

Managing the Risks From New and Emerging Infectious Disease: the “One Health” Paradigm**

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Summary

The global risk from new and emerging infectious diseases continues to grow with recognition that, for the most part, the pathogens involved emerge from animals to infect humans. Recognizing the complexity of these interactions and the need for a strong interdisciplinary approach to effectively manage these risks, new partnerships are being forged under the general umbrella of “One Health.” Involving human health, animal health, and environmental health exponents, solutions are sought for how to prevent as well as respond to the threats. But is this approach working? Whilst a number of key meetings continue to be held under the One Health umbrella, are we really seeing measurable progress in risk prevention and mitigation? Focusing research on the drivers for emergence, on modeling the risks, on improved diagnostics, and on targeted vaccines could considerably enhance our ability to prevent and respond. Ensuring the uptake and applications of new diagnostics and vaccines will be the key to prevention and response, but achieving this will require policies that drive further the One Health collaborations. Such policies should ensure that scant available resources are targeted toward the identified outcomes through research delivery and uptake, and that we genuinely work as “one world” in tackling the very real risks we face.

Current realities

New and emerging infectious diseases are now seen as a major global threat. Much of this realization has arisen as a result of the perceived threat of a global influenza pandemic, but other events such as the outbreaks of severe acute respiratory syndrome (SARS), Nipah virus infections in Southeast Asia, and foot and mouth disease in Korea have focused attention on the impacts of these diseases on humans, livestock production, the environment, and on food security in general. Studies have clearly shown that more than 70% of new infectious diseases in humans arise from animals, and several papers at the recent 1st International One Health Congress, held in February 2011 in Australia, highlighted the emergence of disease from wildlife through farmed species to humans. To better manage these risks, and in recognition of the multidisciplinary needs to tackle them, a One Health approach has been advocated for some time. This approach is cognizant that to effectively manage all the issues, those working in human health, animal health, and environmental health need to collaborate and coordinate in ways that they have not done before. Importantly, the transboundary nature of many of these infectious diseases clearly indicates a need to tackle the situation at the international as well as national levels. Acknowledgment of this need has resulted in, for example, new partnerships among the World Health Organization (WHO), the Food and Agriculture Organization (FAO), and the World Organisation for Animal Health (OIE). The risks of a global influenza pandemic, through the emergence of the highly pathogenic H5N1 strain of influenza from poultry to humans, catalyzed these approaches. Many meetings have been held in recent years to further develop One Health partnerships, enhance collaborations, mobilize resources, and identify deliverables. Recent meetings on One Health have gone to great lengths to document these achievements and to focus on “doables” and deliverable outcomes.

The recent 1st International One Health Congress, however, clearly indicated that much needs to be done. Patchy engagement by the international organizations (e.g., FAO, WHO, and OIE), the “silo” mentality of many governmental departments and ministries, and the protectionism of

resources and mandates by national agencies hamper the impact of proposed policy changes. The paucity of research outcomes in key areas, such as drivers for emergence and effective vaccines, and a number of examples of research duplication, suggest ineffective use and a lack of research resources. With the scant resources currently available at both national and international levels, practical, on-the-ground preventive actions to mitigate these threats seem few and far between. There is a considerable amount of highly constructive talk taking place at all levels. Yet, where are the targeted activities that are needed to bridge the gap between the current dialogue and future solutions? The gains so eagerly sought from a One Health approach remain an enigma.

Scientific opportunities and challenges

To develop effective prevention and mitigation strategies, some basic science is required. It is necessary to understand the pathogenesis of the disease, host-pathogen interactions, drivers for pathogen emergence, and processes underpinning host switching (i.e., pathogens switching from one host to another). For effective disease surveillance, modeling the likelihood of outbreaks using information both on the drivers for emergence and the basic pathogenesis of the disease becomes critical. Linked to this is the use of effective diagnostic procedures that provide both sensitivity and specificity to the surveillance system. Finally, whilst a number of approaches can be utilized for prevention and mitigation, (e.g., prophylactic treatment, slaughter of infected animals, and draconian trade restriction), effective vaccines remain the most potent weapons for prevention, mitigation, and even eradication of disease (e.g., the recent eradication of rinderpest through mass vaccination).

