Griffith
Colbye Prim
Jeongsu Sinn

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Swiss Re
Alex Kaplan
Nikhil da Victoria Lobo
Bridget Carle

SAIS
Dean Vali Nasr
Celeste Connors
Mark White
Josh Michaud
Dr. Jonathan Haskett
Dr. Peter Lewis

Panelists
Dr. Daniel Barnett (Johns Hopkins Bloomberg School of Public Health)
Dr. Dennis Carroll (USAID)
Dr. Priya Basu (World Bank)

World Bank
Dr. Mukesh Chawla
Rocio Schmunis
Timothy Bouley

Bloomberg
Dr. Alfred Sommer
Dr. Mary Sheehan
Dr. Anna Durbin

100 Resilient Cities
Liz Agbor-Tabi

AIR Worldwide
Kierste Miller

Emory University
Daniel Rochberg

Centers for Disease Control and Prevention (CDC)
Dr. George Luber
Paul Schramm

USAID
August Pabst

Columbia University
Dr. Madeleine Thompson

African Risk Capacity
Dr. Simon Young

Results for Development
Dr. Nathan Blanchet

Ghana
Ministry of Health: Deputy Minister of Health Dr. Victor Bampoe
NADMO: Tevi Lawson
GHS: Dr. Michael Adjabeng
EOC: Robert Agyarko
GIZ: Branko Wehnert, Chirantan Banerjee, and Dr. Adriana Ignea
University of Ghana: Dr. Christopher Gordon
USAID and US Embassy: Rachel Cintron and Tamara Chikhradze
CDC: Dr. Talla Nzussouo
UNDP: Dr. Paolo Stella
World Bank – IFC: Dr. Anthony Seddoh
WHO: Dr. Owen Kaluwa, Dr. Okot Charles Lukoya, Braimah Dorkenoo

National Security Council
John Morton

Introduction

Pandemic outbreaks can be economically devastating for the affected countries, overwhelming public finances and reversing hard-won development gains. The immediate economic disruption resulting from loss of life and suspended productivity can translate into lasting impediments to growth. In the current system, response mechanisms are much too slow, particularly in delivering financing to responsible counterparties. In addition, the effects of climate change will increase the inherent risk of pandemic outbreaks by changing environments and disease transmission vectors, heightening uncertainty as to the location, type and severity of the next outbreak. Innovative pandemic risk financing mechanisms that mobilize funds from the public and private sector – such as the Pandemic Emergency Facility (PEF) – are currently being developed to address the need for increased response support. As the market for pandemic risk develops and evolves, climate effects will need to be priced into disease outbreak profiles to create sustainable risk allocation.

However, there is much work to be done at the research and policy level to incentivize this transition. We recommend several strategies to continually strengthen the effectiveness of the PEF as it evolves to manage the changing nature and distribution of pandemic risk:

- Actively encourage data gathering and cooperation between the climate and health sectors;
- Establish an economic link between climate and health costs;
- Mobilize funding for ancillary outbreak response services;
- Expand the insurance market to cover disease outbreaks at earlier stages;
- Adopt a dual engagement strategy to increase likelihood of adoption;
- Engage large donors to better facilitate integrated risk management; and
- Develop an improved indicator to determine eligible recipients of PEF funding.

Serious disease outbreaks are becoming more common. This trend can be attributed to a number of interrelated factors, such as population growth and demographic change, globalization and increased mobility, increased and changing interactions between humans, disease vectors and animal hosts, and environmental change. In addition to their direct impacts on health, these drivers also interact, often compounding each other's effects on disease landscapes and human vulnerability. Climate change adds yet another dimension, acting as a risk multiplier to the aforementioned factors while driving further changes to vector ecology.

Unfortunately, a number of epidemic and pandemic outbreaks in recent memory including SARS (China, 2002–03), H1N1 (global, 2009–10), MERS (Saudi Arabia, 2012 and South Korea, 2013), Ebola (West Africa, 2014–2015) and the Zika virus (Americas, 2015–16) have illustrated painful shortcomings in the global capacity to predict and respond to outbreaks of unfamiliar or emerging diseases (several of which are also considered climate-sensitive). Though these events have varied in mortality rates, geography and longevity, each has resulted in identifiable socioeconomic impacts, and has revealed a number of lessons both about the multifaceted nature of disease risk and about executing effective response.

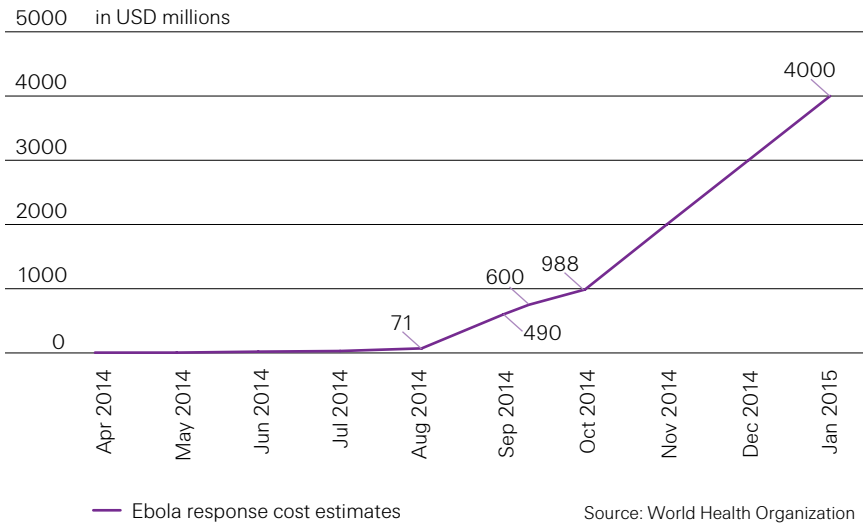
I. Pricing pandemic risk

The economic toll of epidemics

Severe outbreaks take a devastating economic toll on governments and citizens of affected countries, overwhelming limited public finances and reversing hard-won development gains. The immediate economic disruption resulting from emergency expenditures, loss of lives and suspended productivity can translate into lasting impediments to growth. As such, when it comes to response, timing is key; lost time corresponds to lost lives and dollars, as costs of treatment, contact tracing and burials mount.

The Ebola crisis, in particular, demonstrated the need to respond much more quickly to future outbreaks. Six months after the initial cases were reported, only around one-third of financial pledges had been dispersed (much of it at the later end of this period), and this financing lag is often cited as one of the main reasons for the region's failure to achieve early containment of the virus. As the crisis ballooned, resource requirements also grew exponentially (Figure 1).

