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Editorial

Highlights from the 6th International Meeting on Emerging Diseases and Surveillance (IMED 2016) Vienna, Austria from Nov 3 to 7, 2016



Zika Virus, MERS-CoV, Avian Influenza, Yellow Fever and Antimicrobial Resistance – Emerging and Re-Emerging Health Threats

Emerging infectious diseases remain at the center of the world's attention. The current threats posed by Zika, Yellow Fever, MERS-CoV, and pandemic influenza, the recent Ebola outbreak that devastated West Africa, and the realization that new infectious diseases may be recognized at any time, in any place, has dramatically increased public awareness of infectious diseases and underscored the need to understand emerging pathogens. As with each prior iteration, IMED 2016 fully embodied the “One Health” model of emerging diseases, recognizing the commonality of human, environmental and animal health by bringing together human and veterinary health clinicians, scientists, and policy makers from more than 100 countries. With more than 90 talks and 400 poster presentations, it's impossible to adequately summarize all of the important insights conveyed at IMED 2016. Here is a sampling of some of the topics that caught our interest.

IMED 2016 Hackathon

The 2016 meeting incorporated a new participatory program, a hackathon or invention marathon, at the intersection of emerging diseases and technology (<http://www.hackathon.isid.org>). Prototype projects that emerged from the Hackathon spanned from predicting malaria cases in Uganda in real time using climate data to developing a tool to allow humanitarian organizations to easily assess the environmental impact of their operations; improved communication tools to prevent outbreaks; a participatory mobile app to help eradicate rabies in Indonesia; integrated disease surveillance platforms and an improved search function for the ProMED archives based on text recognition.

The Century of Epidemics

IMED 2016 speakers from all regions of the world agreed that over the course of the coming century, epidemics are likely to occur more frequently, as will the risk of global pandemics. The world's increasing population, higher demand for protein, climate change, increasing mobility, social vulnerability and political instability were only a few of the factors discussed that contribute to the projected increase. At the same time, rapid advances in science and improvements in technology and data sharing offer new ways to

prevent, detect, predict and respond to those threats. Although we are not able to prepare when, where or which pathogen will emerge next, we will be better prepared to prevent the next pandemic. The general public's interest in emerging infectious diseases was highlighted in a poster presentation by Dr. Daniel Lucey and colleagues, who showed details of a planned exhibit on “Exploring Pandemics: A Smithsonian museum endeavor for the public” at the Smithsonian National Museum of Natural History in Washington, DC. The exhibit is scheduled to open in early 2018 through early 2020, coinciding with the 100-year commemoration of the 1918–1920 Influenza pandemic and will offer the public an opportunity to explore and understand better 10 epidemics caused by zoonotic viruses from around the world.

One World – One Health: Transboundary Emerging Diseases in Humans, Animals and Wildlife

IMED opened with a plenary session dedicated to transboundary emerging diseases in an increasingly interconnected world. Professor Albert Osterhaus talked about HIV, Avian flu, SARS, MERS-CoV, Ebola and Zika as some of the diseases that originated in animals and passed to humans. While many of these have been well studied, there remain significant gaps in understanding the linkages of infection, making it challenging to predict and prepare for the next epidemic. Several speakers presented results on studies that further examined zoonotic disease spread and aimed at identifying pathogens and environments most conducive to spillover to humans. Professor Christine Kreuder Johnson and Professor Rudovick Kazwala discussed results from USAID's Emerging Pandemic Threats PREDICT project, that uses a risk-based strategy to investigate emerging diseases threats. Dr. Kreuder Johnson's team examined common animal hosts and convergent mechanisms involved in past spillovers of zoonotic viruses in order to identify high-risk interfaces for surveillance activities and interventions aimed at prevention. The team found that viruses transmitted to humans had significantly higher host plasticity. In other words, they were reported in a more taxonomically diverse host range. Viruses with higher host plasticity were also more likely to amplify viral spillover by secondary human-to-human transmission and have broader geographic spread. Dr. Kazwala reported on results from the PREDICT project in Tanzania where bats, rodents and non-human primates were subjected to molecular virology diagnostic tests and revealed the presence of 64 viruses including 48 novel viruses.

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During the oral abstract presentation session on One Health – Diseases Across Species Boundaries, Toph Allen from EcoHealth Alliance and colleagues shared results from an updated model assessing the global distribution of zoonotic emerging infectious disease risk. Highest risk of emergence was concentrated in tropical regions where wildlife biodiversity is high, human populations dense and growing, and land use change is occurring rapidly. These regions were thought most likely to produce the next emerging infectious disease event, and therefore most valuable for surveillance in wildlife, livestock or people. Dr. Ireen Shanta and colleagues from the International Centre for Diarrheal Disease Research in Bangladesh reported data from a cross sectional survey of 9,512 households to identify hotspots of human exposure to rodents, bats and monkeys in Bangladesh. They concluded that more than 13.6 million people in Bangladesh are exposed to rodents each month, more than 800,000 to bats and more than 80,000 to monkeys putting them at risk for contacts to pathogens from those species.

