Scientific strategies from recent outbreaks to help us prepare for *Pathogen X*

ONE HEALTH – scientific lessons for pandemic prevention

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<table>
<thead>
<tr>
<th>Program</th>
<th>Funding source(s)</th>
<th>Year(s)</th>
<th>Funding level</th>
<th>Prevent</th>
<th>Detect</th>
<th>Respond</th>
<th>Recover</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEPI</td>
<td>Wellcome Trust, Gates Foundation, Japan, Germany, and Norway</td>
<td>2017–22</td>
<td>$560 million (as of 2017)</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>Vaccine development; $1 billion target for first 5 years</td>
</tr>
<tr>
<td>Contingency Fund for Emergencies</td>
<td>WHO member contributions (17 countries have contributed to date)</td>
<td>2015–</td>
<td>$69 million received (as of June 2018); $100 million target for 2018–19</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>Separately funded component of the WHO Health Emergencies Program; rapid response to health emergencies: up to $300,000 mobilized within 24 hours; $21 million utilized in 2017 in 23 countries</td>
</tr>
<tr>
<td>Gavi</td>
<td>Governments, Gates Foundation, private sector</td>
<td>2016–20</td>
<td>$9.2 billion in donor contributions and pledges</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>Immunization delivery (includes health system strengthening aspects)</td>
</tr>
<tr>
<td>GHSA</td>
<td>G7 nations</td>
<td>2014–22</td>
<td>&gt;$1.44 billion</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>GHSA itself does not allocate/ appropriate funds; support is allocated by countries under the principles of GHSA to advance prevent, detect, and respond capacities</td>
</tr>
<tr>
<td>Pandemic Emergency Financing Facility (PEF)</td>
<td>World Bank</td>
<td>2017–22</td>
<td>$320 million (Class A pathogens: $225 million, Class B: $95 million); separate cash window</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>Surge financing (insurance window + cash window) in response to activation criteria (outbreak size, spread, and growth); premiums and bonds financed by donor governments</td>
</tr>
<tr>
<td>Pandemic Preparedness Plans</td>
<td>World Bank IDA18 Replenishment</td>
<td>2017–20</td>
<td>Dependents on client country requests</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>Support to 25 IDA countries to develop frameworks for governance and institutional arrangements for multi-sectoral health emergency preparedness, response, and recovery</td>
</tr>
<tr>
<td>WHO Health Emergencies Program</td>
<td>WHO member states</td>
<td>2016–</td>
<td>$485 million requested for 2016-17 (73% funded)</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>Core budget for essential functions, plus an appeals budget that covers additional work in response to acute and protracted health emergencies</td>
</tr>
</tbody>
</table>

* To the extent that Gavi covers Prevent it is for the specific prevention of yellow fever spillover through vaccination in high-risk areas; does not address drivers.
Health risks, including pandemic potential

human - animal - plant - environment interface

- Insufficient attention to financing risk reduction and pandemic prevention
- Ignored lessons learned from previous pandemics and multisectoral health risks
- Resulted in an ongoing cycle of panic and neglect
- Disregarding strong investment case: cost of prevention and preparedness lower than response

Courtesy of F. Berthe, C. Wannous, E. Tagliaro
Risk factors & reforms for wildlife supply chain and wet markets

Factors that result in an increased risk of zoonotic disease spill over based on known cases and biosecurity and hygiene first principles:

- Deforestation and habitat destruction brings wildlife into closer contact with human locations.
- Close handling of stressed and possibly injured wild animals during capture from their habitat.
- Close contact with large numbers of stressed animals and contaminated living spaces in breeding farms.
- Close confinement and contact with multiple stressed species during transportation process.
- Wildlife in stressed conditions tend to shed higher numbers of pathogens.
- Unsanitary contact between various species—stacked cages and effluent.
- On site butchering can spread high numbers of pathogens to other species and humans.
- Multiple species of animals closely contained.
- Direct contact between many people and animals with poor hygiene facilities.
- Presence of bats & rodents which are known primary hosts for many zoonotic diseases.
- The inclusion of species capable of being intermediate hosts for zoonotic diseases.

Potential steps to mitigate the risk of zoonotic disease spill over based on risk factors:

- Reduce habitat destruction.
- Greater regulation of breeding farms.
- Greater regulation of wildlife transport.
- Risk education programs.
- Improve wild animal collection hygiene.
- Greater regulation of wildlife trade laws.
- Enforce wildlife border controls.
- Enforce regulations to limit contact between different animal species.
- Regulate hygiene facilities and educate on risks.
- Ban or strictly regulate bat & rodent sales in wet markets.
- Develop a list of and ban high risk species from wet markets.

Courtesy of Australian Government
Large body of research on presence of pathogens and potential pathogens
A RAPID REVIEW OF EVIDENCE ON MANAGING THE RISK OF DISEASE EMERGENCE IN THE WILDLIFE TRADE
C. Stephen, et al. 2021

- **Large body** of research on presence of pathogens and potential pathogens

- **Little research** on measuring effectiveness of interventions to predictably reduce the risk of an emerging disease arising in the wildlife trade and threatening public health, conservation, or agriculture.
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• Large body of research on presence of pathogens and potential pathogens

• Little research on measuring effectiveness of interventions to predictably reduce the risk of an emerging disease arising in the wildlife trade and threatening public health, conservation, or agriculture.

• Standard tools used to control domestic animal disease and food safety risks are reasonable to implement but their effectiveness, acceptability, feasibility, sustainability, and unintended consequences cannot be forecasted and have not been adequately tested.
Section 2. Ways to Live Safely with Bats: The Basics

One easy way to stay safe is to avoid eating food or drinking water that has come into contact with bat urine or feces. For example, you can cover your food and water. When you do, it is important to regularly clean these covers with soap and running water.

Basic Principles

Avoiding contact with wildlife is the best way to keep animals and people safe and healthy.

- It is crucial to keep a distance from the areas where wildlife live and to avoid disturbing them.

- If you have contact with animals, their bodily fluids, or food they have touched, always wash your hands with clean, running water and soap for at least 20 seconds.
Host Range – at risk and potential new hosts

- Yellow Fever
- Plague
- Rabies
Host Range – at risk and potential new hosts

“Spillback” is the new spillover

- Yellow Fever
- Plague
- Rabies
- SARS-CoV-2
Host Range – at risk and potential new hosts

“Spillback” is the new spillover

- Yellow Fever
- Plague
- Rabies
- SARS-CoV-2
- Monkeypox
- Disease X
Multi-sectoral Research Priorities

• Understanding viral circulation in animal populations
• Investigation of animal sources and routes of transmission to humans
• Socio-economic and behavioural risk factors for spill-over
• Evaluating risk reduction strategies at the human-animal-environment interface
• Addressing “Spillback” earlier in course of events
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