



Photo: Diego Curvo

Tackling Infectious Disease Threats

Prevent, Detect, Respond with a One Health Approach

Conclusions from Uppsala Health Summit
10–11 October 2017



About Uppsala Health Summit

We all know that healthcare today is faced with ever greater challenges. We are faced with both economic and ethical dilemmas, and while advances in research and innovations may open new possibilities for better health and improved care, they do not always reach those who need them.

Uppsala Health Summit is an international arena for frank and challenging dialogue, exploring possibilities and dilemmas associated with advancement in medicine. Uppsala Health Summit stimulates dialogue from various perspectives, such as medical, economic and ethical.

We enable change, and provide a platform for establishing long-term relationships and insights that can help you in your work to improve health outcome in your part of the world.

Uppsala Health Summit is arranged in Uppsala, Sweden, by partners with long experience of developing health and healthcare from different perspectives and with a global outlook.

The effort is run as a collaboration between Uppsala University, the Swedish University of Agricultural Sciences, Uppsala County Council, the City of Uppsala, the Swedish Medical Products Agency, The National Food Administration, The National Veterinary Institute, Uppsala Monitoring Centre, the Swedish Research Council for Health, Working Life and Welfare, and the network World Class Uppsala.

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180 selected decision-makers, opinion-builders and experts from 39 countries met at Uppsala Castle, Sweden, in October 2017, to discuss how to tackle the many aspects of infectious disease threats that the world face with a One Health approach.

Tackling Infectious Disease Threats

Prevent, Detect and Respond with a One Health Approach

In our fast-paced, ever more interconnected world, infectious disease is resurfacing as a major threat to global health and security. Multiple, inter-related drivers such as population growth, poverty, destruction of eco-systems, globalization of travel and trade have created a perfect storm: the rate at which emerging disease events occur is ever increasing while our ability to respond is constantly hampered by factors such as growing antimicrobial resistance.

2018 will mark the grim, rarely mentioned centenary of the Spanish flu – the deadliest epidemic in human history. Since then, we have seen multiple serious infectious disease events occur across the world, including SARS, Ebola, and Zika; others, such as malaria and Tuberculosis are of endemic character and put a constant heavy burden on resource-poor settings in particular.

Turning the tide must begin with the realization that, just as the drivers are complex, the response also needs to be comprehensive: about two-thirds of infectious diseases are zoonotic, i.e. they transmit between animals and humans. Actions aimed at reducing the risks long-term, must therefore consider the strong interdependencies between people, animals and the environment. A One Health approach is called for: a response that enables veterinarians, medical doctors, ecologists and social scientists to interact and find solutions together to pre-empt and stop outbreaks.

At Uppsala Health Summit, some 180 representatives of the various disciplines that form a part of the One Health concept, from 39 countries, met to listen, learn and discuss. This report summarizes conclusions from the lively, in-depth discussions in seven workshops, each approaching the subject from different angles relating to our global ability to prevent, detect and respond to endemic and emerging threats:

- Zoonotic Diseases in Livestock – Mitigating Risk Behaviour
- Empowered and Resilient Communities – A Need for New Perspectives
- A Roadmap for Effective Diagnostics to Combat Global Infectious Disease
- New Vaccines and Medicines – Monitor Safety in Emergency Situations
- Innovation and Big Data in Health Surveillance
- Whose Priorities Count? Empowering Scientific Capacities for Locally-Relevant and Sustainable Solutions
- Drivers and Constraints in Modern Typing Tools for Detection of Foodborne Diseases

Each workshop framed the discussion around the key concepts of **Prevent, Detect** and **Respond**. Despite the range of topics and perspectives presented in the workshops and in plenary, some proposals recurred as common guidelines for developing the One Health agenda with these key concepts in mind in different settings.

Several of the workshops emphasized the need to be proactive, rather than reactive, and focus



In his talk in a plenary session on Governance, Dr. Timothy Bouley, Health and Climate Specialist at the World Bank, emphasized that the benefits of implementing One Health systems, to health, environment and productivity, greatly exceed the investment costs, both at the national and global level.

on **prevention** and readiness before disaster strikes. *Tapping into already available data* can help map pathogens and risk behaviour and predict outbreaks. A country or community with funds and tools to respond to their ongoing endemic disease burden is better placed to deal with emerging epidemic threats.

As the defence strategies are built up, it is critical that they rest on a *thorough understanding of the socioeconomic and cultural structure* of the countries and communities at risk, and are sensitive to local needs, history and knowledge: a hard-learned lesson from the Ebola outbreak in West Africa in 2014. As plenary speaker Professor Paul Richards explained: The humanitarian response to the outbreak in Sierra Leone was most effective in those areas where it supported community initiatives already in place and giving local people agency.



What One Health issues are most critical for communities? Where are the decisions made? What role does information from our social systems play in our behavioural decisions? Professor Maria Lapinski (centre) from the Michigan State University shared a social scientist's research perspective on One Health in her talk in plenary.

It is also important to ask ourselves questions about how interventions diffuse throughout the community and which strategies and incentives function best when it comes to promoting behaviours that protect human and animal health. These could be interventions and incentives to decrease contact with wildlife or promote vaccination of livestock. *Social sciences* play an essential role in our understanding of what will work and why.

