PLENARY
SESSION | 1

ONE HEALTH:

MEETING THE CHALLENGE OF

"A WORLD UNITED AGAINST

INFECTIOUS DISEASES"

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"A World United Against Infectious Diseases"

BACKGROUND

We are now in an era of new, re-emerging and recurring global health threats that argue for a longer-term, more strategic approach to global health preparedness. Underlying the increase in new infectious diseases has been the growing interaction between human and animal populations driven by growth in human population, new trends in animal production practices, changing patterns of wildlife populations, human intrusion on new ecosystems, and trans-border mobility of humans, animals, food and feed products. The speed with which these diseases can surface and spread, as illustrated by the recent H1N1 pandemic virus, presents serious public health, economic, security and development concerns. It also underscores the global interdependence of human and economic security and the need for a more systematic effort to identify and respond to sudden global public health emergencies.

Reducing the threat posed by new emergent infectious diseases requires a "One Health" strategic approach that (1) builds on the understanding that the future well-being of humans, animals and the environment are inextricably linked, (2) promotes cross-sectoral coordination that spans the animal health , public health, educational, environmental and conservations communities, (3) targets promotion of those policies and the strengthening of those skills and capacities critical for both minimizing the risk of new disease emergence and the ability to limit their social, economic and health impact, (4) uses a "risk" based approach to target investments to those places, populations, times and situations where the likelihood of disease emergence is greatest.

MODERATOR

Dennis CARROLL

Director

Pandemic Influenza and other Threats U.S. Agency for International Development USA

OBJECTIVES

Contribute to better understanding of:

- Emerging disease dynamics in the 21st century
- What is "One Health" and its role in addressing emerging disease threats
- Challenges faced in the "institutionalizing" One Health
- The way forward towards meeting these challenges.

TOPICS TO BE DISCUSSED

This session will provide a broad overview of definitions and support for One Health (OH); paradigms and interventions, policy framework and policy constraints; intimate connectivity between sectors and institutions; how to translate an OH vision to address infectious disease threat and human resources for the 21st century.

SPEAKERS

Ending Pandemics in Our Lifetime Requires a One Health Approach
- **Larry Brilliant**, President, Skoll Global Threats Fund, USA

Health, Food and Nutrition Security: Reinforcing Resilience at Interfaces
- **David Nabarro**, Senior Coordinator for Avian and Pandemic Influenza, United Nations/UNSIC, Switzerland

Challenges in implementations of one Health Strategies from a country and regional; African perspective.
- **David M. Serwadda**, Professor, Department of Disease Control & Environmental Health, School of Public Health, Makerere University, Uganda

Larry Brilliant, MD MPH, is the President and CEO of the Skoll Global Threats Fund.He heads a team whose mission is to confront global threats imperiling humanity like: Pandemics, Climate Change, Water, Nuclear Proliferation and the Middle East Conflict.

Prior to joining Skoll, Larry was Vice President of Googleand Executive Director of Google.org.Larry is board certified in preventive medicine and public health and was thefounder of The Seva Foundation, an international NGO whose programs have given back sight to more than 3 million blind people in 20 countries.Larry lived in India for more than a decade while working as a United Nations medical officer where he helped run the successful World Health Organization (WHO) smallpox eradication program in South Asia.

He recently worked for the WHO polio eradication effort as well. He was Associate Professor of epidemiology, global health planning and economic development at the University of Michigan and chairman of the National Biosurveillance Advisory Committee, created by Presidential Directive;a member of the World Economic Forum's agenda council on catastrophic risk; anda "first responder" for CDC's bio-terrorism response effort. He has worked at many levels, from villages to global policy, on smallpox, polio, blindness, disease surveillance and disasters -- and worked as a volunteer physician in Sri Lanka in the refugee camps following the tsunami. He is an international member of the Health Minister of India's rural health program. He was a senior technical advisor to the movie Contagion, and also conceived the Oscar-nominated documentary "The Final Inch" about polio eradication in India.