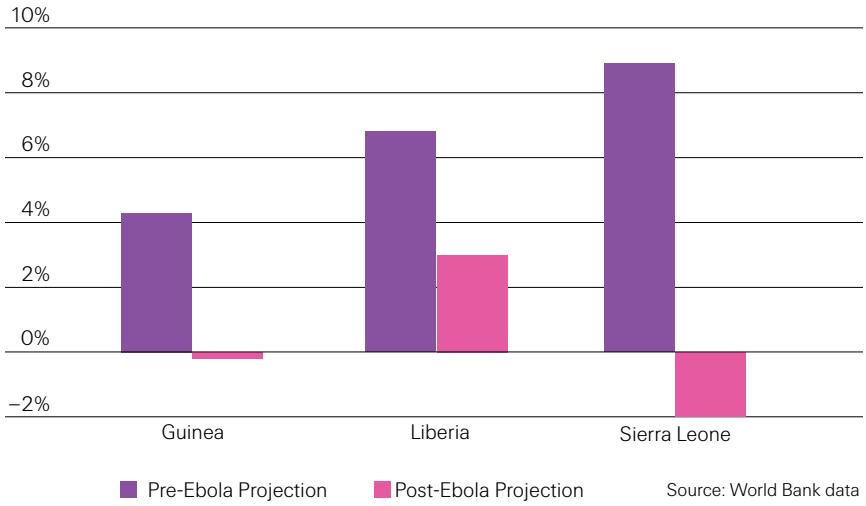
Figure 1
2014–2015 Ebola response cost estimates (World Health Organization cost estimates)



Source: World Health Organization

Appeals for funds by the World Health Organization (WHO) grew from USD 4.8 million in early April 2014 (at the onset of the outbreak) to USD 1.5 billion by November of the same year, to roughly USD 4 billion by January 2015. Combined with a poorly coordinated global response and lack of capacity, this left Guinea, Liberia and Sierra Leone devastated both physically (lives lost) and economically. Figure 2, based on World Bank data, displays the dramatic drop in economic growth projections for all three affected countries following the outbreak, revealing the emergency's lasting impacts. Estimates of lost GDP total over USD 2 billion (USD 1.4 billion in Sierra Leone, USD 535 million in Guinea and USD 240 million in Liberia). The United Nations estimates that the outbreak will decrease the West Africa's per capita income by an average of USD 18 per year through 2017 and reduce GDP growth by an average of 0.8 percentage points per year,[1] totaling between USD 14.7 billion and USD 19.7 billion in losses through 2017.[2]

Figure 2
2015 GDP growth projections



The ongoing Zika outbreak in Latin America has already begun to hamper projected growth in the region, with response costs and lost revenues (particularly in countries heavily reliant on tourism) totaling an estimated USD 3.5 billion in 2016.[3] However, these numbers are dwarfed by the potential costs of a true global pandemic; according to the World Bank, a Spanish flu-like pandemic could cost up to USD 4 trillion[4] if the world remains unprepared and uncoordinated.

While the economic toll of an outbreak is often measured in terms of national income (e.g. lost GDP or slowed GDP growth), severe outbreaks negatively affect other development indicators as well. For instance, impacts on maternal and child health, interrupted education due to illness-related absences or school closures, time reallocated from productive activities to caregiving, loss of livestock or decreased long-term investor confidence can all damage an affected country or region's development outlook. While these indicators are often closely correlated with GDP, it is important to identify and analyze these disaggregated impacts as well in order to shape more robust and effective response systems. A rapid, coordinated global response is critical to stemming an emerging health crisis and minimizing the death toll, economic losses and other threats to livelihoods and wellness. In particular, in order to limit both short- and long-term impacts within affected countries, effective outbreak response requires immediate access to finance to facilitate quick action by health personnel, government agencies and other humanitarian actors.

Clear commitment from the G7 on outbreak response:

"We commit to preventing future outbreaks from becoming epidemics by assisting countries to implement the World Health Organization's International Health Regulations (IHR)…"

"…We support the initiative taken by the World Bank to develop a Pandemic Emergency Facility. We encourage the G20 to advance this agenda."

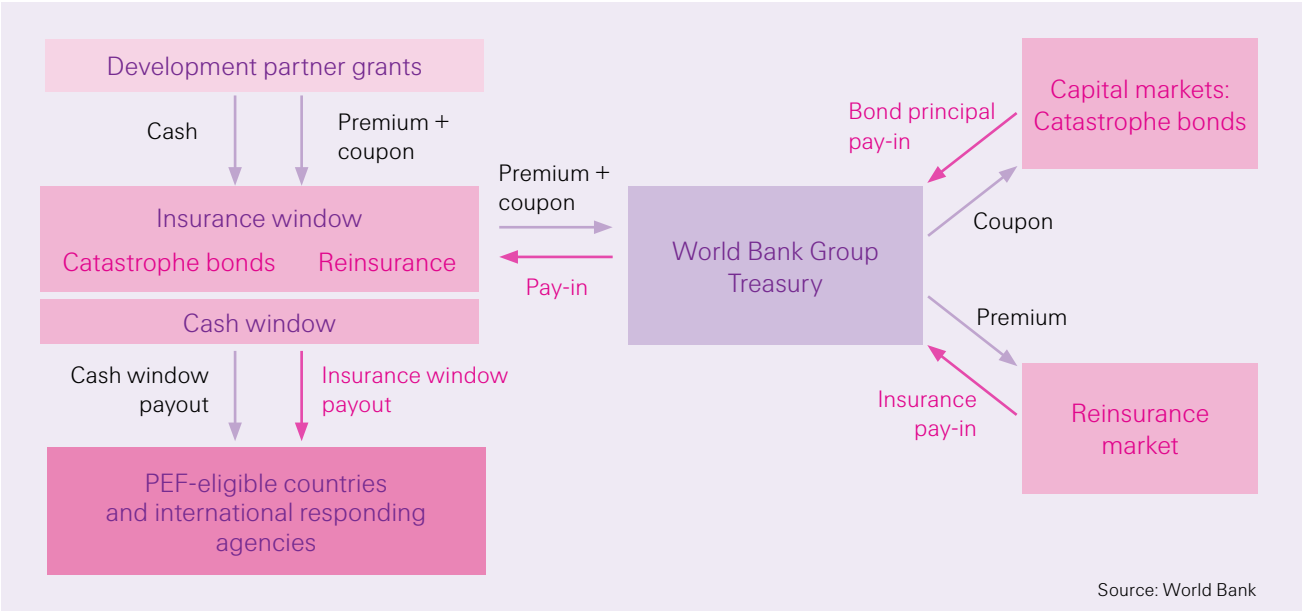
The G7 response: Pricing pandemic risk

The desire to prevent another Ebola-like crisis, particularly in other low-income countries with limited response capacity, has commanded attention from the highest level of political leadership. At the 2015 G7 Leaders' Summit in Germany, heads of state committed "to preventing future outbreaks from becoming epidemics by assisting countries to implement the World Health Organization's International Health Regulations (IHR),"[5] a binding legal instrument designed to "help the international community prevent and respond to acute public health risks that have the potential to cross borders and threaten people worldwide," and "define the rights and obligations of countries to report public health events."[6] Alongside parallel pledges to improve prevention, preparedness and recovery capabilities, this commitment proclaimed G7 countries' support for the implementation of the Pandemic Emergency Financing Facility (PEF), a financial response mechanism currently being developed by the World Bank in cooperation with the WHO, global reinsurance companies including Swiss Re, and catastrophe modelers to facilitate the quick dispersal of funds in the event of large-scale disease outbreaks. The G7 also encouraged the expansion of this agenda to the G20 level.