Infectious diseases pose complex, integrated challenges. Evidence and data are key to understanding the nature of these challenges and the type of intervention needed. Because of the close physical proximity between people and farm animals and communities' co-existence with wildlife – particularly in many poor regions – *transboundary research partnerships* that investigate the disease pathogens that circulate between animals and humans and in the environment are urgently needed.

Lessons learnt from integrated One Health Research in Kenya, carried out by the Institute of Infection and Global Health at the University

of Liverpool and the International Livestock Research Institute in Nairobi, have shown that One Health research can be done in a cost-effective way on a local level. Research of this kind helps to quantify the burden and pave the way for shared budget allocations and integrated surveillance across sites and species.

One of the key recommendations on **detection** from the workshop on mitigating risk behaviours around zoonotic disease transmission emphasized the need to make sure *that there is joint medical/veterinary surveillance* to ensure that all key actors are monitoring for all the risks. Policy engagement and robust institutions, capable of implementing inter-sectoral work plans, require local ownership, prioritization and continuous dialogue between local researchers and public authorities. The participants in the workshop *Whose Priorities Count – Empowering Scientific Capacities for Locally Relevant and Sustainable Solutions* called for a fundamental power shift from international funders and science partners, to allow more scope for local researchers, policy-makers and communities to carry out what is deemed relevant on the local level.



Keynote speaker Dr. Peter Daszak, President of the Eco Health Alliance, explains how an ecological understanding is critical to explaining the systems that drive pandemics. By mapping viruses in wildlife for example, we can begin to protect ourselves against the pathogens that can emerge in the future.

When it comes to **response**, a recurrent point made in the workshops as well as in the plenary sessions was that *outbreaks are best addressed with a multidisciplinary approach*, using collaborative frameworks that have been built up and sustained during “peace-time” and that can be mobilized when a crisis occurs. This would require, for example, establishing an ongoing dialogue between medical doctors, veterinarians and local health workers, community leaders and local politicians to determine priorities, carry out a joint analysis and allocate responsibilities for preventive measures as well as contingency plans for outbreak response. Decision-makers must ask themselves how they best can provide institutional support for such networks, possibly by *creating One Health Coordination Units at the national level* with adequate financial support.

As Jim Gallarda, Senior Project Officer, Diagnostics, from the Bill and Melinda Gates Foundation, explained in his speech at the summit: the future of One Health must of necessity be about platforms and for individual systems to be able to operate with one another. Regardless of whether the platforms are established to fight antimicrobial resistance, pandemic flu or promote vaccines, these consortia will also require new sets of skills among all involved. Along with developing sharp core competencies in their respective field, veterinarians, health workers, ecologists, civil servants and social scientists will also need to “be pro-active, begin with the end in mind, put first things first, think win-win, seek to understand before being understood, synergize and finally, be willing to be part of something larger than themselves”.

Marianne Elvander, National Veterinary Institute, Uppsala Health Summit Program Committee Chair, marianne@elvander.eu

Kerstin Stewart, Uppsala Health Summit Programme Coordinator 2017



Workshop Conclusions and Suggestions

Workshops

- Zoonotic Diseases in Livestock – Mitigating Human Risk Behaviour
- Empowered and Resilient Communities – A Need for New Perspectives
- A Roadmap for Effective Diagnostics to Combat Global Infectious Disease
- New Medicines and Vaccines – Monitor Safety in Emergency Situations?
- Innovation and Big Data in Health Surveillance
- Whose Priorities Count? – Empowering Scientific Capacities for Locally Relevant and Sustainable Solutions
- Drivers and Constraints in the Use of Modern Typing Tools to Trace Foodborne Disease

Zoonotic Diseases in Livestock

Mitigating Human Risk Behaviour

Sofia Boqvist*, Swedish University of Agricultural Sciences, Department of Biomedical Sciences and Veterinary Public Health

Gunilla Ström, Swedish University of Agricultural Sciences, Department of Clinical Sciences

Ulf Magnusson, Swedish University of Agricultural Sciences, Department of Clinical Sciences

* sofia.boqvist@slu.se

Aim

The overall aims of this workshop were to come up with a set of recommendations to mitigate human risk behaviour associated with the emergence and spread of zoonotic diseases in livestock in low and middle income countries.

More specifically, the first aim was to identify both who is involved in preventing, detecting and responding to zoonotic livestock diseases and consequently the associated behaviours that need to change. The second aim was to identify changes needed to reach the desired behaviour and the incentives that will make this happen.

The fifty workshop participants with various professional backgrounds generated the following three general recommendation:

- With respect to **prevention** the key recommendations are: *implement effective biosecurity measures, good communication on all levels, and long term investment*. It was emphasized that a zoonotic infection in a sick human is an indicator of failure. Investing in up-front prevention of disease in animals will keep people healthy.
- With respect to **detection** the key recommendations are: *make sure that there is a good infrastructure in rural areas to overcome geography, distance and poor connectivity; joint medical/veterinary surveillance* so all the key actors look out for all the risks; and *proper economic compensation* to protect livelihoods when animals need to be culled to contain disease.
- With respect to **response** the key recommendations are: *acknowledge the importance of*

strong and effective institutions that carry out their assigned tasks and roles well; *effective communications* and especially media engagement to not only provide proper information but also help to avoid scares; and ensure *that sufficient resources and expertise* to actually tackle the situations are identified.