LARRY BRILLIANT

President

Skoll Global Threats Fund USA

He is also a "techie" and holds an early patent in advanced telephone systems and was a co-founder of the Well, a pioneering digital community and has been CEO of many venture backed and public companies. His recent awards include the "TED Prize", Time Magazine's "100 Most Influential People", "International Public Health Hero" and two honorary doctorates.He is the author of two booksand dozens of articles on infectious diseases, epidemiology and global health policy.

Dr Dennis Carroll currently serves as the Director of the U.S. Agency for International Development's (USAID) Pandemic Influenza and other Emerging Threats Unit. In this position Dr. Carroll is responsible for providing strategic and operational leadership for the Agency's programs addressing new and emerging disease threats, which has included leading the Agency's response to the H5N1 avian influenza and H1N1 pandemic viral threats. He is presently coordinating the roll-out of USAID's new Emerging Pandemic Threats program – a global effort to combat new disease threats before they can become significant threats to human health.

Dr Carroll was initially detailed to USAID from the U.S. Centers for Disease Control and Prevention as a senior public health advisor in 1991. In 1995 he was named the Agency's Senior Infectious Diseases advisor, responsible for overseeing the Agency's programs in malaria, tuberculosis, antimicrobial resistance, disease surveillance, as well as neglected and emerging infectious diseases. In this capacity Dr. Carroll was directly involved in the development and introduction of a range of new technologies for disease prevention and control, including: community-based delivery of treatment of onchocerciasis, rapid diagnostics for malaria, new treatment therapies for drug resistant malaria, intermittent therapy for pregnant women and "long-lasting" insecticide treated bednets for prevention of malaria. He was responsible for the initial design and development of the President's Malaria Initiative. Dr. Carroll officially left CDC and joined USAID in 2005 when he assumed responsibility for leading the USAID response to the spread of avian influenza.

DENNIS CARROLL

Director
Pandemic Influenza
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Dr Carroll has a doctorate in biomedical research with a special focus in tropical infectious diseases from the University of Massachusetts at Amherst. He was a Research Scientist at Cold Spring Harbor Laboratory where he studied the molecular mechanics of viral infection. Dr. Carroll has received awards from both CDC and USAID, including the 2006 USAID Science and Technology Award for his work on malaria and avian influenza, and the 2008 Administrator's Management Innovation Award for his management of the Agency's Avian and Pandemic Influenza program.

David Nabarro trained as medical doctor, worked for six years in South Asia, East Africa and Iraq and taught for six years at the London and Liverpool Schools of Tropical Medicine.

In 1990 he served as Chief Health and Population Adviser in UK Overseas Development Administration (ODA) then in 1997 he became Director for Human Development in the UK Government's Department for International Development (DFID).

In 1999 joined the World Health Organization (WHO) to lead Roll Back Malaria: he moved to Health Action in Crises in 2002.

In September 2005 he joined the UN Secretary-General as Senior Coordinator for Avian and Pandemic Influenza. In January 2009 he also became Coordinator of the UN system's High Level Task Force on Global Food Security; in October 2009 he was nominated as the Secretary General's Special Representative for Food Security and Nutrition and – in December 2011 – he was appointed Coordinator of the Scale Up Nutrition (SUN) Movement.

DAVID NABARRO

Senior Coordinator
Avian and Pandemic
Influenza

United Nations/UNSIC
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Professor Serwadda, infectious disease epidemiologist, is Professor, Disease control and the former Dean of the School of Public Health at Makerere University in Kampala. He received his medical degree, M.B.Ch.B and Masters in internal medicine M.Med from Makerere University and an MPH and honorary doctorate from Johns Hopkins Bloomberg School of Public Health. Dr. Serwadda was among the first researchers to report on the presence of AIDS/HIV in Uganda (Lancet, 1985) and has worked continuously on HIV-related research and prevention since the mid-1980s. He has been a senior investigator on the Rakai Program since its inception in 1988, and is the Ugandan principal investigator on the ongoing NIH-funded "Trial of Male Circumcision for HIV Prevention".

