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Financing a Global Viral Surveillance Network: a Benefit-Cost Analysis

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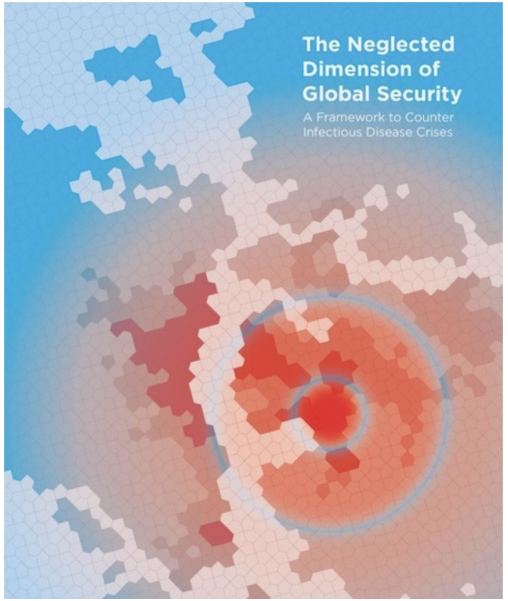
The investment case for surveillance

Panic, neglect (and financing)

- Covid-19 is the third pandemic of the 21st century, and follows several major regional epidemics (e.g. ebolavirus, MERS CoV)
- Despite numerous warnings, basic aspects of preparedness, including surveillance, are persistently underfinanced.
- Why is under-financing so problematic?
    - Start-up and upkeep costs
    - Perceived tradeoffs between preparedness and other health priorities (e.g. high burden diseases)
    - Irregular occurrence of pandemics
    - As a result:
        - The cost of inaction is (somewhat) unclear
        - The benefits of improvements are difficult to estimate

"Infectious diseases remain one of the biggest risks facing humankind… yet the global community spends relatively little to protect populations from the risks of pandemics."



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Applying a benefit-cost framework

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Applying a benefit-cost framework

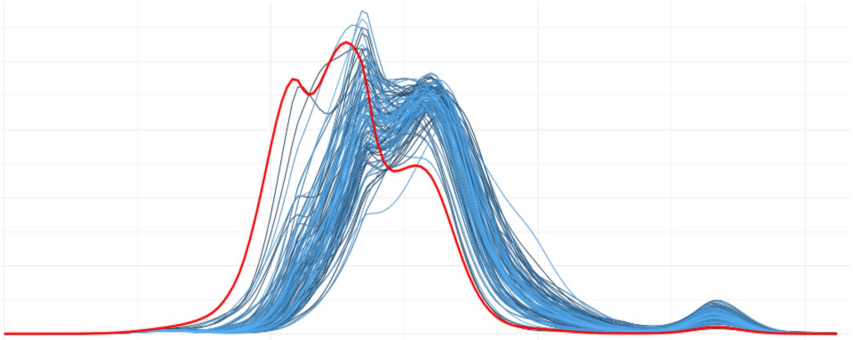
We aimed to fill two knowledge gaps:

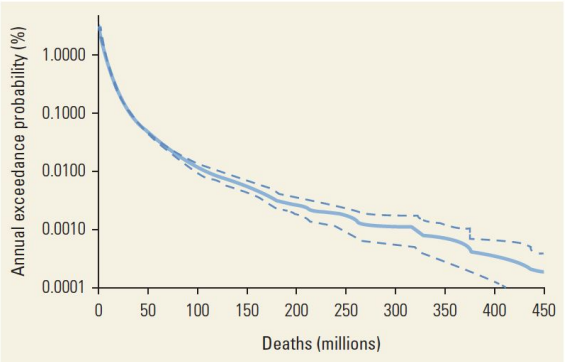
- What are the likely future losses from pandemics?
  - What are the health impacts (e.g. infections, deaths)?
  - What are the economic impacts?
- What impact could a global viral surveillance system have on future pandemic risk?

Applying a benefit-cost framework

Analytical approach:

- Applied global stochastic infectious disease modeling to generate exceedance probability functions (EPFs) for viral threats where a surveillance system would yield significant marginal gains (filovirus, coronavirus, nipah, etc.)
  - EPFs allow for estimation of epidemic frequency and severity, as well as future expected losses, e.g.:
    - *What is the likelihood of a flu pandemic as severe as in 1918?*
    - *What is the expected annualized mortality from filovirus epidemics?*
- We generated a baseline estimate of future epidemic and pandemic risk for key viral classes
- Then produced alternative EPFs incorporating a global viral surveillance system, to model a range of potential impacts in terms of human and economic losses averted





Source: Madhav, N., Oppenheim, B., Gallivan, M., Mulembakani, P., Rubin, E., & Wolfe, N. (2017). Pandemics: risks, impacts, and mitigation. In Disease Control Priorities: Improving Health and Reducing Poverty. 3rd edition. The International Bank for Reconstruction and Development/The World Bank.