The Pandemic Emergency Financing Facility

The PEF, which is expected to enter into operation by late 2016, is the result of international efforts to price pandemic risk. It will consist of two financing pillars: a parametric insurance mechanism (the focus of this report), and a cash reserve composed of long-term pledges from development partners that will allow for additional flexibility. The insurance mechanism is designed to facilitate quick, efficent outbreak response by providing funds to hire and deploy pre-approved international responders (response organizations, emergency task forces or national governments depending on existing response capacity) in affected countries to cover immediate objectives in the event of a major outbreak. Payouts will be triggered when an outbreak meets a set of predetermined thresholds (e.g. number of deaths or infections within a given timeframe), which have been set in advance based on the characteristics of each of the covered diseases. Critically, this mechanism will allow funds to reach affected countries in as little as ten days by offering a faster alternative to slow, subjective political decision making processes related to dispersing funds (i.e. when, how and at what levels) and avoiding lengthy contractual delays and other bureaucratic hurdles. In this way, the PEF is intended to prevent a potentially serious outbreak from becoming a larger international crisis.

Figure 3
Initial three-year phase for the Pandemic Emergency Facility (PEF)



Source: World Bank

In its first three-year phase (Figure 3), G7 donor countries will provide premium support to the World Bank, allowing the PEF to purchase insurance coverage on behalf of the developing countries (defined as the 77 countries currently eligible for World Bank International Development Assistance) to cover the costs of containing disease outbreaks. This phase will cover four main disease classifications: Filovirus, coronavirus (including SARS/MERS), ADOM, and pandemic influenza (i.e. severe multi-country outbreaks of non-seasonal flu). Subsequent phases will attempt to expand the facility to cover more countries (with middle-income countries paying at least a portion of their own premiums) and additional disease classifications as modeling capabilities improve.

In order to maximize the effectiveness of the PEF, and ensure that it most effectively provides the basis for the development of a mature pandemic insurance market, it is necessary to examine the evolving landscape of pandemic risk. As alluded to earlier, climate change is highly likely to amplify existing risks while directly affecting certain disease transmission pathways and introducing new uncertainties. However, current risk analysis and public health emergency response frameworks do not adequately incorporate climate considerations into planning. While academics and health experts in both developed and developing countries are beginning to recognize the role of climate change in contributing to the spread of emerging diseases, climate and health policy remains relatively siloed in practice, largely as a result of limited and inflexible funding streams. Going forward, it will be critical to take a more holistic, interdisciplinary approach to pandemic risk management in order to more accurately anticipate future needs and enhance global capacity to prepare for and respond to future outbreaks.

II. Climate change and pandemics

The link between climate change and public health has received increasing attention on the policy front at the international and national level. The 2016 Global Risk Report published by the World Economic Forum identifies the link between climate change and the spreading of infectious diseases, which are two of the top ten high impact, high frequency risks highlighted in the report.[7] Also, in early April 2016, the U.S Global Change Research Program (USGCRP) released a report that examines the various ways through which climate change will affect overall public health. Changes in climatic conditions will act as threat multipliers to a wide range of non-communicable and infectious diseases, from temperature-related deaths, asthma and allergy conditions, water-related diseases such as cholera and meningitis, to mental health and stress-related illnesses.[8] This section of the paper will focus specifically on channels that will increase vulnerability of human populations to zoonotic and vector-borne diseases – two disease groups that are of particular concern because they are climate sensitive, and comprise the majority of emerging or re-emerging infectious diseases.[9]

The One Health concept and the Haddon Matrix

There are multiple channels through which climate change will directly and indirectly affect the frequency and intensity of pandemic outbreaks. Due to the highly complicated and multidimensional nature of these links, applying analytical and holistic frameworks improves understanding of these various interconnections. Applying the One Health concept, which recognizes the connections between environmental, animal and human health, helps identify the mechanisms through which changes in the environment can affect the spreading of infectious diseases.[i] [10] The Haddon Matrix facilitates analysis of factors leading up to the event, as well as those that affect the severity of an outbreak.[ii] [11] Modified versions of the two frameworks will be applied in this report to identify the first, second, and third order effects that climate change will have on pandemic risk. The effect on human health can be measured in terms of vulnerability, which is defined by USGCRP as "the tendency to be adversely affected by climate-related health effects."[12] Three key elements of vulnerability to infectious diseases are: Exposure to vectors and disease carrying agents, sensitivity to climate change and its health effects, and adaptive capacity of communities.[13] This report will elaborate on the mechanisms through which climate change will affect the first two elements.

i The One Health approach is an effort to actively integrate human, animal and environmental health sectors both conceptually and in practice in various sectors such as veterinary science, medicine, and public health response. Government and international organizations that have adopted and promoted the One Health approach include US Centers for Disease Control and Prevention (CDC), US Agency for International Development(USAID), European Commission, World Health Organization(WHO), World Bank, Food and Agriculture Organization of the United Nations (FAO), World Organization for Animal Health (OIE), and so on.

ii The Haddon Matrix was first developed by Dr. William Haddon to analyze traffic safety injury epidemiology and prevention. Utilizing this analytical framwork facilitates better understanding of the human, vehicle and environmental factors that attribute to an accident before, during and after the event. It also helps identify and evaluate various intervention strategies or policies. Public health experts such as Dr. Daniel J. Barnett later modified and applied the Haddon Matrix to the field of public health emergency preparedness and planning.

Climate change affects vector ecology and the vulnerability of human populations before an outbreak, and exacerbates the intensity during an outbreak. Prior to an outbreak, changes in temperature, precipitation patterns and pH levels will affect the quantity and quality of ecosystem services such as provisioning services (food supply, water availability, etc) and supporting services (soil formation, nutrient recycling, etc). This will in turn affect migratory patterns and habitat of certain animals and insects. Moreover, changes in precipitation patterns, atmospheric temperature, and seasonality will influence animal and insect populations and their survivability. The steady increase in temperatures in the Northeast and Upper Midwest regions of the US has contributed to the geographic expansion of tick habitat.[14] Also, extended spring and summer periods and higher average temperatures lead to faster growth rates of mosquitoes, allows them more time to reproduce, and contributes to mosquito population growth. Such changes may directly affect the vulnerability of human populations by increasing human-animal or human-vector contact. Climate change can also affect sensitivity if it negatively affects overall health and nutrition conditions of vulnerable populations in developing countries where food and water security are at risk. These fundamental conditions are related to how susceptible a population or individual may be to the spreading of infectious diseases.