Fortunately, current research is poised to deliver significant insight into a number of these areas. Whole genome sequencing, whether at the cellular, host, or pathogen level, is providing exquisite insight into the host-pathogen relationship and underlying mechanisms of host and pathogen adaptation. High throughput systems for rapid and large-scale sequencing and data management processes are allowing rapid discovery to take place. Due to the use of complex science modeling systems, drivers of emergence and the emergent process, particularly around host switching, are becoming clearer. This in itself will lead to alternative preventive approaches and to targeted preventive actions. Equally, new systems of field-based assays (e.g., penside/bedside tests) linked to multiplexed assays can considerably enhance the predictive capabilities of surveillance systems and approaches. Finally, new approaches to vaccine construction, and new processes for fast tracking vaccine-use approval (e.g., those agreed to for influenza vaccine production in Australia) suggest the potential for greater use of vaccines in both prevention and mitigation. That science can deliver in the short term is not the key challenge. But targeting resources to drive this delivery, as well as directing additional resources to ensure vaccine uptake and widespread use, remain the key goals for effective risk reduction from new and emerging diseases in the short to medium term.

The underlying challenges remain — an appreciation of the risks, an understanding that science can deliver solutions to manage these risks, and that resources are required from those who control the purse strings. We are all aware of the current fiscal challenges, but when there is a problem with available solutions it must merit serious prioritization for resource allocation.

Policy issues

- First and foremost, build on what is already being undertaken at both national and international levels. The CDC initiative on “operationalizing One Health;” the establishment of working groups following the U.S. Centers for Disease Control and Prevention (CDC) One Health meeting at Stone Mountain, U.S.; and the identification of

“doable” activities are all under way and will be continued during the proposed November 2011 meeting in Mexico. Building on these initiatives should be a key focus for all involved in One Health.

- Continue to build genuine One Health partnerships at the national level among governmental departments and agencies, with real organizational change, to avert “business as usual.” Also, ensure the incorporation of wildlife surveillance activities into mainstream disease reporting.
- Given the difficulties reported by many countries in gaining real traction at the national level across agricultural, health, and environmental sectors, it could be valuable for countries to consider the development of “One Health Divisions” or equivalents that can act as a national focal point for specific activities in the One Health area.
- Accept the transboundary nature of the risks and establish a global system for disease reporting that transcends the activities already undertaken separately by WHO, FAO, and OIE. Create, within either WHO or FAO, a staffed One Health Division with responsibilities for international disease reporting of new and emerging diseases, for monitoring of national One Health surveillance systems, and for the identification and implementation of key researchable areas.
- International reporting needs to recognize existing reporting systems, such as those under the FAO Emergency Prevention Systems (EMPRES) program, the OIE formal disease reporting processes, and more informal systems such as the Program to Monitor Emerging Diseases (ProMED). In reporting as a single definitive source of information from this WHO or FAO One Health Division, the reports would draw on and recognize these currently fragmented but valuable information sources.
- In taking on the issues of research needs in this area, the “One Health Division” should develop a structured process for: the identification of the research required, the identification of the key deliverables in a time-bound process, the determination of the resources required, and the funding sources. The division should seek proposals for undertaking this research through an international process seeking competitive bids. Once approved, the division would oversee the completion of the research and facilitate the uptake of the findings both through international and national One Health activities.
- The key research areas to be considered under the aforementioned process would be: (i) identifying drivers for emergence and the basis for host switching; (ii) developing disease-targeted penicillin tests and multiplexed assays; (iii) further enhancing modeling tools to underpin targeted and general national and international disease surveillance; and (iv) improving vaccines for new and emerging diseases based on rapid production and utilizing licensed vaccine processes.
- Create an International Society for One Health (ISOH) to foster collaboration between and among researchers and policy makers, through the convening of biannual meetings, a specialized journal, and the establishment of networks to facilitate further collaboration and coordination of research in this area. A meeting to further consider the development of ISOH is planned by the committee of the recently held One Health Congress in Melbourne (2011), to take place in London (June 2011).