Background

Around seven out of ten human infectious diseases are zoonoses. Thirteen zoonotic diseases infect over 2 billion people and they kill 2.2 million each year, mostly in low- and middle income countries. Poor people are more exposed to zoonoses because of their greater contact with animals, less hygienic environments, lack of knowledge on hazards, and lack of access to healthcare. Eighty percent of the burden of these zoonotic diseases thus falls on people in low- and middle-income countries.

In many cases, they originate from livestock which can serve as a bridge for disease transmission between animals and humans. Thus, controlling zoonotic diseases in livestock is an important means to reduce infectious disease threats to humans. Zoonotic diseases are a threat not only to public health, but also to food production, food safety, animal welfare, and rural livelihood. The most severe infections are also a threat to international trade as outbreaks lead to the imposition of trade restrictions.

The transmission of zoonotic pathogens is more common in low-income countries where people



“We need to move away from the one host, one pathogen, one outcome approach. Understanding that endemic diseases can be treated as a whole when thinking about how we might intervene to address behaviour is both cost-effective and provide key additional insights” Professor Eric Fèvre, from the University of Liverpool and the International Livestock Research Institute, presented findings from research in Kenya in plenum and in the workshop.

often live in close proximity to their animals, hygienic conditions are likely to be poor and the population may lack knowledge about zoonotic hazards or are unable to prioritize biosecurity measures.

Within their own sectors, researchers and practitioners from different fields have a considerable understanding of outbreaks of disease and how to handle them. They also know they must bear in mind how local factors, traditions and politics can determine the outcome. But a disease outbreak causing deaths and disruption is always a complex picture. It requires all actors to gather knowledge from beyond their own field of expertise to be fully able to address disease outbreaks efficiently.

Main Conclusions

Biosciences and human behaviour

One of the main challenges for controlling zoonoses in livestock lies within the intersection between biosciences and behaviour. There is a lot of knowledge about the biosciences, for example about diagnostics, vaccination, biosecurity and risk factors for various zoonotic diseases; but for the biosciences to be effective, we need to change and strengthen the behaviours of different actors involved in controlling infectious diseases. To understand disease transmission between livestock and humans it is useful to think in terms of physical and social ‘interfaces’ and to argue that the behaviours of people and institutions, as well as policies in and across these interfaces, are critical when mitigating spread of zoonotic diseases.

Cultures and traditions are important in the transmission of zoonotic diseases. Effective prevention, detection and response require good understanding of the specific 'local' situations in which livestock are kept and especially the roles of different people in this. This is very critical when designing interventions to tackle zoonotic infectious diseases. The local cultural practices and their effect on handling and consumption of some animal-source foods like milk or cheese is one example of where there might be variations. It is important to understand why people perform a certain behaviour in order to be able to make changes. Effective and culturally sensitive communication, strategies and training are important if the goal is to change a behaviour. This can for example be promotion of small, but manageable changes that are acceptable and easy to implement.

To prevent, detect and respond to zoonotic diseases it is important to understand who does what in the livestock production system, for instance there might be variations related to gender. Women are more often involved in the daily management of smaller livestock (pigs/ small ruminants) and the farmstead. Men are more often involved in the management of larger ruminants, the slaughtering process and marketing, and dealing with external actors like veterinarians. Some of these differences may result in variations of zoonotic disease exposure between women and men. In addition, the children are often not taken into account, but are frequently in very close contact with animals and may thus be at risk of contracting diseases.

There are certain specific urban perspectives on zoonotic diseases in livestock and we need to get better understanding of the role of urbanization in low income countries in the emergence and spread of zoonotic pathogens. Generally, urban dwellers demand and eat a more varied diet including animal source foods. Some of these animal source foods originate from animals reared in, or just outside, the city. The urban animal keeping and animal source food value chains comprise many different public and private actors, each with specialized roles and sets of desirable behaviours. Mapping and measuring these from a zoonotic perspective will allow current and future disease risks to be understood, leading to improved prevention, detection, and response.

Prevent

The key actors for preventing the spread of zoonoses in the livestock population and transmission to humans varies slightly between rural and urban settings. Farmers and the local authorities (public sector) are obviously important in both settings. In rural areas local leaders and educators are also critical for success. As regards urban livestock keeping, the private sector, the public (consumers) and health care professionals are also key.

Examples of desired changes in behaviour from these key actors include: improved biosecurity at the farms; increased risk-awareness among consumers; increased skills among professionals in communication; and evidence based decision-making; One Health-concepts; and closer cooperation between different kind of professionals and authorities in a One Health-approach. It is also crucial that farmers and consumers and the public at large gain more trust in the public sector (individual professionals and governmental authorities) by reducing corruption and establishing evidence- and risk-based regulations.

The challenge in investing in preventive measures, particularly in resource poor settings, is that the returns are not immediate: it is rather like paying insurance premiums. Unfortunately, there is often a short-term perspective to secure immediate gains, all the way from poor livestock keepers to underfunded governmental institutions. When making appropriate long-term investments, these various stakeholders must have trust in the current system and a belief that they will indeed get their return. Stability and non-corruption is thus key. Incentives for farmers are healthier animals and thus better economic returns; for consumers reduced risk for illness; for the private sector it is benchmarking and increased markets; and for the governmental agencies wider trade access and economic growth in the country.