A pandemic outbreak could occur after a natural disaster and/or a sudden collapse in regulating services, such as pest control or water purification. The 1976–77 drought in California, for example, reduced the populations of rodent predators. The subsequent rainfall led to an increase in plant growth, which in turn increased rodent populations as well as the transmission of Hantavirus Pulmonary Syndrome (HPS) – a fatal disease with a 38% mortality rate.[15] If a pandemic outbreak occurred during periods when there is increased activity of vectors in regions where human-human interactions and transmission levels are high, such as urban areas, then the impact of an outbreak will be even more severe.

Climate change will affect the environment, animals, insects, and human populations through various channels, increasing exposure and sensitivity to infectious diseases before and during a pandemic outbreak. In short, climate change can act as a threat multiplier. The application of the One Health concept and the Haddon Matrix has helped identify such channels – these are summarized in the table below.

Application of One Health and the Haddon Matrix

	Environment	Animals & Insects	Humans
Pre Outbreak	■ Ecosystem services ■ Supporting services ■ Provisioning services	■ Migratory patterns ■ Habitat ■ Population and survivability	■ Human-animal contact ■ Health and nutrition
Outbreak	■ Natural disasters ■ Regulating services	■ Increased activity	■ Human-human interactions ■ Human-human transmission

Climate change and mosquitoes

Mosquitoes are one of the most climate-sensitive vectors whose habitat will likely expand in regions where climate change will create a more favorable environment for them to live in. Their population will also grow more rapidly during their most active seasons, and will survive for longer periods of time. Mosquitoes transmit diseases such as Zika, Dengue, Malaria, West Nile Fever and Yellow Fever.

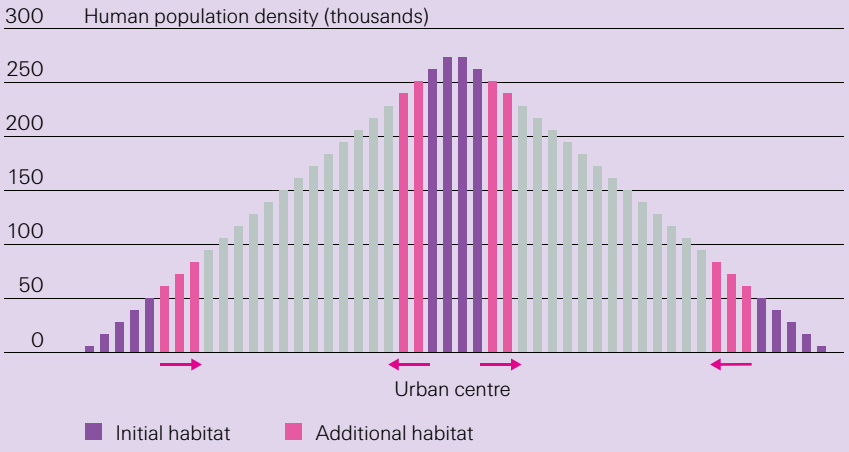
Mosquito habitat change in urban areas

Mosquitoes lay eggs in stagnant water bodies, where they spend their larval and pupal stages before leaving the breeding site. In large cities where population densities are much higher compared to rural areas, water bodies such as lakes or irrigation systems for urban farming in urban peripheries serve as major breeding sites for mosquitoes. In urban centers, where population density is highest, drainage systems or stagnant water bodies near rivers are mosquito incubators that can affect a large number of people. An increase in precipitation levels can potentially increase the quality and quantity of mosquito breeding sites.[17] In a city with over 2 million residents and an area of 173 km^2, an increase in the frequency of rainfall will create additional breeding sites (small puddles in residential areas, old tires, containers, etc) for mosquitoes, and a 1 km encroachment from both urban peripheries and urban centers will double the total number of susceptible population.

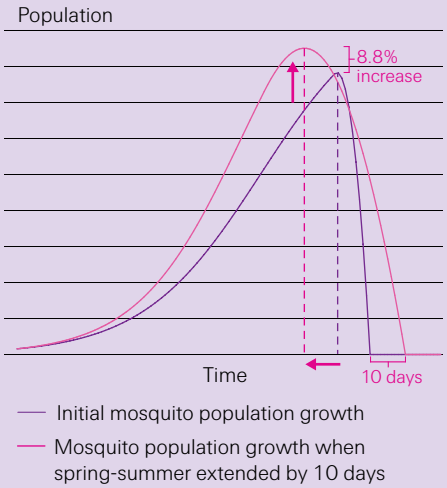
Mosquito populations

Higher temperatures during spring and summer, and an extension of mosquito breeding seasons will affect mosquito populations, allowing them to peak higher and earlier. Although warming above 34°C generally has a negative effect on mosquito survivability, an increase in the number of days where average temperatures fall in the range of 14–18°C will affect the incubation period of mosquitoes, their population, and mosquito-borne disease transmission.[18] A rise in water temperature accelerates larvae development, and shortens the time it takes mosquitoes to mature.[19] Mosquitoes are able to produce more offspring, which leads to an increase in their population. Moreover, transmission intensity is further increased because female mosquitoes are able to feed more frequently and also digest faster in warmer climates, and because the number of infective mosquitoes increases due to faster development of parasites and viruses.[20]

Mosquito habitat expansion and susceptible human population increase



Mosquito population increase during spring-summer[21]

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TAXI

Uncertainties and dangerous synergies

Climate change is a threat multiplier that can increase exposure to vectors and vulnerability before a pandemic outbreak, and also exacerbate the severity of an outbreak. Human populations in certain areas will experience more frequent and intense re-emergence of disease they have been previously exposed to, while others will be newly exposed to diseases they are immunologically naïve to. When a number of climatic factors are combined with other non-climatic trends, such as urbanization, changes in land-use and livestock, potentially dangerous synergies will be created. Unfortunately, however, it is extremely difficult to predict the precise location and timing of the next emergence or re-emergence of an infectious disease strain. Thus, in addition to efforts to enhance health infrastructure and preparedness, robust response mechanisms need to be in place. Both global and national response mechanisms and funding are crucially necessary, and the next section of the report will examine response planning strategies and capacities of Ghana.

III. Ghana case study

Response planning in Ghana

Ghana is one of 77 low- and low-middle income International Development Association (IDA) countries that would be eligible for Phase I coverage from the PEF. As a signatory country, if a trigger event occurs within a small enough distance to signify a pandemic threat, Ghana would be eligible to receive an influx of funding from the PEF. Funding would disseminate in under two weeks to the state or non-state authority deemed most capable of efficiently utilizing those funds. Based on our research of eligible facilities, funds to Ghana would likely flow to the National Disaster Management Organization (NADMO).