References

Abstracts of the 1st International Congress on One Health. Melbourne, Australia. February 14–16, 2011. (2011). *EcoHealth*, 7(Suppl. 1), S1–S170.

Coker, R., Rushton, J., Mounier-Jack, S., Karimuribo, E., Lutumba, P., Kambarage, D., Pfeiffer, D. U., Stärk, K., & Rweyemamu, M. (2011). Towards a conceptual framework to support one-health research for policy on emerging zoonoses. *The Lancet*, 11(4), 326–331.

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The following summary is based on notes recorded by the ISGP staff during the not-for-attribution debate of the policy position paper prepared by Prof. Martyn Jeggo (see above). Prof. Jeggo initiated the debate with a 5-minute statement of his views and then actively engaged the conference participants, including other authors, throughout the remainder of the 90-minute period. This Debate Summary represents the ISGP's best effort to accurately capture the comments offered and questions posed by all participants, as well as those responses made by Prof. Jeggo. Given the not-for-attribution format of the debate, the views comprising this summary do not necessarily represent the views of Prof. Jeggo, as evidenced by his policy position paper. Rather, it is, and should be read as, an overview of the areas of agreement and disagreement that emerged from all those participating in the critical debate.

Debate conclusions

- The “silozation” of activities for responding to infectious diseases threats is a key problem. The One Health approach addresses this challenge by encouraging cooperation among various bodies (e.g., intergovernmental agencies, national governments, academia) concerned with human, domestic animal, and wildlife health. The appropriate degree of leadership that international organizations should assume in the One Health process is a key question yet to be resolved. However, existing international reporting structures need to be harmonized to be more effective.
- Despite much encouraging discourse by international organizations and governments, securing more widespread support is required if the One Health approach is to be made operational. The research arena is an obvious starting point for generating the collaboration needed to support One Health. Successful implementation at the research level should encourage policy-level reform and integration within national government organizational structures.
- There are significant challenges to the full and transparent implementation of One Health principles, including economic and budgetary concerns, intragovernmental power struggles, and trade and tourism implications. Economic and social factors must be taken into consideration when developing prevention plans for emerging and persistent infectious diseases, and therefore must be studied in conjunction with the biological components of disease control. Economists and social scientists need to be included in designing One Health approaches if they are to be practical.

- The One Health approach is a useful framework for responding to *both* emerging and persistent infectious diseases. Yet, emerging diseases (e.g., pandemic influenza) have received disproportionate attention because they are a priority of affluent countries. Less-wealthy countries shoulder the majority of the world's infectious disease burden and are primarily concerned with persistent diseases. Hence, ensuring that persistent infectious diseases are adequately integrated into One Health approaches is a priority.
- Successful adoption of One Health principles may require the introduction of legal frameworks and requirements, along with either voluntary or imposed methods of enforcement to ensure compliance.

Current realities

It was acknowledged that the One Health agenda has been extensively discussed by many countries and organizations, yet questions were raised as to how supportive these groups are in practical terms (e.g., with financial and/or logistical support). It was further recognized that, despite ongoing dialogues, there has been limited international implementation of One Health objectives.

There was extended debate about the role of economics for driving how organizations respond to the appearance of infectious diseases, and it was agreed that economics as a discipline has not been adequately incorporated within the One Health framework. At the microeconomic level, not all drivers involved in disease emergence can be understood in biological terms (e.g., interactions among wildlife, domestic animals, and humans). Economic issues must be considered together with biological interactions, particularly given that increased biological contact among species is driven by the economics of production and the overall domestic and international economic environments. Consensus was reached that economic factors play a large role in determining how governments respond to infectious disease threats.