Detect

The key actors are largely the same in rural and urban settings for detecting zoonotic diseases and comprise of farmers/livestock owners, veterinarians, health care professionals. There is however one particular challenge in rural areas that needs to be addressed specifically and that is the infrastructure. To ensure fast and accurate diagnostics, samples need to be transported in a



Mapping the many different public and private actors in urban animal keeping and food value chains help better understand future disease risks. Here the participants in the workshop on Zoonotic Disease Management are deeply engaged in the task.

way that does not jeopardise the final analytical results; thus *a good infrastructure is a prerequisite for accurate detection* of zoonotic diseases in rural areas. It is not always obvious who the key actors for infrastructure are. They probably range from, for example, local district veterinary/medical organisations, to delivery services and national politicians.

The main desired behaviour identified was similar for urban and rural areas, namely improved reporting of zoonotic diseases at all levels (farmers/veterinarians/health professionals) to com-

petent/relevant authorities. Modern technology will probably drive the development towards faster and easier reporting using smart-phone-based applications. These tools can also be an important source of up-dated knowledge for veterinarians and health care professionals and facilitate the detection and recognition of zoonotic diseases. From a One Health perspective it is critical that these groups work together and share information through official channels and networks. A good information flow between the key actors is very important.

The *veterinarians* are usually just paid for the direct work at the farm and not for all the subsidiary and related work, for example surveillance, reporting and transportation of samples. Thus, they need to be *acknowledged and financially rewarded* for all the work they are performing for controlling and detecting zoonotic diseases. For the farmer, the incentives for a rapid detection of zoonoses are healthy animals and better economic return, along with compensation when controlling diseases that require culling of animals. *Official recognition of successful collaboration between veterinarians and public health professionals* is probably also an important incentive. The importance of improved transportation and logistics in rural areas cannot be emphasised enough.

Respond

Probably it is fair to say that each disease outbreak is a failure of the preventive measures. The key actors to respond to a disease outbreak are to a large extent the same individuals who were initially responsible for trying to prevent these outbreaks. However, there is another kind of actor who plays an extremely important role in the response: the media. The communication of balanced and accurate information to farmers, professionals, the public and politicians is crucial for effective containment of disease. In

rural areas specific actors are also connected to the distribution/trade chains and others to the challenges of ensuring accessible diagnostics.

Critical and desired behaviours at an outbreak are timely and risk-based decisions at all levels, continuous early reporting of new disease cases, and compliance with contingency plans including proportionate compensation schemes for farmers if livestock is to be culled. This necessitates confidence in professionals' actions. To ensure an early response, case finding needs to be improved, both within the veterinary and public health sector.

For all kind of farmers reasonable compensation schemes for losses are important incentives. At the other end of the process, economic penalties for trading of animals or animal source foods may serve as an important means to enforce necessary responses. For larger farms and the government, a fast return to economic gains and lifting of trade barriers are significant incentives for a fast and effective response to disease outbreaks. For service providers within the veterinary and public health sector, rapid feed-back and professional capacity development are also important incentives for rapid response.

Further reading

FAO. 2013. *World Livestock 2013 – Changing disease landscapes*. Rome.

Rushton J, Uggla A, and Magnusson U. (2017). *Animal health in development – its role for poverty reduction and human welfare*. The Swedish Expert Group for Aid Studies (EBA) Report 17:03.



Dr. Marcia Mourão, Ministry of Agriculture, Livestock and Food Supply, Brazil.

Comments from the discussions

“Communication is key”

“The cultural diversity makes this very challenging, because the challenges vary”

“Increase awareness and then you will decrease the risk behaviour”

“Should the risk be managed at the household level or rather at the industrial level?”

“These issues are complex. Pathogens may also be transmitted with animal foods, not only from the individual animal”

“The trade-off between risk mitigating behaviour and the risk of not, for example, getting access to nutritional foods. Health v.s nutrition or disease vs undernutrition”

Empowered and Resilient Communities

A Need for New Perspectives

Mats Målvist*, Uppsala University, Department of Women's and Children's Health, International Maternal and Child Health

* mats.malqvist@kbh.uu.se

Aim

The aim of the workshop was to discuss how current strategies to engage communities and interact with local stakeholders are facilitating or hindering agency at the grassroots level. Questions in focus included: how should we utilize existing capabilities and resources of communities; how can we integrate medical and cultural knowledge; and what are the benefits of and conditions for a bottom-up approach vis-à-vis a top-down one? Furthermore, the purpose was to give recommendations on how to move forward and how to promote a new perspective on community empowerment and resilience.

Background

In a rapidly changing world, with a growing amount of international interaction, collaboration, trade and travel, it has become increasingly important to address the threats posed to global public health by emerging infectious diseases and pandemics. In line with Hart's inverse care law, the most vulnerable are the ones who will be most severely affected by these threats. There is therefore a need to work with the local community, to strengthen the ability to counter emerging disease threats at the grassroots level. This should be done through efforts to promote empowerment and stimulate resilience for communities to prevent, detect and respond to emerging health challenges.