NADMO played a significant role in organizing and training healthcare workers during the Ebola outbreak. Although Ghana is geographically close to countries affected by the 2014 Ebola outbreak, it did not report any cases within its borders. Ghana was able to divert the threat from its borders, but this outcome was primarily coincidental. Although Ghanaian medical institutions and response systems are fairly robust when compared to other countries in the region, there was little indication that those systems would have been able to withstand or contain the Ebola outbreak once it arrived in Ghana.

Ghana's health care system

Ghana is a regional leader in health care systems development and planning, spending roughly 10% of its annual budget on health care[24]. In 2004, it was one of the first countries in Africa to introduce a national health plan (National Health Insurance Scheme, NHIS), which stood at 40% penetration as of 2014.[25] As a result, the number of healthcare workers in Accra, the capital of Ghana, has increased significantly. However, rural regions in the north have not fared as well and need stronger policy support from the central authority in Accra.

NADMO is at the heart of the national disaster response system in Ghana. Its primary responsibilities include the training and coordination of relevant stakeholders and system-wide planning in preparation for pandemic outbreak. In 2011 the US state of North Dakota and the Centers for Disease Control and Prevention (CDC) coordinated with the Ministry of Health in Ghana to create the Emergency Operations Center (EOC). The EOC was created with the goal of using relatively advanced technology to perform detailed coordinated disease risk assessments within Ghana. The EOC in Ghana is one of the only centers of its type to operate in West Africa. Nigeria has a similar program but its mandate does not include the same level of surveillance and data gathering. The final piece of the health threat response system in Ghana is Ghana Health Services (GHS). GHS's mandate is to increase preparedness to deal with health threats through the strengthening of the total healthcare framework in Ghana. Coordination across these three bodies is of vital importance in case of an outbreak.

The national health threat preparedness plan is currently under development, with a final plan to be agreed upon by 2018. The current plan includes provisions for the inclusion of animal health experts in responding to zoonotic disease outbreaks, but does not include language related to environmental surveillance or climate change mitigation. The plan mentions limits to effective collaboration across the human and animal healthcare sectors, primarily due to capacity and budgetary constraints. For example, the animal research laboratory only retained one veterinarian at the time of writing of the most recent plan.

Ghana: Despite economic improvements, budgetary risk remains a concern

Ghana is classified as a low-middle income country due to a 2011 recalculation of GDP/ capita. The recalculation followed discovery of offshore oil reserves in the Jubilee oil field and stronger commodity exports in economically significant crops in Ghana (gold, cocoa, etc)[22].

Petroleum revenues make up a significant portion of the present and projected national budget, and the recent low oil price environment has taken a measurable toll on domestic spending. Revenue from the oil industry dropped by 50% in 2015, reducing its total portion of the budget from 13% to 5.8%[23].

Sales of cocoa and gold are similarly integral to Ghanaian economic growth. Agricultural sales make up 19% of total GDP, and the ongoing effects of climate change in the region threatens to increase the volatility of economic return from agricultural sales.

While Ghana is no longer classified as a low-income country, its high vulnerability to external and climate-related shocks makes budgetary risk a primary concern.

Not included in the current version of the national plan are stipulations to develop a One Health strategy (incorporation of animal, human, and environmental experts) to respond to outbreaks. However, these capabilities are available to NADMO. The Ghana Meteorological Service Agency (GMSA) has been reporting climate data since 1957 and provides regular updates and projections on climate-related changes that could be linked to outbreak risk. Ghana is also in the process of operationalizing a detailed National Climate Change Strategy, which makes the connection between the effects of climate change and the risk of disease spread. This initiative currently lacks sufficient funding however.

Response and coordination

While increased capacity is an important consideration for effective coordination, budgetary limits represent an equally important constraint. NADMO is housed within the Department of the Interior while the Ghana Health Service and EOC are related to the Department of Health. Animal experts are housed within the Department of Food and Agriculture while GMSA is within the Department of Communications. Properly coordinating across these agencies represents a redoubling of efforts which will be difficult under the current national plan and structure.

A revision of the national plan that requires cooperation across the three pillars of the One Health strategy would be the first step to adequately address this gap. An additional step is a strategy for the provisioning of funds from all of the relevant agencies in case of a disease outbreak.

Budgetary restrictions are bound to impact the effectiveness of the latter strategy. In this case, funding from an insurance vehicle such as the PEF could provide financial support in case of a triggered pay-out.

Evolution of the Ebola outbreak and response in Ghana

Ebola was declared a Public Health Emergency of International Concern by WHO in August 2014[26]. Later that month, WHO invited healthcare teams from Ghana to Brazzaville, Republic of the Congo for training on preparedness and response strategies related to Ebola. Two additional healthcare workers were able to receive training from Médecins Sans Frontières (Doctors without Borders) in Brussels. As a result, 10 training workshops were held from September to December in Ghana with 571 healthcare experts ultimately trained and deployed across Ghana[27]. One of the main challenges to this process was the lack of sufficient training materials. Personal protective equipment was only available in limited supply so that training remained a theoretical exercise for most of the trainees who were more likely to forget the proper steps even after being shown several times. Lack of funds also meant that they were unable to scale training quickly enough.

Potential benefits of the PEF for outbreak response and training

By providing external funding before a disease has had a chance to spread to pandemic levels, trainers will be able to effectively scale trainings as well as obtain additional needed equipment.

The response efforts in the Ebola experience were reactive rather than proactive. By waiting until news of a deadly disease had created a permeating fear in most healthcare workers, the efficiency of training was curtailed. The PEF is a forward-looking mechanism that includes an algorithm to predict the location and severity of an outbreak, and the algorithm is coded to become better at prediction over time. The entire response-building process can therefore be started before the outbreak can spread to uncontrollable levels and leave high levels of panic in its wake. This reduces significantly the risk of pandemic spread if disease hits countries with low capacity to prepare.

Finally, the PEF provides assurance to any response plans. With the PEF funding mechanism in place, additional preparedness for outbreak response can be utilized more effectively. We predict this will have a catalytic effect on outbreak planning and preparedness as countries become more confident in its investment.

Climate change in Ghana

Ghana is highly sensitive to climate effects. The drivers of Ghanaian economy – agriculture, energy and forestry – are highly susceptible to output fluctuation due to weather phenomenon. As is the case in many developing countries, the poorest populations, rural inhabitants and the urban poor, are most vulnerable to these fluctuations. For example, only 89% of cultivated land is irrigated in Ghana. These farmers, who have traditionally relied on seasonal rains, are left exposed as flooding and drought damage certain areas[28]. Sea level rise and increases in drought, which have been well-documented in Ghana, are estimated to significantly reduce crop output and threaten coastal trading zones[29].

