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COMMENTARY

One Health Economics to confront disease threats

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Global economic impacts of epidemics suggest high return on investment in prevention and One Health capacity. However, such investments remain limited, contributing to persistent endemic diseases and vulnerability to emerging ones. An interdisciplinary workshop explored methods for country-level analysis of added value of One Health approaches to disease control. Key recommendations include: 1. systems thinking to identify risks and mitigation options for decision-making under uncertainty; 2. multisectoral economic impact assessment to identify wider relevance and possible resource-sharing, and 3. consistent integration of environmental considerations. Economic analysis offers a congruent measure of value complementing diverse impact metrics among sectors and contexts.

Keywords: Economic, Environment, Epidemic, Multisectoral, One Health, Prevention

Recent outbreaks of emerging infectious disease resulted not only in high health impacts, but also substantial economic costs locally, regionally and globally. Most emerging diseases are zoonotic, and many are driven by agricultural intensification and changes in land use, demographics and behavior.[1,2] Human and animal health communities also continue to grapple with endemic diseases (e.g. rabies, brucellosis), with low- and middle-income countries disproportionally bearing the brunt of global burden of zoonoses (some estimate over 2 billion human cases and 2 million deaths per year).[3] Given the increasing factors facilitating disease emergence and spread, a One Health approach is needed to manage threats at the human-animal-environment interface.[1,4] Despite support for One Health in concept and intergovernmental buy-in, on-the-ground investments remain limited, relying on reactive and segregated resource-intensive disease response.

Thus, One Health approaches for early detection and rapid containment of outbreaks warrant economic examination. Global-based analyses suggest high return on investment in human and animal health systems in low- and middle-income countries to mitigate pandemic and epidemic risks, predicting US$1.8 billion to US$4.5 billion annual expenditure would yield a >US$30 billion to US$60 billion benefit per year in avoided cost.[4,5] Analysis of country-level impacts can provide tangible information for policy making, based on locally relevant and accurate data and aligned with local priorities and options. Since economic analysis of integrated approaches for zoonotic disease prevention, preparedness and response is relatively rare at the country level to date,

demonstrating the added value of this approach would be relevant to ministries of finance to optimize sectoral budgetary decisions. Based on this premise, in February 2017 experts in economics, environment, data science, policy, human and veterinary medicine, and public health participated in a workshop on One Health Economics. The workshop considered multiple aspects of economic assessment methodologies for One Health approaches, producing recommended guiding principles.

Hazard-specific system-mapping to identify risk mitigation and control opportunities

Based on a given hazard, system mapping elucidates potential pathogen transmission pathways at the animal-human-environment interface, associated risk factors and key sectors for involvement and interaction through surveillance, prevention and control interventions. This approach allows the reinforcement of roles and responsibilities of actors in the socio-ecological systems where specific hazards occur, and informs upstream and downstream mitigation and management options.[6] This is true even if comprehensive impact across sectors is unknown, and is consistent with best practice of decision-making under uncertainty. For example, Nipah virus in Malaysia could be viewed solely from the public health sector perspective to inform control measures and therapeutic options for humans, but better appreciating drivers of emergence (such as land use changes affecting bat behavior) requires engagement of agricultural and environmental sectors. This approach was previously applied to understand relationships and actions between actors of animal health surveillance systems, aiming to integrate sectors to better apprehend complexity of systems under evaluation.[7]

Multisectoral economic impact assessment to identify wider relevance and possible resource-sharing