Main conclusions

There was a general consensus that, in order to prevent, detect and respond to emerging disease threats, communities need to be part of the equation and that a top-down approach is not enough to counter the rising challenges. Through examples from how the Ebola epidemic finally was curbed in Sierra Leone in 2015 and how the struggle to mitigate the effects and reduce transmission of HIV in Swaziland, recommendations for future action were formed. To establish resilient communities, we need to:

- Build an economic case for community engagement by promoting awareness and providing evidence that allocating money to *building resilient health systems is an investment*, not a cost.
- *Build on existing institutions and structures*, not create parallel systems. The Ebola response during the 2014–15 outbreak in West Africa experiences demonstrated how the creation of response mechanisms which did not take community practices and needs into account had severe shortcomings that caused considerable delays in the response.
- Acknowledge that empowered and resilient communities *are not built overnight*. We need to be proactive, not reactive, focusing on prevention and readiness before disaster strikes.
- *Recognize the culture and context*, not simply as a sideline and an afterthought, but as a key fac-



“Families are important in managing disease outbreaks, because they are the front-line carers. They need a better response than marginalization” Professor Paul Richards, anthropologist from University of Wageningen shares his experiences from the Ebola outbreak in Sierra Leone. Here with journalist Inna Lazareva.

tor in response success. We need to acknowledge that communities have an invaluable local understanding and are able to adapt to challenges from within. This insight should be utilized and strengthened as part of the medically oriented response to emerging diseases.

- Understand that the essential component when working with, together and in the community, is to *generate trust*. Without trust and strong social capital, efforts will be undermined and run the risk of being ineffective. We therefore need to work together with all the different stakeholders and create an open and honest dialogue.
- Finally, for all this to happen we need to *build capacity outside the health system* and among other professionals. An interdisciplinary approach is essential in order to build up empowered and resilient communities, able to prevent, detect and respond to emerging disease threats.

International perspectives: Talking “with” the people instead of “to” people

Four inspirational speakers were invited to the workshop to reflect on different perspectives focusing on the Ebola outbreak in West Africa in 2014–15 as an example of a rapidly emerging disease threat with global implications and a high level of uncertainty, and the HIV/TB epidemic in Swaziland as an example of a disease outbreak of a more slow-burning character with far-reaching societal consequences.

Professor Paul Richards, an anthropologist with considerable experience from Sierra Leone, has summarized his experiences from the Ebola outbreak in a recent book, and shared the main conclusions. Richards emphasized how both local and international communities were powerful and resourceful but had pulled in different directions during the initial response. It was not until they started pulling in the same direction that the crisis was solved. He explained how the initial top-down approach of the international community had focused on centralized health

How can women get a stronger voice in community development? Dr. Rubyath Binte Hasan from the Chittagong Veterinary and Animal Science University



facilities with high security isolation. This resulted in disruptions in the traditional approach to care of the sick by separating family and caregivers from the affected, with distant burials and facilities far from people's homes. This approach created mistrust and a reluctance to adhere to medical recommendations that were not contextualized. Instead, communities adapted their own systems of disease control based on experience from previous disease outbreaks. Only when this knowledge was integrated with the resources of the international community, was it possible to end the epidemic.

Anders Nordström, Swedish Ambassador for Global Health, shared his experiences as the WHO representative in Sierra Leone during the waning of the Ebola outbreak. He confirmed the description of how the initial response by the international community had failed since efforts to engage and inform on a local level were done through a top-down approach, spreading messages that were not contextualized, coherent, and sometimes even focused on the wrong things. Eventually two anthropologists became involved who stressed the importance of talking "with" the people instead of "to"