Little has been done in Ghana to address the link between climate effects and health threats. Nonetheless, the effects of a changing climate on disease outbreak have been noted. For example, experts reference the discovery of meningitis outbreaks south of what is typically known as the "meningitis belt" in Northern Ghana. Water-borne diseases also pose threats to new populations as flooding patterns change.

A One Health approach is necessary to promote inter-departmental collaboration on this issue. In Ghana's case, a data gathering and disaster response unit exists that could coordinate with meteorological services experts to monitor climate data and outbreak trends. This group could also mobilize a team of animal, human and environmental health experts to respond to potentially dangerous outbreaks.

Funding for these types of collaborations can be hard to come by in a country, like Ghana, with a constrained budget. In Ghana's case, the availability of forward-looking response funding will be key to the sustainability of these systems. With the PEF in place, policy planning and promotion for a One Health response strategy will be more than just a tick in the right box. The PEF will give these response plans actionable validity.

The PEF funds will only be disbursed in cases of the risk of a pandemic outbreak. However, the PEF can also act to catalyze additional actors in the area of outbreak insurance by incentivizing the development of a favorable investment ecosystem. Indeed, several local-scale actors such as the African Risk Capacity and the Climate Change, Agriculture and Food Security's Climate Risk Management program are already making strides in this area.

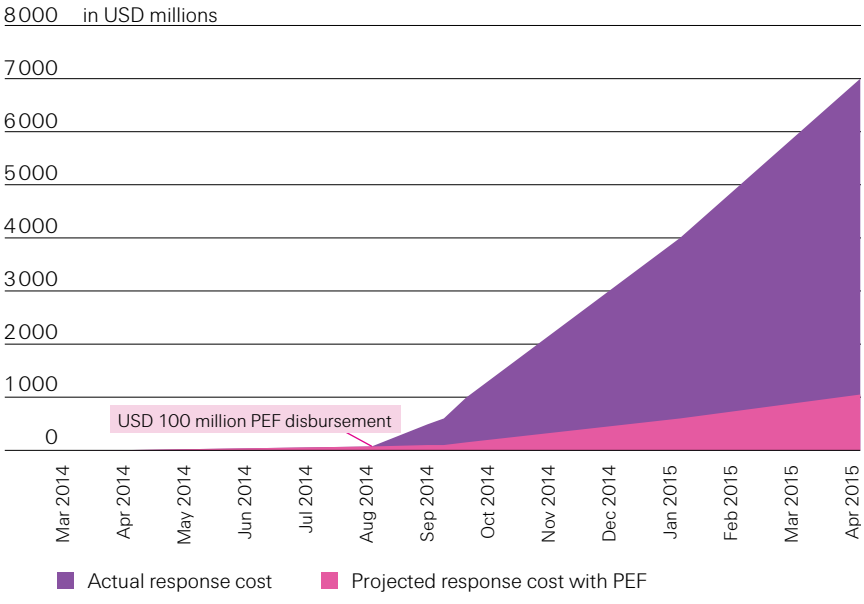
IV. The future with the Pandemic Emergency Facility

The PEF is expected to change how the international community finances responses to large disease outbreaks in three main ways. First, the PEF will put a price on pandemic risk. Second, by pre-financing pandemic response, the PEF will make funding for future outbreaks predictable in terms of magnitude and timing. Finally, the PEF will create more accountability and efficiency in pandemic response spending.

The first manner in which pandemic financing will change is that the risk will be quantified. By allocating capital to the risk of a pandemic outbreak, reinsurer and capital market investors will be effectively putting a price tag on the frequency and severity of pandemic outbreaks. Until now, responding to large outbreaks has been done on an ad hoc basis, with the WHO, affected countries and international organizations estimating the cost of the response as an outbreak progresses. As shown earlier, the amount of funding that was requested by the WHO, World Bank, and United Nations during the Ebola response in West Africa in 2014–2015 was updated upwards numerous times. The PEF has already placed a price on responding to pandemic influenza, SARS, MERS, Ebola, Marburg and other zoonotic diseases such as Crimean Congo, Rift Valley, and Lassa fever. The insurance models that determine those costs will only improve.

The second way in which the PEF is expected to change pandemic response is by making the response funding more predictable for the affected countries. During the 2014–2015 Ebola response, Guinea, Liberia, and Sierra Leone had to rely on donor funding as it arrived. This made the response difficult for all actors on the ground, as they could not predict when or how much money would come in. This was problematic; not only was the money late to arrive, but by February 2015, only 40% of the commitments from donor countries had reached the affected countries.[29] The result of that was an outbreak that escalated exponentially in terms of cost and lives lost. Had the PEF been in place in 2014, it is estimated that a USD 100 million disbursement would have occurred as early as July. Had a disbursement of that kind happened, it is likely that billions of dollars for response and recovery would have been saved along with the lives of thousands of people. With the PEF in place, a disbursement will be predictable since the triggers and size of the tranches of money are set ahead of time in addition to the allocation to first-responders.

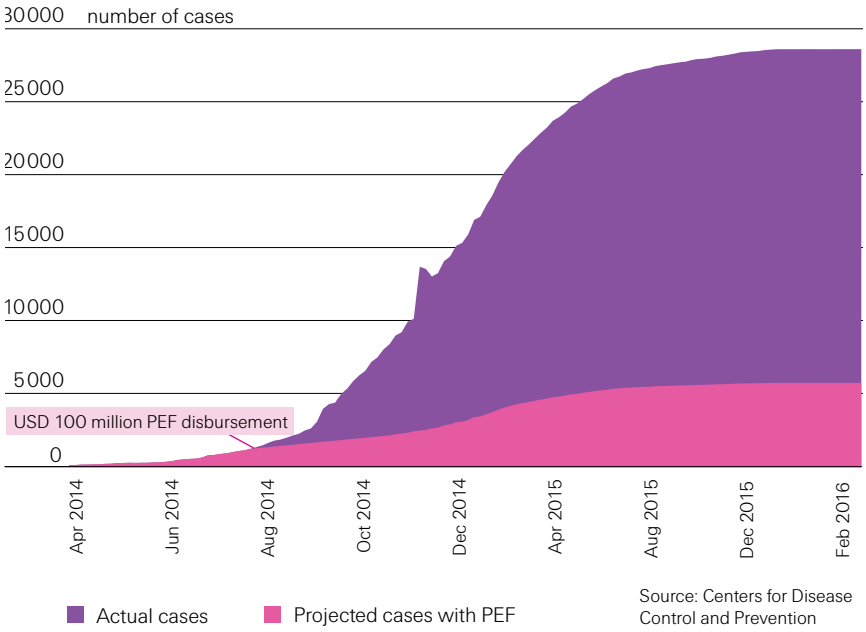
Figure 4
Actual response cost and projected response cost with the PEF for the 2014–2015 Ebola Crisis



Source: World Health Organization, World Bank, United Nations

Projected response cost with the PEF
Had the PEF been in place in 2014, it is estimated that a USD 100 million disbursement would have occurred, potentially saving thousands of lives and billions of dollars in response and recovery spending.