Professor Serwadda is a recipient of numerous awards. This include the Johns Hopkins Bloomberg school of Public Health Alumni Knowledge of the World Award-October 2010, Significant Contribution Award, British Council-2008, Pioneer in Behavior based HIV prevention, Harvard University May 2006. In recognition of his work Professor Serwadda has been inducted as a Johns Hopkins University society of scholars, May 2006, A member of the Institute of Medicine, IOM, Washington, D.C October 2011. Fellow of the Uganda National Academy of Science - 2012

DAVID M. SERWADDA

Professor

Department of Disease Control & Environmental Health, School of Public Health, Makerere University Uganda

CHALLENGES IN IMPLEMENTATIONS
of One Health Strategies from a Country and Regional;
African Perspective.

David SERWADDA
Makerere University School of Public Health

The one Health strategy is intended to control the Public Health threat that arise from zoonotic infections, antimicrobial resistant pathogens or emergence of novel strain. The strategy involves a) early detection, b) Identification and c) management and control of the threat. Regional effort in the control of these epidemics is neccessary to prevent spread both locally and internationally. Political leadership is critical. There are challenges and opportunities experienced in Africa in the course of implementing the one Health strategy.

Early detection: 80% of the African population reside in rural populations. However there is an increasing dynamic movement of individuals between rural and the ever expanding urban population. Zoonotic epidemic, particularly Viral Hemorrhagic fever, VHF, usually start in rural population. Lack of community awareness/ education and in many cases this includes the local Health worker, is a major challenge in early detection of something unusual going on. Improving local road network facilitate infected individuals to rapidly move on to towns and thus spread the disease. However with the ever increasing penetration of mobile phone network there exist the opportunity to rapidly communicate the emergence of unusual illness from community members and health workers to regional hospital or established surveillance networks.

Identification: Highly trained health and laboratory staff are a challenge to find in Africa. Further specialised laboratory that are need to handle highly infectious specimen are very expensive to build and maintain. Identification still remains one of the most significant challenge managing particularly zoonotic disease threats. In the recent Ebola and Marburg epidemics that have occurred in Uganda. Blood samples still had to be sent to CDC, Atlanta for identification. DNA based technologies have completely changes the feasibilities of undertaking surveillance of microorganisms that were deemed too expensive to study in rural populations in Africa. Further they have enabled us to take specimens from household without invasive procedures. Inexpensive, reliable and easy to use technology of identification will significantly improve our abilities to rapidly indentify microorganisms at a more rural or primarily health setting

Management. At the local and country level the biggest constraint is the lack of well trained health personnel. In addition there are few or no proper treatment facilities to take care of infected individuals. Sadly in every Ebola epidemic experience in Uganda this year, health workers have died as a result of contracting the disease often due to a lack of proper protective gear. Further the cost of managing these epidemics is high. Although

Uganda has witnessed a regular occurrence of VHF epidemics in the last three years, there is no systematic budgeting for management these epidemics. Often there is a need for emergency budgeting/ reallocation of funds or donor partners supplement. Significant process has been made in some countries i.e Uganda to set up and maintain a good surveillance system for zoonotic infection however many countries either lack or have a dysfunctional system. Further there is lack of coordination between the veterinary, wild life and the health services

Regional Control. The emergency of rapid movement of diseases makes it imperative to have regional effort to coordinate, support and help manage disease control effort. This would involve having a collaborative effort in training a wide range of health and veterinary staff from monitoring and investigation of epidemic to managing and identification or diseases. Addition establishing regional centres of excellence in diagnostics will further help to leverage both financial and human resources. There are regional political / economic zone that can act as entry points to promote and coordinate one Health activities. For example there is the East Africa Community, EAC, that includes five countries; Uganda, Tanzania, Kenya, Rwanda and Burundi with a Health secretariat in Arusha. The leadership in this region have not yet demonstrated that one health is a priority which is a challenge. However the South African Development Countries, SADC countries, which include 15 states South African countries, are now served by the National Institute for Communicable Disease, NICD. This centre based in South Africa serves as a regional resource for early detection, identification of infectious microorganism in the region. The African Field Epidemiology Network, AFENET, based in Kampala has done an excellent

job of ensuring that several Africa countries a facilitated in training health and veterinary workers in the investigation of epidemics and their control