While financial losses associated with sickness and death are typically highlighted, significant financial impacts to sectors beyond public health are often under-emphasized. Indirect financial losses due to reduction in tourism, trade, livestock production and consumption resulting from contagion fears may substantially exceed direct public health costs.[8,9] Disruption of trade and supply chains and tourism and public event attendance declines accounted for the majority of the estimated US$54 billion in global losses from SARS in 2003.[8] The 1998–1999 outbreak of Nipah virus in Southeast Asia imposed hundreds of millions of dollars in devastating losses for Malaysia's swine industry.[4] The 2014–2016 Ebola crisis in West Africa resulted in a sharp 12% contraction of gross domestic product (GDP) in Guinea, Liberia and Sierra Leone, aggravating impoverishment in already-poor communities.[10] A 3-year Q Fever outbreak in the Netherlands resulted in a mass cull of goats and thousands of human cases with intervention costs estimated at €35 000 per Disability Adjusted Life Year (DALY).[4,11] Some economic impacts are long-lasting, particularly for industries suffering animal export bans, with severe losses along the value chain from bovine spongiform encephalopathy (BSE) outbreaks in the UK, or permanent, for instance in the hospitality industry.[4] The World Bank estimated the potential costs of a severe influenza pandemic at 4.8% of global GDP, primarily due to individuals' efforts to avoid infection.[4,12] Thus, economic examination of One Health approaches for early detection and rapid containment of outbreaks should be inclusive of multiple sectors (parallel methodologies are used to approximate health costs from other environmental externalities; e.g. climate change). Similarly, narrow sectoral approaches inconsiderate of other sectors (and lacking understanding of socio-economic and cultural contexts) may result in unanticipated and unwanted consequences. For example, culling of birds in response to avian influenza in Egypt was hypothesized to result in increased stunting in children; while investments in modernizing agriculture, partly motivated by improving food safety, can displace the women who dominate many traditional food systems.[13,14] Systems approaches offer ways to model feedback loops and downstream effects, increasing understanding of intervention costs and benefits.

Economic impacts of disease include opportunity costs of resources and effort that would have been spent elsewhere, sometimes for greater developmental impact. Financial consequence assessment of zoonotic disease scenarios inclusive of relevant sectors allows for wider appreciation of impacts and vested interests of other sectors in mitigation. Subsequently, evaluation of the benefits of prevention (i.e. costs avoided) can then be examined to identify a broader pool of investors for risk-avoidance, a wider range of intervention opportunities, and guide optimal resource allocation (e.g. brucellosis vaccination strategies for cattle in Mongolia were shown to be highly cost-effective when gains for the whole of society are analyzed).[15] Such findings may be particularly significant for finance ministers and development agencies with the latitude to finance budgets across sectors. Additionally, as there are already diverse impact metrics within each sector, economic impact offers a congruence measure of value. Finally, cross-sectoral economic impact evaluation may help surface inefficient resource use, opportunities for capacity sharing or future investments that promote collaboration and mutual benefit; the quality of investment choices will benefit from technical, socio-economic and cultural performance indicators of One Health program implementation.

Consistent integration of environmental considerations

The environmental component is often underrepresented in economic analyses, limiting the potential of a One Health approach. While acknowledging challenges in completely capturing environmental factors, the value of ecosystem services warrants consistent consideration. This includes valuing ecosystem regulation of disease risk, the impact of mitigation measures on ecosystem services, and the role of pathogens in regulating other ecosystem processes and services. Examples include malaria-regulating services lost to deforestation, and pest-regulation services affected by culling wild species in response to a disease concern and subsequent altered food chain dynamics. Systematic integration will help identify priority information gaps for analysis (e.g. via the Intergovernmental science-policy Platform on Biodiversity and

Ecosystem Services) and account for disease hazards from current and future environmental change (e.g. change in land use or climate). Frameworks from related disciplines, such as pollution impact assessment and ecosystem-based management in fisheries, may provide guidance. Where economic data are unavailable, qualitative impact direction and magnitude information provide a meaningful starting point.

Methods to integrate these guiding principles into practice will be tested and refined in countries where the USAID Emerging Pandemic Threats PREDICT project is operating, recommendations will be integrated into the World Bank's forthcoming operational framework on One Health, and translated to tools and guidance for the WHO for integration in National Action Plans for Health Security. A detailed workshop report will be publicly available. This work supports integrated impact assessments that anticipate that efforts to reduce risks at the human-animal-environment interface have costs and benefits, helping to improve national decisions and optimize development investments toward the United Nations Sustainable Development Goals. Such information, plus partnerships formed in the process of obtaining it, enables governments, private sector actors and communities to address drivers of disease and build risk reduction into planning processes, thereby supporting implementation of the Sendai Framework for Disaster Risk Reduction as well as country action planning for health security. An integrated economic evaluation approach promotes resilience by expanding partnerships to reduce far-reaching financial impact of disease and can harness added investment in prevention and intervention strategies. Overlooking such considerations is a missed opportunity for global and local public health systems.

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