A pervading theme of the debate was the problem of siloization of human, animal, and environmental health issues. Siloization routinely occurs at international, national, and sub-national levels. This compartmentalization is largely due to the current division of responsibility and competing budgets among intergovernmental organizations, government agencies, jurisdictions, the private sector, and/or academia that address various aspects of the infectious disease response.

Success stories for the integrated One Health approach do exist, such as the collaboration between the Red Cross and animal health agencies to concurrently deliver rinderpest vaccines to cattle and a range of vaccines to young children in southern Sudan.

Scientific opportunities and challenges

Education and training of the next generation of wildlife, domestic animal, and human health professionals that encourages them to work cooperatively and to approach infectious disease issues with a One Health mentality was deemed critical to improving future responses to these issues. However, concern was raised that although courses specifically focused on One Health concepts have recently been developed, it will take many years to train people in this transdisciplinary approach and for them to develop their careers based on cooperation among disciplines. In the meantime, the infectious disease community should continue to explore organizational changes that can be made in the immediate future to enhance transdisciplinary activities.

It was recognized that mentalities that support siloization in national and international organizations will be challenging to overcome. There are multiple vested interests in terms of territorial control and/or budgets that will need to be changed toward a more integrated One Health approach at all levels (e.g., local, regional, national, and international).

Questions were raised as to the appropriate priority to be given to One Health efforts with respect to emerging and persistent infectious diseases. Some suggested that it should move quickly beyond the current concentration on *emerging* infectious diseases to encompass *persistent* infectious diseases as well. It was asserted that the recent focus predominantly on emerging infectious diseases has been too narrow. Many of the emerging disease issues considered under One Health (e.g., pandemic influenza) were dictated by affluent country concerns despite disproportionately impacting less-wealthy countries. Moreover, although less-wealthy nations must contend with emerging diseases, it was argued that persistent diseases frequently pose an equal — if not greater — threat to those less-wealthy areas. It was further suggested that the One Health approach is particularly useful for those less-wealthy countries with a disproportionate risk of both emerging and persistent infectious diseases. Such an integrated approach could offset the effects of limited resources and help to counter imprecise reporting in these countries.

It was widely asserted that gaining a better understanding of the drivers for new infectious disease emergence must begin with an expanded view of biological factors (e.g., host switching), but that this work also must include the economic and social drivers that lead to increased interactions between animals and humans. Establishing a more robust picture of these drivers may potentially provide new opportunities for preventing and mitigating infectious diseases.

The importance of crises (e.g., H5N1 and H1N1 influenza) in changing attitudes toward One Health approaches was extensively discussed. Many felt that organizational and attitudinal changes are catalyzed only by global disease crises. However, it was suggested that being too effective in driving the One Health approach (i.e., by reducing catastrophic disease outbreaks) may perversely prevent the very crisis environment needed to bring about wide-ranging changes. There was general agreement that the current reactionary approach — wherein public policy change and financial support are largely driven by infectious disease crises — is a barrier to long-term solutions.

The role of economics in internationally implementing a One Health approach was discussed. It was noted that trade implications, both positive and negative, would directly affect uptake of the One Health model. For example, it was contended that the detrimental effect of a hypothetical foot-and-mouth disease outbreak in Australia on the Australian cattle export trade would be considered a significant impetus to participate in a One Health approach that could reduce chances of importing the pathogen. Conversely, the fear of negative trade or tourism impacts as a result of reporting disease outbreaks was considered a significant barrier for countries to report accurately or expeditiously.

Policy issues

There were divergent opinions as to whether moving toward a One Health approach requires a legal framework. Some argued that the creation of a One Health structure would necessitate legal instruments to combat entrenched systems with vested interests that are resistant to change. Among those who supported legal action, it was questioned whether the International Health Regulations (IHR) would provide a suitable model. Others, however, disputed proposals for legal intervention and suggested that the self-interest of relevant organizations would be enough to promote a voluntary system. No consensus was reached on the best way forward,

although some improvements were viewed as essential to fostering an effective One Health system.