Opportunity for University Leadership – the role of One Health networks in Africa in transforming the educational experience of future leaders in public health, animal health and the environment. One Health Central and Eastern Africa, OHCEA, is recent efforts by 14 school of Public Health and veterinary science in six countries in East and Central Africa , funded by USAID through the Respond program, to bring together Health and veterinary professionals to increase awareness, state of preparedness, monitor and evaluate disease threats in this region, which is considered a 'hotspot' for emerging and re-emerging diseases

One Health Policy Dialogue – mainstreaming OH in the Africa region requires significant review of current policy frameworks that largely stove-pipe the sectoral roles of key ministries likely to be involved in any OH agenda. Recent efforts by WHO, along with FAO and AU-IBAR to promote cross ministerial dialogue at a forum in Libreville, Gabon on12-14 November 2012 opens up opportunities for higher level policy dialogue on the role of OH in Africa and its implications for cross-sectoral partnerships involving health, environment and agriculture. Key points for consideration the need for inter-sectoral partnerships, between Public health, animal health and the environmental sectors, reinforcing laboratory capacity in the African region and to build capacity for surveillance, preparation and response to outbreaks Emphasis was made on the participation of communities in support of preparedness to zoonotic outbreaks.

HEALTH, FOOD AND NUTRITION SECURITY:

Reinforcing Resilience at Interfaces

DAVID NABARRO

INTERFACE WORKING IN PRACTICE

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Collaborative work on the health of humans, animals and ecosystems reinforces the resilience of societies in the face of disease risk, reduced access to food or the threat of malnutrition. It means focusing on the interfaces between disciplines and systems in ways that give greater priority to people's needs than to professional boundaries or organizational simplicity. Descriptions of this work often use terms like One Health or Food and Nutrition Security. The multi-disciplinary approach is supported by many visionaries from community organizations, Governments, the UN system, development banks and academic institutions. It has been described for nearly 10 years and is proving increasingly popular with policymakers. Implementation – in relation to the prevention and control of zoonotic diseases, the promotion of food safety and enabling people to realize their rights to food and nutrition - has gained momentum in the past four years.

2

The one health approach builds on work done on avian and pandemic influenza preparedness and response, forging strong linkages between non-traditional partners from different sectors— agriculture, animal health, public health, military,

and the humanitarian community— increased "whole-of-society" capacity for pandemic preparedness and response. It called for (a) building trust amongst the diverse community of actors that is needed in a major crisis; (b) bringing stakeholders together to agree on their roles and responsibilities; (c) building constructive relationships through collaborative planning; (d) testing the effectiveness of collaboration through immersion in simulations.

3

The one health approach was proposed by representatives of communities and governments at a range of events within nations, in regions (eg in the Mekong delta) and at the global level. Important milestones include the development of the "Manhattan Principles" for "One World One Health" in 2004, and the succession of International Ministerial Conferences on Avian and Pandemic Influenza between 2005 and 2011.

4

The meeting series and their output declarations and road maps have served as the platform for the start of broader One Health discussions. In 2007, the concept of "One World, One Health " was highlighted as contributing to pandemic preparedness and human health security. In 2008, an Interagency Strategic Framework "Contributing

to One World, One Health – A strategic framework for reducing risks of infectious diseases at the animal–human–ecosystems interface" was developed and officially released. The 2010 Hanoi meeting was a key landmark for One Health, as it represented a more global shift toward, and acceptance of, cross-sectorial policy and coordination to deal with serious threats at the human–animal–ecosystem interface.

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The Hanoi conference was also the venue for the release of both the FAO–OIE–WHO Tripartite Concept Note on " Collaboration – Sharing responsibilities and coordinating global activities to address health risks at the animal–human–ecosystems interfaces" and the Global Progress Report Framework for Sustaining Momentum on Animal and Pandemic Influenza.

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In the following year, an international High Level Technical Meeting on the One Health approach took place in Mexico City. Participants in the meeting identified both "supporting" elements that enable collaborative work on One Health approaches and "operational" elements that reflect the attributes of successful collaborations. Participants also identified impediments to success and considered how they can best be overcome.