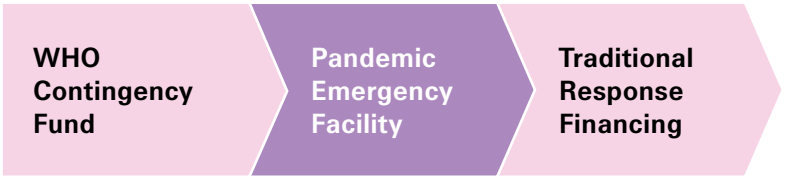
Figure 5
Actual cases and projected cases with the PEF for the 2014–2015 Ebola Crisis



The third way that the PEF is expected to change pandemic response will be to ensure more accountability and efficiency. The World Bank, Swiss Re, and its partners have determined which stakeholders will receive a disbursement of funds in each country and region. If an outbreak occurs, the most capable actors, whether they are a government agency or an international organization like The Red Cross, Médecins Sans Frontières, or another organization, will receive the cash. This will circumvent slow bureaucratic processes and ensure that the money reaches the people on the ground as soon as possible. Once the outbreak is contained, an assessment of the effectiveness of the disbursement will be completed. Keeping the parties that received funds accountable for how they spent the money and getting their feedback will be important for improving the PEF in future phases. Finally, improving data gathering and continuing to research the changing dynamics of pandemic risk will not only allow the PEF in its current form to improve, but it will also allow it to expand to cover more diseases and at earlier stages in an outbreak.

The primary advantage that the PEF has over traditional pandemic response funding is the speed at which funds will be available to emergency responders, increasing efficiency and moving the focus away from having to do substantial fundraising at the onset of an outbreak. Minimizing bureaucracy by following prepared response plans and having health care workers and facilities that are ready will be crucial. As the response efforts progress and countries maintain surveillance efforts, the PEF will supply affected client states with additional tranches of support if the pandemic worsens. The PEF fills a crucial hole in pandemic response financing that became apparent during the 2014–2015 Ebola crisis. The WHO contingency fund is available to supply cash immediately for nascent outbreaks and for WHO activities. On the other hand, large amounts of donor funding will arrive once an outbreak has reached pandemic severity. However, the critical time in between those two types of funding is now covered by the PEF. Disease outbreaks with pandemic potential will now be given the attention that they warrant.

Pandemic response financing: How the PEF bridges a gap in funding



In order to spur this change and continue development of this novel type of pandemic financing, the PEF will need to prove that it is effective fiscally and in terms of public health outcomes. This means that during the first phase of the PEF, which will last for three years, it will be vitally important for the suppliers of the insurance, the donor institutions, and the client states to be prepared for a potential payout. The PEF has made reliable data gathering and surveillance a priority from the start, utilizing the processes already put in place by national health surveillance agencies and partners like the WHO. These entities will detect and quickly confirm cases of the diseases that are covered by the PEF so that the parametric triggers can be activated as soon as possible. The PEF will then rapidly disperse funds to pre-approved health responders on the ground.

Why an effective response matters

Another impact of having the PEF and insurance markets become active in the pandemic response area will be to improve confidence in public health responses. During the 2014–2015 Ebola response, the affected countries were not hurt just by the cost of the outbreak itself, but also by a lack of confidence in their ability to respond. The countries that are covered by the PEF are not just some the most vulnerable to disease outbreaks but also the most vulnerable to losing investor confidence, and as a result, development gains. There was a stark difference between the world's perception of the 2014–2015 Ebola outbreak in West Africa and the 2015 MERS outbreak in South Korea. There was confidence that South Korea would be able to respond effectively to the MERS outbreak and, although it did experience an economic downturn – GDP growth slowed by 0.5% during the three months of the outbreak compared with the three months prior – it was nowhere near as bad as what took place in West Africa.[31] Travel bans, business closures, and loss of tourism in response to news of a disease outbreak can cripple countries' economies long after the disease is contained. The PEF will give the international community the assurance that disease outbreaks will be addressed before they become severe enough to shut down a country's commerce.

Making sure the right infrastructure is in place

It is important to note that the PEF is also being implemented alongside other improved disease outbreak preparedness measures. The World Bank and other international organizations are working to improve public health laboratories, disease surveillance infrastructure, create maps of health facilities, and train health workers in detection and response methods. The efforts will not only make pandemics less likely but they will also improve the effectiveness of the PEF if it is needed. Improved public health infrastructure worldwide will ensure that there are people and facilities on the ground that can receive and utilize a payout successfully.

Evolution of the pandemic insurance market

The PEF is expected to evolve to expand coverage and encourage private sector involvement in pandemic financing. The initial phases of the PEF will reduce the cost for other insurance companies and institutional investors who want to become involved in the market. As a global insurance mechanism, it will pool the outbreak risk from different regions and also build a knowledge base of how factors driving the risk of disease in one region can affect the rest of the world. The PEF will increase global demand for data on diseases and it will encourage further research and understanding into how to respond to pandemics and how factors like climate change affect the occurrence of disease outbreaks. The barriers to entry into the industry of pandemic risk will be greatly reduced by the trailblazing efforts of the PEF and its partners.

As disease surveillance and modeling improves over time, it will enable the insurance market to expand to cover a wider spread of disease outbreak risks. Currently, the PEF will cover most of the diseases that the WHO identified as in need of "urgent action" in December 2015. In the future, the PEF could expand to cover Nipah virus (NiV), which is a member of the family Paramyxoviridae, genus Henipavirus, which is also on the list of diseases needing urgent attention. It could also expand to cover chikungunya, severe fever with thrombocytopenia syndrome and Zika, which were listed as serious diseases "necessitating further action" as well.[32] Once the dynamics of how these diseases spread and how much cash would be needed to address them are understood, reinsurance companies like Swiss Re will be able to include them in their coverage.

The importance of early detection

Since early detection is key to preventing disease outbreaks from becoming pandemics, insurance companies and their partners will seek to identify threats as soon as possible. Detecting early warning signs, like certain weather events or instances of human migration, will allow disease surveillance systems to catch epidemics earlier and allow insurance companies to feel confident covering localized outbreaks. More innovative triggers may also emerge as relationships between pandemic risk, climate change and other threat multipliers become better understood and are able to be incorporated into modeling and surveillance systems. During the 2014–2015 Ebola outbreak in West Africa, for example, software designed by HealthMap, which is based in Boston, detected a "mystery hemorrhagic fever" in Guinea nine days before the WHO announced the epidemic.[33] HealthMap uses data from social media sites, like Twitter, local news websites, government announcements and other sources to find warnings of impending disease outbreaks. Tracking zoonotic diseases before they can jump to humans will also improve early detection. Global surveillance of zoonotic diseases is currently lacking, even in areas that are at high risk of Avian influenza.[34] Using information from new sources could allow for a qualitative assessment by a panel of epidemiologists to decide if a payout is necessary to stop a more limited disease outbreak before it spreads to other regions.