It was acknowledged that mentalities that support siloization among different professions are highly unproductive. This led to discussions regarding how to integrate diverse disciplines, institutions, and individuals into more cooperative approaches to One Health. Proponents of a legal One Health framework contended that cooperation is unlikely unless required by a higher authority and/or international agreements. Others, however, asserted that siloization should be addressed by building trust and managing competing interests.

It was suggested that, as an incremental step toward wider reform, the research arena is the obvious starting point for adapting international attitudes, programs, and organizations to a One Health approach. It was generally agreed that the existence of established research collaborations among different sectors and countries, and the system of mostly external funding sources for such research (which lessens concerns about permanent budget reductions), makes a One Health research agenda more achievable in the near term than wholesale change to institutions. It was contended that the second stage of reform should occur at the policy level, although no specific action items were identified. Lastly, it was proposed that a third stage of reform should take place at the national government level. National reforms were viewed as the most challenging area for One Health operational change to be implemented due to the common siloization mentality that pervades departmental structures (e.g., wildlife, agriculture, and health departments).

The current priorities of wildlife and agricultural agencies are typically focused on areas outside the realm of human health, such as tourism or farmers' interests. It was accordingly proposed that providing political support, which encourages the consideration of human health outcomes, to officials and bureaucrats in these agencies will be key to advancing these wildlife and agricultural institutions toward a One Health approach for infectious disease prevention, mitigation, and control.

During a related discussion on the influence of policy makers, a question was raised as to whether change required direction from above (i.e., from the head of a government), or whether change could be driven organically from within the relevant organizations. Considerable support was given to focusing the attentions of the higher levels of government on implementing effective One Health systems.

Much discussion was focused on the role of incentives for voluntary adherence versus the imposition of penalties for non-compliance with the One Health structure. The incentives for moving toward the One Health approach are apparent, but the consequences for failure to do so are much more difficult to identify (e.g., preventing a negative outcome remains largely unrecognized). The potential compliance issues involved were debated, and it was questioned whether inspections or binding regulations are required. It was agreed that more detailed discussions are needed before specific methods for enforcement are implemented.

A significant part of the debate surrounded the appropriate role, scope, and mandate of international organizations (e.g., UN agencies). It was suggested that these organizations should exert a greater leadership role in setting agendas and coordinating domestic and international activities. Counter arguments were made by those familiar with these organizations suggesting that they are already overloaded with responsibilities, financial pressures, and workloads. Moreover, widespread (though not unanimous) views were expressed that there is a specific lack of cooperation among international bodies regarding One Health initiatives and, to be successful, any proposals to make significant changes in One Health initiatives must come from the member states. The member states have the ultimate decision-making power in these international bodies.

There was general agreement that the aim of disease-response structures should move away from the current reactionary approach to specific incidents or crises, to a predictive or anticipatory model. This will require improved coordination of international surveillance systems, which include biomodeling and whole genome sequencing, to reveal outbreak indicators and consequently allow early risk mitigation.

There was general agreement that, in addition to animal and human health experts, the One Health process should include economists and social scientists to help understand and manage the responses of both governments and individuals to this new approach.

There was substantial debate about the extent to which international reporting structures (e.g., those maintained by the World Health Organization [WHO], the Food and Agriculture Organization [FAO], and the World Organisation for Animal Health [OIE]), could be harmonized or aligned to promote more efficient and timely responses. It was proposed that a single reporting portal be established. Although agreement was not reached with respect to the creation of a unified reporting portal, there was consensus that greater harmonization among reporting structures is highly desirable. It was also recommended that the positive aspects (e.g., flexibility and agility) of other existing structures, such as ProMED-Mail (a notification service operated by the International Society for Infectious Diseases), be considered when reshaping international organization reporting structures. It was further noted, however, that ProMED (the nonprofit international Program to Monitor Emerging Diseases) is not a perfect model — it is significantly underfunded and some concerns do exist about the reliability of ProMED's reports.