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Priority actions for advancing the One Health agenda were proposed: 1) policy and technical messages of relevance to Ministers 2) actions that can usefully be implemented at national and regional levels, 3) clear plans for building cross-sectorial approaches into existing protocols, and 4) systems that are both efficient and effective in delivering vital services.

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Working Groups, One Health Commissions, academic programmes and training activities were established to accelerate the positive international momentum of the One Health vision.

INTERFACE BETWEEN ONE HEALTH AND FOOD SECURITY

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The demand for food, and especially for meat products, grows at nearly 2% per year. Livestock production is increasing rapidly (poultry in all continents, bovines in South and East Asia, and pigs in sub-Saharan Africa).

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Livestock production systems benefit many of the world's poorest people, with at least 1 billion of them (75% of rural people, and 25% of urban people) depending either directly or indirectly on livestock for their nourishment, their income and their livelihoods.

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Sustainable livestock systems play a major role in alleviating food insecurity and poverty. Livestock contribute up to 33% of household income and up to 36% of dietary protein intake. In many developing countries, especially in sub-Saharan Africa, livestock contribute almost 40% of agricultural GDP.   The livestock sector is a critical element of food and nutrition security.

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Concerns about the increasing levels of livestock production are linked to the potential for movement of pathogens between wildlife

and domestic animals, concerns about the lack of biosecurity and antimicrobial resistance as livestock production is intensified, the potential adverse environmental impact of livestock production, consumer demand for livestock products produced in a humane way and continued threats posed by human consumption of unsafe food.

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The potential threat posed by livestock to public health – via agriculture-associated diseases – is played out at the intersection between human health, animal health and agro-ecosystems. It includes neglected zoonoses (like TB, brucellosis), emerging infectious diseases (like SARS and Avian Influenza), and food-borne diseases. They are all best addressed through the One Health (OH) approach.

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The one-health approach is particularly relevant when efforts are made to reduce threats in settings where resources are limited. Applying the approach depends on people being able to access and apply relevant information in ways that enable them to reinforce their resilience in the face of multiple threats. They can only do this effectively when empowered through incentives and a positive regulatory environment. Hence the increasing interest at policy level in options for improved livestock sector governance, together with appropriate investment in veterinary and other services appropriate for securing livelihood and environmental well-being.

REINFORCING RESILIENCE THROUGH COMPREHENSIVE APPROACHES

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Societies affected by recurring crises have established resilient systems for ensuring livelihood and food security. Governments increasingly appreciate the particular challenges associated with supporting people's resilience in the face of recurrent and often unpredictable risks: indeed, it is emerging as an important element of development strategy.

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In practice resilient societies are able to anticipate threats, adjust local and national strategies to mitigate them and act to put both immediate and longer term programs in place to build resilience to repeated shocks. They respond quickly when the lives of individuals are threatened, provide a range of viable livelihood options, and maintain the functioning of essential services, and the capacity of institutions. They enable rapid recovery after periods of insecurity and make medium- and long term investments in more robust systems.

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Governments and development partners are exploring options for flexible and imaginative support to the new narrative. They respond to the growing perception - at community and national level, among governments and civil society - that early responses to crisis are vital to prevent catastrophic decline in assets, agricultural output, food availability and livelihood security. This is essential when peoples' capacity to cope has been weakened by repeated crisis. It is vital in societies challenged by the combination of a potential doubling of their population in less than 30 years and increasing frequency of adverse climatic events. This is especially true

in arid lands, as pressure on range land increases and more marginal land is taken for agricultural production.

ONE HEALTH AS AN INVESTMENT IN RESILIENCE

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The One Health approach is an example of investing in resilience: it combines a focus on the long term security of our planet's natural resources, the security of people's access to nutritious food at all times, human security in the face of threats to their health, and the links between them that define people's resilience in the face of stresses or shocks. Such novel approaches are best pursued as multi-actor movements - by youth groups, business leaders, government leaders, civil society at local regional and global levels.