To identify early signals for the emergence, spill over and spread of animal pathogens, Dr. Julio Pinto (Food and Agricultural Organization of the UN) then called for a new mindset in the way the international community coordinates and manages disease emergence. The new approach should be multi-disciplinary and should strengthen local capacities in epidemiological analysis, use open analytical tools and GIS platforms, integrate new technologies such as mobile devices and rapid diagnostics and be committed to the open sharing of data.

Flaviviruses - An Expanding Global Threat

Since the last IMED, flaviviruses have emerged as prominent threats in the world. The flavivirus session addressed the ongoing Zika virus epidemic in the Americas and other regions of the world and the Yellow fever virus outbreak in Africa, which threatened to go global. A major concern of the Zika virus epidemic is the association of maternal infection with birth defects, a complication that has not been seen with flavivirus infections in humans in the past but has been seen with congenital infections in animals. Professor James MacLachlan discussed what is known about congenital infections of animals with flaviviruses and highlighted the critical role of the timing of infection. For example, infections with Bluetongue virus (BTV) have clearly shown the critical role of gestational age in determining outcome. Fetuses infected prior to mid-gestation that survive congenital BTV infection are born with cavitating central nervous system defects that range from severe hydranencephaly to cerebral cysts (porencephaly). Bunyaviruses cause gestational age-dependent teratogenesis in fetal ruminants but, in addition to cavitating central nervous system defects, affected fetuses are born with contracted limbs - congenital hydranencephaly/arthrogryposis syndrome. Dr. Vanessa van der Linden, a pediatric neurologist from Recife, in Northeastern Brazil then gave a heartbreaking description of Zika-related neurologic complications. Recife is one of the areas hardest hit by the Zika epidemic and Dr. van der Linden was one of the first to recognize the microcephaly epidemic in this area. She reported patients suffering from the full range of manifestations including craniofacial disproportion, spasticity, seizures, irritability, brainstem dysfunction, limb contractures including arthrogryposis, hearing and ocular abnormalities, and brain anomalies detected by neuroimaging. She emphasized the importance of vigilant health professionals to recognize changes in the neurodevelopment during the first years of life and the necessity of a team approach to provide the best care to affected children and support for their families.

Professor Oyewale Tomori from Nigeria highlighted the Angolan Yellow Fever outbreak, the largest in 30 years, that

spread to neighboring countries, and quite worrisomely via travelers to Asia. Despite the long availability of an effective vaccine, the shift of hotspots from West to Central Africa, failures of vaccination policy and vaccine shortages combined to produce this global threat.

Epidemics Without Borders

Rapid urbanization, mass population movements, climate change, and resistance to pesticides and available treatments increase the risk of epidemics in the future, argued Dr. Mercedes Tatay from Doctors Without Borders. Current strategies to prevent major outbreaks of disease show limited success. Epidemics continue to occur with devastating consequences for less developed countries. She argued that in reality, not all epidemics are viewed equally. The global health security concept at the heart of the International Health Regulations defines protection against a threat as the main trigger for international action. She concluded that emergency response needs to be prioritized not in competition with long-term goals such as public health surveillance and health systems strengthening.

Global Pandemic Preparedness

West Africa's Ebola epidemic was unprecedented with more than 28,000 reported cases, more than 11,000 reported deaths and more than 10,000 survivors. In response to the epidemic, four global commissions were established to critically evaluate the national and global response and to enhance preparedness to prevent, detect, and respond to future infectious disease threats.¹ Professor Daniel Lucey summarized the commissions' recommendations including the importance of strengthening national health systems, consolidating and strengthening World Health Organization (WHO) emergency and outbreak response activities, and enhancing research and development. WHO agreed to one of the most profound transformations in the Organization's history by establishing a new Health Emergencies Programme. The programme is designed to add operational capabilities for outbreaks and humanitarian emergencies to complement its traditional technical and normative roles. Similarly, the recommendations of the Review Committee on the role of the International Health Regulations (IHR) was focused on the implementation aspects of the IHR.

The implementation of a vaccine trial during an epidemic was discussed by Dr. Barbara Mahon, US CDC Lead for the Sierra Leone Trial to Introduce a Vaccine against Ebola (STRIVE), a phase 2/3 trial sponsored by CDC in collaboration with the College of Medicine and Allied Health Sciences, University of Sierra Leone, and the Ministry of Health and Sanitation.² The trial was designed to accelerate introduction and use of the recombinant vesicular stomatitis virus Zaire Ebola vaccine (rVSV-ZEBOV) among at-risk people in Sierra Leone with concurrent evaluation of the efficacy and safety of the vaccine. She talked about the challenges implementing STRIVE in the face of limited infrastructure, high community concern, and changing epidemiology. Preliminary analysis of safety data indicated no vaccine-related deaths or other serious adverse events; Although STRIVE did not produce an estimate of vaccine efficacy because of low case frequency as the epidemic was controlled, data on safety and immunogenicity will support decisions on licensure of rVSV-ZEBOV.