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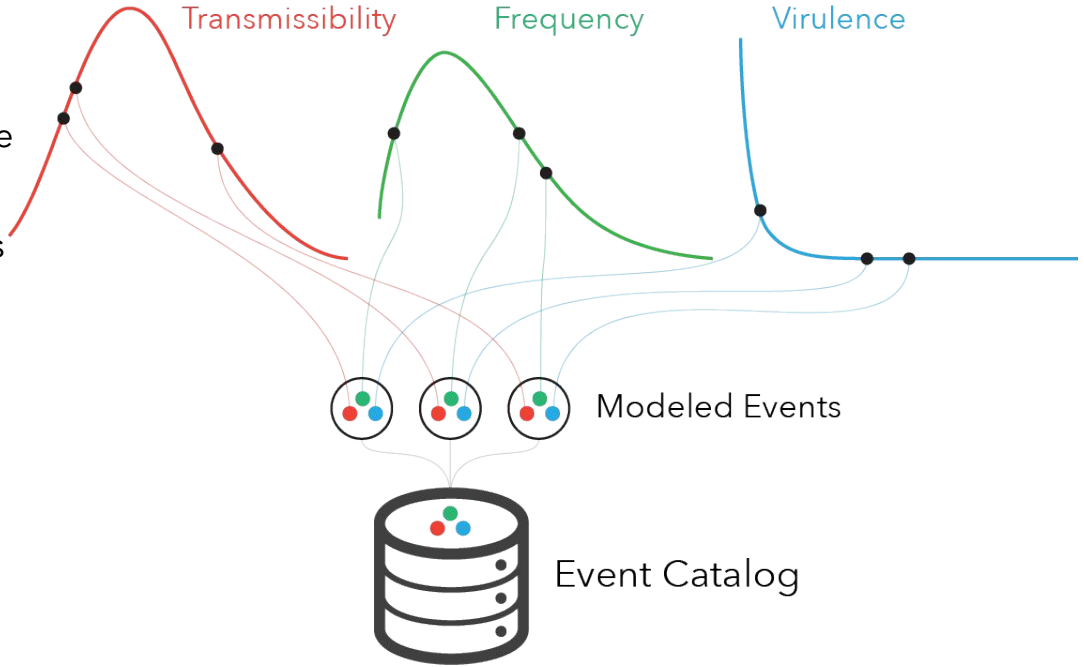
Epidemic simulations

Modeling approach

- Global metapopulation model; simulates disease spillover and spread on a daily timestep
- Incorporates preparedness and policy responses
- Generates a collection of scientifically plausible, hypothetical scenarios ("events")
- Event catalog contains more higher probability parameter combinations and fewer lower probability parameter combinations
- Generates tens to hundreds of thousands of simulated years



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Estimating the impact of a global viral surveillance system

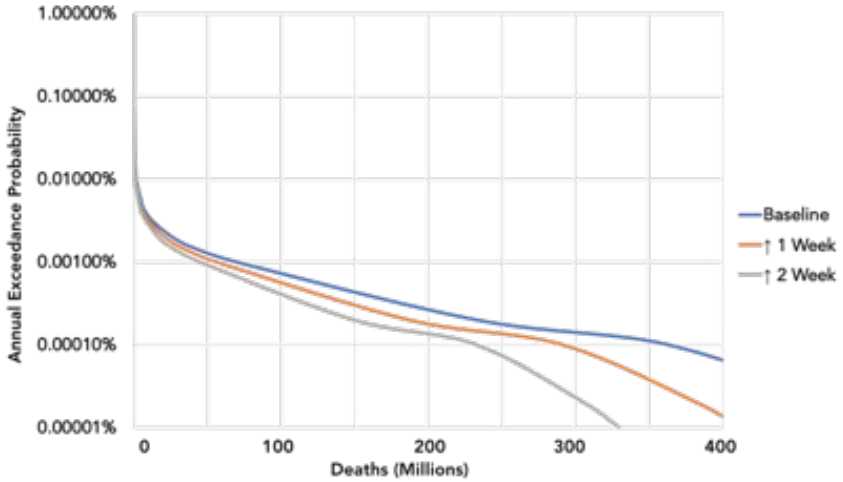
Impact mechanisms:

1. Improvements to outbreak detection and response time enabled by capacity-building
   - e.g. training of epidemiologists, virologists, development of lab infrastructure, etc.
2. Reductions in spillover frequency
   - E.g. through improved risk/hotspot maps, targeted behavioral risk reduction programs, better regulation

Quantifying potential benefits:

- Compare baseline and impacted EPFs to estimate:
  - Deaths averted
  - Economic losses averted:
    - Intrinsic value of lives saved (modeled as the value of a statistical life, or VSL)
    - Losses to national income averted

Example of a shocked exceedance probability curve



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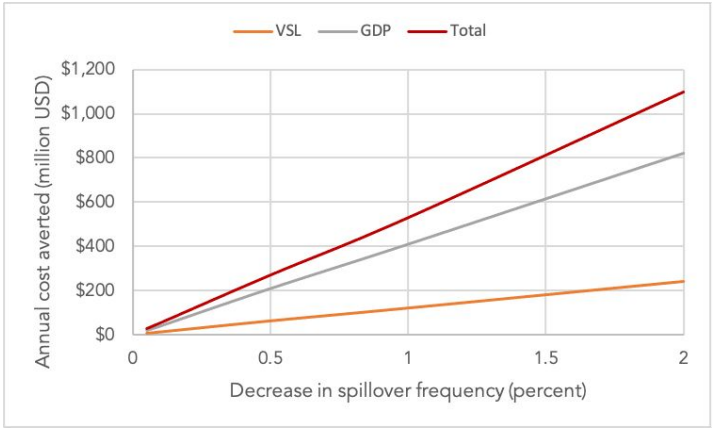
Benefits of improved viral surveillance

A global viral surveillance system could yield large reductions in future risk

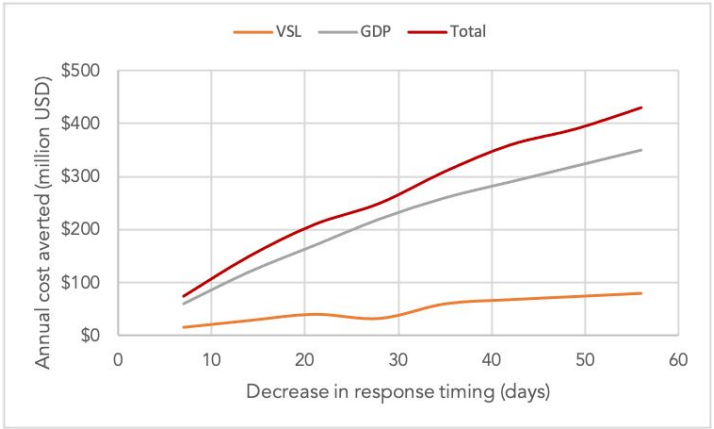
- Reducing the rate of viral spillover has a particularly strong effect:
  - 1% reduction → ~500 million USD in annualized losses averted. Effect scales linearly
  - Suggests key role for identifying hotspots and implementing targeted prevention efforts
- Improving early detection, identification and reporting has significant, though smaller, effects:
  - Reducing detection time by 2 weeks → 150 million USD in annualized losses averted

Even modest improvements in risk reduction and early warning could yield a positive return on investment

Impacts from spillover risk reduction



Impacts from improved detection/response



Conclusions

Without action, future losses from future epidemics will be significant

- Expected annualized damages from a subset of high risk viral pathogens alone exceeds ~50B
  - This does not include potentially large losses from other known threats (e.g. pandemic influenza) or unknown unknowns (e.g. viral zoonoses which have yet to spill over)

Relatively small improvements can yield large impacts

- Investments in basic science and surveillance can help avert large losses, especially to national income
  - Costs are small relative to potential health and economic benefits
  - There is a business case for making these investments, in addition to clear public health and ethical imperatives

Implications for program design

- There are particularly significant benefits to prevention and risk reduction activities
  - Spillover risk is concentrated in hotspots, which should be identified, targeted, and characterized
- However, a surveillance system should be global in scope
  - A significant stream of benefits comes from improving detection and response, which requires national capacity building on a global scale. No countries should be left behind