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The focus on Risk Reduction is an essential element of all these areas of work: It is about reducing underlying risk factors and strengthening response capacity through preparedness.
The emphasis on open and self-perpetuating movements is key when multiple actors from different disciplines are working together on an issue. The Movements achieve direction and impact through an emphasis on common goals, shared skills among key practitioners and on mutual accountability.

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Inter-sectorial thinking leads to a growing consensus that what happens at interfaces -– between people, species, systems, professions and cultures - does matter. This means that work which cuts across boundaries and focuses on interfaces needs more attention despite the continuing pressure for greater emphasis and prioritization on the "core activities" of different groups. Given the constraints on organizations, interface working is often NOT prioritized. Movements are most useful as a means to address interfaces between species, cultures, livelihood groups, ethnicities, and geographical areas, sectors of government, professional groups and nations.

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Such working calls for systems that make the vision come to life and the careful investment of time to make the systems work. The time must be used well – to build trust, to innovate and learn lessons and establish sustainable ways of working. It will require collective commitment to building trust with agreed ways to react at times of difficulty as well as retaining the ability to respond when crisis strikes and people's lives are endangered.

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Adequate resources are needed to make this happen: if the funds needed for close working together are not available, there won't be collaboration. Funding should be efficient and flexible. Cross-sectorial work is not easy to sustain within institutions but individuals committed to such working are increasingly linked in Movements or Networks of practitioners: the One Health Approach and Towards a Safer World are examples of action that has been sustained through individuals working within movements.

ADVANCING THE ONE HEALTH APPROACH

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The One Health approach is an example of a

vibrant movement with soft governance - no new institutions or new laws are needed to make it happen. Instead, it relies on existing institutions and capacities to create new ways of dealing with threats at the interfaces. The direction provided by governments for One Health issues is critical to the success of prevention, management and preparedness strategies for diseases at the animal-human-ecosystem interface.

The heart of this effort is professional training – ensuring that practitioners are skilled in the One Health approach and their skills are tested within their professional examinations.

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Here are ten practical lessons of experience in the One Health approach to risk management and reinforcing resilience:

1. Start with experience of both rural and urban communities: listen, absorb, respond: seek concurrence of communities if new ideas are to be introduced; avoid divisive involvement and coercion; build on local practice and strengthen institutions: be extremely wary of "external takeover".

2. Bring livestock, food security and nutrition into all policies related to poverty and equity, climate change, value chains and risk management.

3. Focus on resilience in face of risks to health and livelihoods at Interfaces between species, cultures, livelihood groups, ethnicities, geographical areas, sectors of government, professional groups and nations as – given the way in which organizations work the interfaces are often NOT prioritized and may be a source of risk.

4. Engage the Whole of Society in work on risk management – analysis, preparedness, threat response, lesson-learning: more likely to cover the interfaces.

5. Nurture practitioner networks that span interfaces: people, through their inter-personal relationships, may be better able to do this than institutions, government sectors or even political leaders: select the extraordinary people who have demonstrated inter-sectoral and whole-of-society working.

6. Back up this work with evidence ensuring that this is converted into normative guidance and standard setting.

7. Stimulate innovative actions through alliances that link people (civil society, youth groups and consumers), businesses (entrepreneurs, farmers and processors), and government (legislators, sectors, institutions, research bodies) in principled and mutually accountable relationships.

8. Establish and maintain frameworks for action as a basis for investment [frameworks that cover livelihood resilience, healthy livestock rearing, long-term food security, and optimal nutrition] ensuring that they have a strong legislative and regulatory basis.

9. Seek innovative financing that reflects the benefits of interface working as an individual, commercial and public good.

10. Encourage countries to be in the lead on work for One Health and Livelihood Resilience; that the international system offers responsive guidance and backing; that the business sector, international NGOs and research community offer consistent support within the context of this national leadership.

ENDING PANDEMICS IN OUR LIFETIME REQUIRES

a One Health Approach

LARRY BRILLIANT

INTRODUCTION

Despite out best efforts, diseases jump from monkeys, pigs, birds and bats to humans. About three dozen such zoonotic diseases have newly infected humans in the past three decades: SARS, HIV/AIDS, ebola, lassa fever, West Nile, highly pathogenic avian influenza H5N1 (bird flu) and the 2009 pandemic H1N1 'swine' flu to name a handful .