The importance of open data sharing during epidemics and ethical challenges of using big data for early detection and prevention were discussed during a roundtable discussion moderated by Professor Effy Vayenna who was joined by experts from the WHO, the Wellcome Trust and the Centre on Global Health Security (Chatham House, London). The importance of

communicating to the press and public during an outbreak and how to best communicate uncertainty was reviewed by Helen Branswell of the US-based STAT news. She noted the importance of building rapport between public health authorities, scientists and journalists prior to the onset of an outbreak. Dr. Edward Rubin presented advances in diagnosis and how the genomic revolution and acceleration of DNA sequencing throughput allows us to increasingly consider unbiased metagenomic analysis as a tool to detect emerging diseases. The lack of therapeutics for the next viral epidemic were discussed by Professor Paul Tambyah.

In a separate session, the challenges posed by climate change on infectious disease outbreaks and how to best prevent and track diseases in mobile populations were discussed. Dr. Joel Montgomery stated that while researchers are understanding how changes in temperature, precipitation and vegetation phenology impact malaria and certain arbovirus vectors, relatively less attention has been paid to the impact of climate change on neglected tropical diseases (NTD) and the challenges migration may pose to NTD elimination efforts.

Tracking Emerging Diseases

The “Tracking Emerging Diseases” session highlighted innovations in disease surveillance and the increasing role of informal sources to detect unusual health events early. Dr. Mark Smolinski, the Chief Medical Officer and Director of Global Health Threats at the Skoll Global Threats Fund described a transformation of citizen engagement in public health through systems that empower users to directly report on symptoms of disease via email and smartphone technology. These new and innovative systems provide early warning for outbreaks and other health and safety issues, even before users seek health care, and have the potential to transform rapid risk assessment and epidemiological studies. Further exploring the role of informal data sources to detect outbreaks earlier, Professor Anna Thorner discussed how physician searches using UpToDate – an evidence based, online, clinical decision making tool that is continuously updated - can be used to detect outbreaks early on before cases are reported and confirmed.

A Refugee's Journey from Insecurity to Stability

The European migrant crisis has raised questions regarding the re-emergence of infectious diseases and the monitoring and screening of migrants arriving in Europe and elsewhere. In a session presented in collaboration with the European Society for Clinical Microbiology and Infectious Diseases, physicians from Germany and Turkey, both countries with a recent high influx of refugees, talked about their countries' challenges and experiences in providing health care and preventive services to refugees and asylum seekers. They called for uniform screening practices and early access to primary and specialized healthcare and emphasized the need for appropriate vaccination coverage. They were joined by colleagues from Italy and Switzerland discussing the related topics of disease surveillance and tracing antibiotic resistance in mobile populations.

Antimicrobial Resistance in the One Health Context

Antibiotic resistance is a major global public health concern and resistance is growing faster than new drugs are being developed. Antibiotic resistance needs to be understood in the One Health context. The importance of the food chain as a source for emergence and spread of antimicrobial resistance between animals and humans was highlighted in a nation-wide study in Lebanon. Dr. Ghassan Matar described a direct transfer of resistant determinants in bacterial clones from animal food products to humans. But understanding antimicrobial resistance is expanding even further, from human and animal antibiotic use to the human influence on resistance in the environment. Dr. Ursula Theuretzbacher noted that the link between the animal and human sector was well studied and led to policy changes in some parts of the world. Such regulatory initiatives are still missing in the environmental field which is usually not included in the One Health approach to tackle the global resistance problem. The direct release of multidrug resistant bacteria from healthcare settings, antibiotic manufacturing facilities and animal farms into the environment as well as the pollution of the environment with high concentrations of antibiotics create a dangerous resistance reservoir.

Know your enemy

Drs. Peter Daszak and Dennis Carroll closed IMED 2016 with a plenary talk on the proposed “Global Virome Project”, a global initiative to map all of the planet's viral threats over the next 10 years which would represent a dramatic step towards knowing our viral enemy. Researchers so far have identified only the tip of the iceberg of viral threats and even fewer of these viruses had effective vaccines or antiviral agents developed. The speakers presented viral discovery data estimating that there are around 500,000 yet-to-be-discovered viral species capable of posing public health threats circulating in the world. They discussed the resources and effort it will take to realize this vision and the technical advances that will make it possible.

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