Improved pandemic response

Another vitally important part of the development of pandemic insurance and finance will be to improve the ability of the client countries to deploy the funds that they receive. One way that this could happen would be to create an international pandemic response force that would be comprised of medical doctors and public health officials that would be obligated to respond in the event of a crisis. If an outbreak is particularly virulent, it may be difficult to find volunteers from other regions to respond. An obligatory international response force, backed by funds from the PEF and the WHO, will drastically improve the response and the usefulness of the funds. The PEF will also help to incentivize the supply of better pandemic response tools. Since international organizations and countries can be assured that pandemic response will be financed, they will be able to confidently invest in rapid

vaccine development laboratories, stores of equipment, and training for community responders, knowing that the money to deploy those elements will arrive quickly and how much there will be. Improved and specialized storage methods for vaccines will also allow them to be stored longer and in more regions. The PEF will make the demand side of the pandemic response problem more predictable, which means that suppliers of health products can increase investment confidently.

As the initial client states see the effectiveness of financing mechanisms like the PEF, the current donor model may change. On the coverage side, additional countries may decide to purchase insurance and the originally covered countries may decide to expand coverage and begin paying the premiums. Middle income countries that are at risk of outbreaks but do not have the robust public health infrastructure that G7 countries have, may decide to buy into a global insurance mechanism like the PEF. The World Bank will syndicate the PEF placement allowing premiums to be sustainable. Regional organizations like the Economic Community of West African States (ECOWAS) may also decide to insure their pandemic risk.

Expanding the Pandemic Emergency Facility

On the donor side, the G7 has already committed to funding the first phase of the PEF but the G20 could expand on this commitment. G20 countries like Brazil, China, India, and South Korea, which have experienced recent outbreaks of diseases covered by the PEF or of pathogens on the WHO's list of diseases necessitating further attention, have a clear stake in expanding the PEF and the insurance market for those diseases. There will also be more political will to expand the PEF as policy silos are broken down. Policy-makers are just beginning to get actionable information on how climate change, pandemic outbreaks, economic development and national security impact each other. The development and convergence of insurance markets that quantify risk in all of those areas – and provide a mechanism to address that risk – will make it politically and fiscally easier for policy-makers to act.

If a mature pandemic insurance market evolves as described above, the world will start to see additional public health improvements as countries become incentivized to improve their health systems. The prospect of buying into data sharing networks and insurance pools will encourage countries to take measures to improve their health infrastructure and reduce their premium costs. There will also be an incentive to improve disease surveillance in order to guarantee every case of a disease is caught in case the requirements for the triggers have been met.

Looking ahead: Reducing the cost of insuring pandemics

In the long term, the cost of insuring against pandemic risk is expected to decrease. As the pool of covered countries expands, the premium costs will go down for all members. This has already proven true with other, sustainable types of sovereign risk mechanisms like the Caribbean Catastrophe Risk Insurance Facility (CCRIF) and the African Risk Capacity (ARC).[35] [36] The CCRIF has even been able to offer discounts following years without payouts. The cost of insuring pandemic will also decrease as the world's understanding of pandemic risk improves. Catastrophe bond markets, institutional investors, and other private financiers will make funds more readily available once the PEF has proven itself as a successful public-private partnership. Historically, costs come down as investors and risk takers understand pandemic risk better. The involvement of the insurance market to pre-finance pandemic risk allows for a more efficient, faster response, thus stopping the outbreak sooner and leading to lower financial and human costs.

Recommendations

Actively encourage data gathering and cooperation between the climate and health sectors. The PEF can become a tool to catalyze the creation of targeted incentives for sustainable long-term market growth. For example, PEF or International Health Regulations (IHR) compliance requirements will incentivize data gathering and improved surveillance. Policy-makers should create additional policy incentives or a policy framework for including climate data in early warning systems. These incentives should be combined with best practices in health-climate data synthesis (employed at the Centers for Disease Control and Prevention (CDC) or elsewhere) to promote efficiency and sustainability.

Establish an economic link betweeen climate and health costs. Advocate for the health impacts of climate change to be assessed and included in an external carbon price. As improvements in modeling allow for better predictions as to regional and sub-regional impacts of climate change on weather patterns, this data should be incorporated into assessments of pandemic risk.

Mobilize funding for ancillary outbreak response services. In cases where internal capacity is not sufficient to respond to a pandemic outbreak, the PEF should engage the services of a pre-identified international task force of response experts and epidemiologists in order to standardize a high quality of response. This may build on the services of an existing response corps or require the establishment of a new contingent force to step in when necessary.

Expand the insurance market to cover disease outbreaks at earlier stages. The World Bank and its partners should research and encourage the development of an insurance market that can cover disease outbreaks before they become pandemics. During localized outbreaks, payouts could be triggered by judgment of a panel of experts that determines an outbreak should be addressed early on due to qualitative considerations related to its location, virulence or potential impact.

Adopt a dual engagement strategy to increase likelihood of adoption. Multilateral stakeholders should engage local administrators at the top and bottom of the decision-making pyramid. At the top, finding well-known and respected champions will help with global adoption. Health and security-related NGOs and research institutions should continually be involved in the conversation prior to PEF implementation in order to broaden political buy-in and ownership.

Engage large donors to better facilitate integrated risk management. Donors, and in particular major philanthropic organizations, can drive policy changes by tying funding to priority research initiatives. These funders must be made acutely aware of the linkages between climate and disease in order to better facilitate the development of more holistic approaches to risk management.

Develop an improved indicator to determine eligible recipients of PEF funding. GDP is often an inadequate indication of a developing country's ability to fund emergency response efforts. The World Bank and WHO should create a new or use a modified GDP indicator that more accurately reflects a country's ability to effectively fund response activities in the case of pandemic outbreak. These could include benchmarks against other countries that reflect actual government spending in emergency situations.

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Title
Pandemics in a changing climate –
Evolving risk and the global response

Authors
Rachel Estrada
Andrew Griffith
Colbye Prim
Jeongsu Sinn

The Johns Hopkins University
Paul H. Nitze School of Advanced International
Studies (SAIS)

Faculty Advisor
Celeste Connors

Swiss Re Advisor
Alex Kaplan

Managing Editor
Urs Leimbacher

Graphic design and production
Swiss Re Corporate Real Estate & Logistics/
Media Production, Zürich

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8022 Zurich
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