In addition, insects still carry malaria, dengue, and leptospirosis. Rodents harbor the next hantavirus or plague. We live amidst pandemic potential. We can't stop this – it's nature at work.

What we can do is find every novel organism that has the potential to become a pandemic early enough to limit its spread. Digital disease detection – automated web scrubbers, infobots, self-reporting systems and social networks – together with the power of mobile phones, computers, tablets and innovative communication networks, can help us find new pandemic threats earlier than ever before.

The stakes are high. Population growth, development and human encroachment into new ecological zones increase the likelihood of viral jumps to humans. Air travel accelerates the rate of potential spread. We must build the missing links

in a worldwide network of tools and practices to make it possible to eliminate pandemics.

SURVEILLANCE IS A CRITICAL TOOL

Eliminating pandemics will require intensive, coordinated action across many groups in and between countries. But one activity ranks above all others: early detection and response. In a word: surveillance. Surveillance includes detecting the threat and verifying its authenticity, identifying the causative infectious agent, and sharing information for effective first response.

While technology and improved communications help us detect disease threats faster, verifying that threat is often challenging. Accuracy is critical. False reports breed skepticism in publics and governments. Often, the capacity to rapidly verify emerging disease threats is insufficient given shortages of trained medical professionals in areas where outbreaks occur. But, in truth, we have not thought enough about how to engage those who can help and give them the tools they need. Innovative community-based models can tap into existing local know-how and networks, which often know of outbreaks before the formal health system. Conversely, local health communities are often unaware of the larger picture in which unusual or high local levels of syndromes of illness might fit.

Beyond the challenge of detecting and verifying disease outbreaks lies the third element of surveillance: a response that works. Effective prevention and control measures include having the capacity to develop, distribute and administer vaccines and other medical countermeasures. Effective response might also require social distancing, including isolation and quarantine. It certainly demands diplomacy, trans-boundary cooperation, and trust. Surveillance that includes the sharing of real time data to inform public health action is essential.

DIGITAL TOOLS OF SURVEILLANCE

Leveraging technology, the global community has significantly reduced the time it takes to detect an emerging disease outbreak. We owe much to early pioneers in the field of digital disease detection —which, of course, did not have this name 20 years ago. Event-based biosurveillance, as it is also referred to, is a scientific discipline in which diverse sources of data, many Internet-based, are tapped to prospectively provide information about infectious disease events .

Digital disease surveillance was born with the 1994 creation of the Program for Monitoring Emerging Diseases, ProMED-mail, an Internet-based reporting system that disseminates information on outbreaks of infectious diseases and acute exposures to toxins that affect human, animal and plant health. This was followed by the Global Public Health Intelligence Network (GPHIN), an infectious disease web crawler that gathers preliminary reports of public health significance in seven languages in real-time, 24 hours a day, 7 days a week. In 2006, HealthMap (an initiative of Boston Children's Hospital) introduced a visual platform for current global infectious diseases and their effect on human and animal health. And in 2008, engineers at Google expanded the field of digital disease detection to include automated analysis of search terms for detection of influenza in communities. By aggregating all search terms that correlated with the annual influenza season, we built a system that could monitor influenza activity continually . This became Google FluTrends, which surfaces influenza outbreaks some two weeks before official public health data.

Researchers at Children's Hospital in Boston found that, in 1996, it took up to 167 days from the start of an infectious disease outbreak until its discovery by health authorities. By 2009, the comparative number had been reduced to 23 days . Different countries show great variance, but the overall improvement is clear and impressive.

But can we do better? Can we find infectious disease outbreaks soon enough to prevent their global spread?

Today, social media promises to expand digital disease detection. Twitter is a natural candidate, with its open data and built-in geo-location. SMS, blogs and Facebook are other potential sources of data signals for disease outbreaks. Leveraging these tools will require new techniques to allow anonymity and/or privacy of individual data. Public/private partnerships must develop clear rules for capturing and sharing the data needed to manage public health as a common public good.