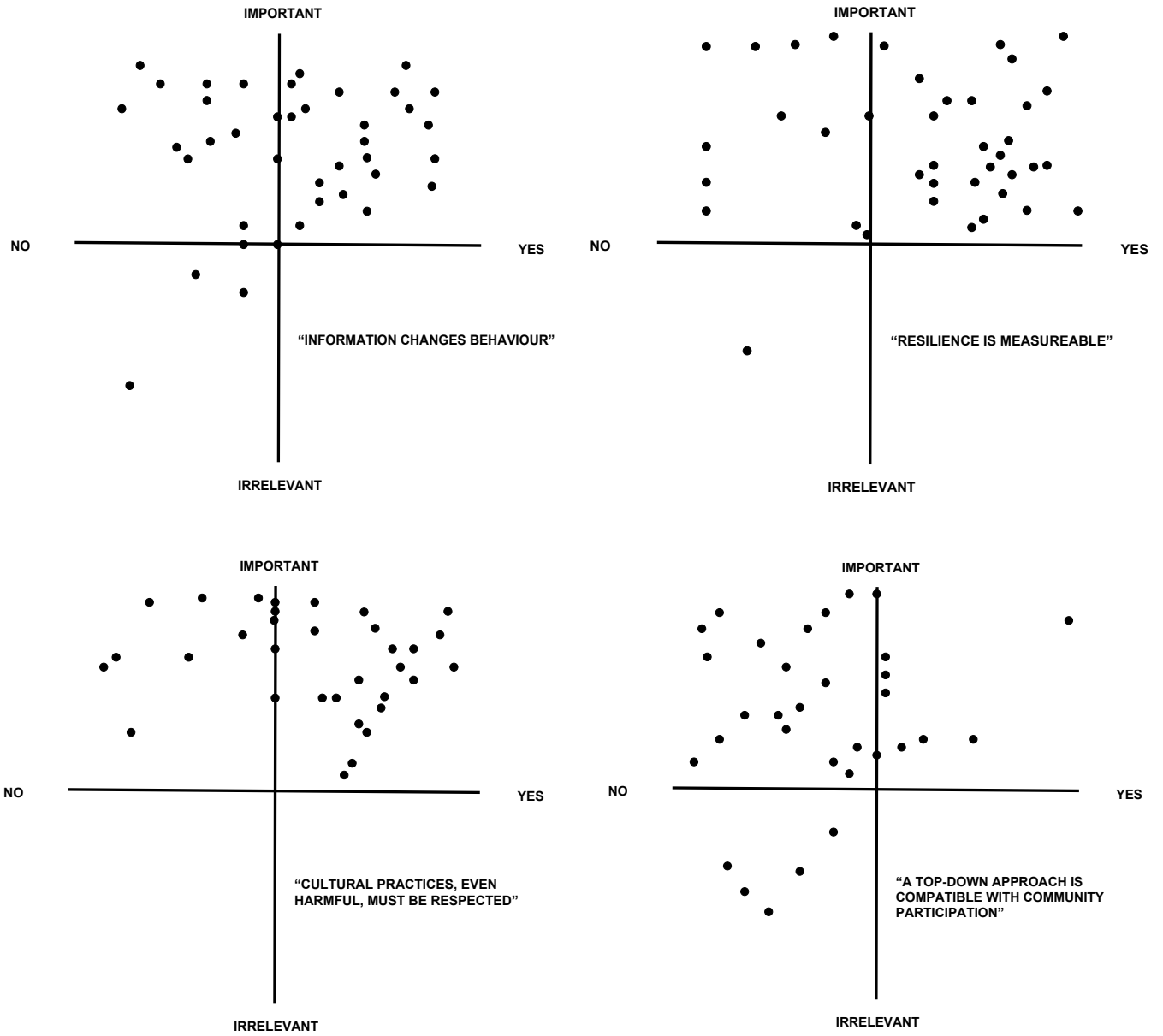


Figure 1. Summary of core value exercise. Each dot represent the opinion of a workshop participant.

people. It became evident that in order to effectively work together and to develop life-saving messages and for routines to be practiced, trust had to be built. This was done through forming relationships and having an open dialogue. In order to foster dialogue, get access and change behaviours: we need trust.

Gunilla Hallonsten, policy director at the Church of Sweden, shared experiences from Swaziland and the HIV epidemic. She also emphasized the need for a deepened cultural and contextual understanding. To acknowledge that when working with communities, local and international, there are different discourses going on at the same time: both a discourse guided by a biomedical and rights-based approach and a discourse based in the socio-religious sphere. In the Swazi setting, religion and culture were the main driving forces of the HIV epidemic. Just like in the response to Ebola in West Africa, it took a long time for the international community to understand the importance of cultural perceptions and belief systems when tackling the HIV threat.

Samson Haumba, country director of University Research Collaboration, an international non-governmental organisation working in Swaziland with HIV/TB prevention and response, confirmed that the recipe for a successful response is that communities are able to identify challenges and design and carry out interventions themselves. He stressed the importance of engaging local stakeholders since they have important know-how on their specific context. Moreover, if cultural and behavioural change is going to happen, it has to be rooted in the community. However, the contribution of the international actors is also very important when they can act as a catalyst for that potential to be harvested.

Core values

Most participants in the workshop represented the international community or had a governmental perspective. In order to work with public health interventions in an effective way, it is important to scrutinize the core values shaping one's perceptions. These values guide the approach, response and strategy development when engaging with local communities. To stimulate discussion and self-reflection, workshop participants were engaged in a value exercise in which they were asked to assess four different statements in relation to importance for implementation as well as to what extent they agreed or disagreed with the statement. The four statements were:

1. Information changes behaviour
2. Resilience is measurable
3. Cultural practices, even harmful, must be respected
4. A top-down approach is compatible with local participation

The results compiled from this exercise are displayed in Figure 1. Most participants agreed that all of the four statements were important issues in intervention planning and performance. For the three first statements there was no clear consensus on whether the statements were valid or not. There was however a stronger agreement on the statement claiming that a “top-down approach is not compatible with community participation”.

Defining problems and solutions

Participants were divided into groups and asked to define problems with and challenges to community engagement and consequent solutions. Problems defined and solutions suggested reflected to a large extent the accounts from the inspirational speakers. Table 1 outlines some of the topics discussed.

Lessons learnt from the Ebola response

- Make use of and strengthen already existing structures
- Communication is not easy
- “We must learn to listen if we want to be heard”
- “Where we had dialogue is where we had success”
- The recognition of the need of information in order to respond.

Table 1. Selection of challenges and solutions when engaging communities, as discussed by workshop participants.

Challenges	Solutions
Lack of women's empowerment	<ul style="list-style-type: none"> • Education can hopefully lead to better financial circumstances and a voice for women. It is also important to create incentives for girls to stay in school and for equal job opportunities. • Advocate for undiscriminating legislation and its implementation. • Challenge culture through socializing.
Mistrust in the time of crisis and how to build trust	<ul style="list-style-type: none"> • Establish a functioning primary health care system that has sustainable funding and is accountable. • Persuade and explain to the politicians that putting money into health care is a good investment for the future. • Talk <i>with</i> the communities not <i>to</i> the community. • Seek to understand risks, priorities and challenges. • Identify stakeholders • Find tools, processes and platforms to engage stakeholders and the community • Build networks, relationships and social structures.
How to include marginalized groups	<ul style="list-style-type: none"> • Engage and work with the community in order to explain why extra resources are allocated to certain groups while avoiding the creation of more stigma. • Identify the leaders for the marginalized groups and design and carry out interventions together.
How to connect and engage local and international actors	<ul style="list-style-type: none"> • Better understanding of the bottom-up approach is needed. • Use institutions and structures that are already in place. • Engage anthropologists and local leaders. • Improve communication between institutions that are already in place. • Follow-up community interventions and give feed-back to the community on what went well and what can be improved. This will also enhance and build trust. • Build knowledge about health challenges among non-health professionals.
Lack of commitment, from the communities themselves, from the health system, lack of political will	<ul style="list-style-type: none"> • Create political awareness and common will to build resilient health systems. • Change the perception of community health workers from the role of volunteers into professionals with appropriate salaries. • Organize community advisory boards with diverse members.

Further reading

Richards, Paul. Ebola – How a People's Science Helped End an Epidemic. ZED Books, London 2016

Hallonsten, Gunilla. Not the whole story - the impact of the church, traditional religion and society on the individual and collective perceptions of HIV in Swaziland. Thesis, Lund studies in sociology of religion, 1651–4432 ; 10. Lund University 2012.



Workshop C

A Roadmap for Effective Diagnostics to Combat Global Infectious Disease

A Variety of Threats Demand a Variety of Solutions

Stefan Bertilsson*, Uppsala University, Dept. of Ecology and Genetics

Karin Troell, National Veterinary Institute

Josef Järhult, Uppsala University, Dept. of Medical Sciences

Eva Molin, Science for Life Laboratory

Cecilia Nilsson, Uppsala University Innovation

Tove Hoffman, Uppsala University, Dept. of Medical Biochemistry and Microbiology/Dept. of Medical Sciences

* stebe@ebc.uu.se

Aim

To identify major bottlenecks and describe future strategies that will be effective in translating scientific and technological advances into clinical practice in the field of diagnostics.

Bringing together thirty-three delegates from academia, industry, policymakers, and not-for-profit organizations during the Uppsala Health Summit 2017, we aimed to identify such bottlenecks and obstacles, put the spotlight on possibilities, and to suggest further actions to be taken. The approach taken was to build on the experiences and perspectives of the participants while using points raised by inspirational speakers as fodder for discussion. The format of the workshop was tailored to be interactive, inspire dialogue and result in concrete ideas and action points at the level of individuals, groups, and societies.

To make expectations more concrete, the workshop participants were presented with the following questions:

- What are the major obstacles for getting rapid, reliable, and affordable infection diagnostics on the market and implemented in different healthcare systems?
- How can we accelerate this development to produce emerging diagnostic tools for the future?
- What incentives are there for venture capital and business to invest in this sector and what will be the role of non-profit and government-supported stakeholders?
- Who should take responsibility for the different steps to get new infection diagnostics to the market?
- How can different sectors work more efficiently together?



Engaged and frank discussions between stakeholders from different sectors are the hallmark of the workshops at Uppsala Health Summit. From left to right: Dr. Peter Daszak, EcoHealth Alliance, Dr. Linus Sandegren, Uppsala University, Dr. Eelco Franz, Institute of Public Health, Netherlands, Chipupu Kandeki, from GraceChem Pharmacies/CK Pharmacy Consulting Zambia Ltd, and Dr. Josef Järhult, Uppsala University.

Background

Infectious disease and the health threats entailed invoke a significant amount of pressure and stress on societies across the globe. Effective and broadly implemented diagnostics can be one instrument to better manage, control, and minimize the negative impacts from such infectious agents. There are, however, many obstacles to inventing, developing, marketing, and implementing such diagnostic tools, especially on a global scale.

Main conclusions

Crossing chasms by beginning with the end in mind and avoiding pitfalls

Before Uppsala Health Summit, all participants were provided with the pre-conference report

illustrating the problem and the challenge. Additionally, three inspirational speakers gave concise and complementary talks to inspire dialogue and highlight some of the key challenges.

Jim Gallarda at the Gates Foundation talked about beginning with the end in mind and avoiding the pitfalls if you want to be successful in the innovation process. He stressed the importance of asking questions like: *What is success? What am I missing? How many DALYs (Disability adjusted Life Years) are at stake?* To derive the greatest health benefits for the invested resources, efforts typically need to aim to impact on population level. Diagnostic companies often fail because the technologies do not meet the actual clinical needs or the companies may have inad-

Inspirational Speaker
Dr. Sabine Dittrich Head
of Fever at Foundation
for Innovative New
Diagnostics, FIND.



equate business models, which have a focus on supply over demand. By understanding these problems and pitfalls, assessing the status of the health system, carefully choosing the management team, and rigorously planning the work, the chasms between development, commercialization, and roll-out can be crossed!

Streamlining processes enabling rapid response to clinical needs

Diagnostic assay development typically takes too long to be fully effective! Time-consuming and rigorous validation efforts are needed throughout the assay development process to ensure safe and effective diagnostics. Stephan Jaeger from Roche Diagnostics presented their solution to combat infectious diseases: by streamlining and standardizing as many steps as possible in the assay development, the process can be accelerated. Four components are needed: instruments, core reagents, software, and assay specific reagents. Only the latter, e.g. the probes and the primers, need to be changed whereas all others should ideally already be implemented and available. The time of development can, in this way, be significantly shortened, and developmental focus can be shifted to ensure rapid response to emerging diseases and coverage of

subtypes for precision diagnostic and treatment. In conclusion: “aim at diagnostic solutions, not diagnostic tests”.