ENGAGING THE PUBLIC DIRECTLY

New communications tools also allow us to

directly engage the general public in surveillance. Some early projects show promise. Australia's Flutracking system has been working since 2006 to engage volunteers to submit weekly reports on symptoms related to influenza , with over 10,000 people participating each week. In a similar vein, Influenzanet tracks self-reported influenza in twelve countries in Europe .

In 2011, our organization, the Skoll Global Threats Fund, partnered with HealthMap as technical experts and the American Public Health Association as a trusted public health community to build a self-reported surveillance system, Flu Near You, to track symptoms of influenza in the United States. It is easy to participate, requiring only five to ten seconds once each week to complete the email survey. Flu Near You participants report if they have any of ten symptoms related to influenza and if they've had a flu shot. As important, the system allows participants to report they did not have any symptoms of the flu, potentially giving us information about the level of wellness in communities; numerator and denominator data is coming from the same geo-location. The system is new but shows promise.

ONE HEALTH SURVEILLANCE - THE NEXT STEP
Today, technology allows us to cost-effectively apply research to drive innovation on all fronts in the battle against disease. We can monitor everything on our planet, including our atmosphere, on an ongoing basis. One Health surveillance is detecting, verifying and reporting information on the health of humans, animals and the environment in which they live, work and recreate. It means monitoring wild birds, rodents, bats and insects for infectious agents capable of spreading to livestock, humans or food. It means diligent health monitoring in

humans and domesticated animals, and protecting against the introduction of new pathogens by banning illegal wildlife trade and discouraging bush meat hunting in response to the growing global demand for animal meat as protein.

On the environmental front, local tracking of weather patterns can be merged with regional data to better understand the impact of climate and weather on disease emergence and spread. The same is true with water security and its impact on health. Adding factors related to global travel patterns, mass gatherings, migratory patterns of birds and animals, and shipping of goods will help us better predict and prevent the spread of disease.

In the not too distant future, people, animal and environmental health information will be a public good shared in emails, SMS, blogs and almost any online activity will be scraped to find its public health value (with the aforementioned privacy protections in place!).

BUILDING THE INFRASTRUCTURE
So how do we move forward? How do we ensure accuracy of the systems we are building for tomorrow? Are we collecting the right data? What sort of institutions do we need to make all this happen?

We have the technology we need. But we're lacking systems and decision-support mechanisms that ensure the information gets where it needs to be. Despite better bird flu surveillance in recent years, the WHO reports it still takes, on average, two weeks after the onset of symptoms for human cases to be identified

and notification sent to the WHO. Laboratory confirmation of suspect cases can add several days to weeks more to verify the threat. We need a better system, across the globe, with institutions designed from the ground up for this approach.

Ending pandemics will require trust-based regional public health governance models that are innovative, multi-sectoral and leading the charge for faster detection and verification through cooperation and data sharing. Connecting Organizations for Regional Disease Surveillance (CORDS) is a move in this direction through shared practices and trust . In cooperation with WHO, the World Organization for Animal Health (OIE), and the Food and Agricultural Organization (FAO), CORDS is bringing regional networks together for knowledge sharing and training to implement best practices for early detection, verification and reporting on emerging infectious diseases.

CONCLUSION

Can we end pandemics in our lifetime? Yes, we can. The global public health community eradicated smallpox, beat polio back to a handful of niches, and has made dramatic progress against river blindness and Guinea worm. Nature – including the bugs that bring us infectious disease – has an inexorable imperative to evolve to survive. So theoretical pandemic risk will never disappear. But we have reached a point in the evolution of technology and medical advances that we can realistically aspire to prevent actual pandemics. We now need to develop the infrastructure to support early detection and verification, and to ensure that the information needed to combat threats is shared rapidly and accurately.

Stopping smallpox required millions of feet on the street and billions of house calls . Today, clues from, and the tools of, the information cloud mean we can move faster, more efficiently and more cheaply than ever before. Engaging the public in this public health challenge will accelerate the process. It's in our power to sideline infectious disease as a pandemic threat and reduce the overall burden of suffering from infectious diseases across the globe.

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