First prescription should be a diagnostic test – not a drug
Antimicrobial resistance (AMR) is a growing concern with major effects on global mortality. Proper diagnostic tools enabling appropriate and effective treatments have an impact on both human health and economics. Sabine Dittrich at FIND Diagnostics stressed the importance of highlighting the problem and putting the spotlight on the most affected populations: young children and others who are already vulnerable. One way of doing this is to predict the number of infectious-disease-related deaths in the absence of efficient diagnostics. In this context, it is critically important to understand the agents that cause the disease, map all relevant factors influencing the disease, and then develop tools to guide further actions. Diagnostics as the first prescription instead of medication would help to ensure appropriate treatment and possibly assist in averting the AMR crisis. To be efficiently and broadly implemented, diagnostic tests should not be too expensive, as such price models would lead to prescription of drugs instead of informed diagnosis. Additionally, it is important to under-

stand the utility of biomarker tests and how these impact prescription and disease outcome. In this context, it is important to understand that biomarker tests do not always work on a global level due to genetic and cultural differences and this might lead to overuse of antibiotics. Rapid malaria tests is one relevant example of this. Dittrich concluded that AMR and other emerging threats require a multitude of responses and diagnostics need to be addressed across the entire value chain. It is also important not to forget about the individual patient and that one actor cannot address this challenge effectively alone – strong partnerships are the solution!

Identifying the major bottlenecks and obstacles by shared experiences

The delegates identified several obstacles and bottlenecks in getting rapid, reliable and affordable infection diagnostics on the market and implemented in different healthcare systems during the group discussion. Some of the primary **obstacles** identified by the delegates were:

- Long-winded political decisions and slow innovation process in academia.
- Inhibitory regulations and taxes.
- Industry may have a deviating agenda and goals, and a low political commitment.
- Hindersome civil engagement, such as anti-vaccine movements (note that there are of course also positive influences from civil engagement).
- A lack of (or limited) local awareness.
- Obstacles to data sharing (ownership of data, legal barriers).
- Availability and low costs of certain drugs which are used instead of diagnostics (e.g. antibiotics).
- Lack of affordable diagnostic tools, incomplete or compromised infrastructure, and poor prospects of long-term funding. The latter, may be due to dynamic or cyclic political systems and diminishing awareness in between outbreak periods.
- Healthcare benefits are not clearly demonstrated or articulated and prevailing healthcare is not conducive to implementation.
- Low return on investment, especially for diagnostics to diagnose rare or neglected diseases.
- Narrow scope and limited appreciation for the One Health approach.

Analogously, there were several **bottlenecks** identified:

- Limited venture capital and poor prospects for long-term funding.
- Lack of required infrastructure (i.e. limited infrastructure and resources in low-income settings may for example influence the applicability of a diagnostic test).
- Limited communication, shortage of training, and insufficient education.

Recognizing possibilities and strengths

The prospects for effectively using diagnostics to combat global infectious disease may seem uncertain if we consider all of these obstacles and bottlenecks, but the delegates also identified and articulated several **strengths**:

- A growing body of knowledge, competences, and experiences to build upon.
- Emerging technologies, potentially enabling existing diagnostic tests to be produced at lower costs and entirely new ways of detecting and diagnosing infectious disease with increased precision and sensitivity.
- A growing volume of openly available information and data, promoted by a movement in the scientific community and demands from the public via governing and funding bodies.
- Substantial public funding for strategic research in diagnostics and infectious disease research.
- An emerging political will, awareness, and consensus about the nature and magnitude of the problem.
- Industrial and civil society involvement as well as community engagement.
- Global coordination and open access to journals, databases, samples, and expertise.

Possibilities recognized and highlighted by participants:

- New techniques and technologies, with broadly applicable (cross-cutting) technologies specifically highlighted.
- Reduced costs and opportunities for cost-effective multiplexing and hence affordable diagnostic solutions.
- Open innovation funded and promoted by stakeholders and a variety of economic interests.



Dr Pierre Formenty, Team Lead at the WHO Department of Communicable Diseases Surveillance and Response in conversation with Dr. Erik Bongcam-Rudloff, Professor in Bioinformatics at the Swedish University of Agricultural Sciences.

- Increased communication between researchers and end-users and the creation of meeting places for information exchange and forward-looking discussions (Uppsala Health Summit as one pertinent example).
- A global fund to which many countries could contribute with money (has been done for e.g. the Yellow Fever vaccine).

A call for a common and coordinated approach

There is undoubtedly a global need for affordable, rapid, and accurate diagnostic tools and political guidelines for how these tools should be translated into effective treatment. Such diagnostic solutions cannot be too costly since this may lead to prescriptions of drugs without

proper diagnosis. Associated with this, the actual healthcare benefits from implementation of diagnostics for precision treatments need to be articulated and visible.

In addition, there is a great demand for global and sustainable funding to drive and develop diagnostics, both broad funding solutions and long-term schemes. Supporting mechanisms for industry engagement are certainly called for, and various solutions to achieve this could for example be taxation of antibiotics to fund complementary research and development (R&D), inter-sectorial work, establishment of partnerships between innovators and low middle-income countries (LMIC), and faster LMIC based R&D validation. Such resources could also be mobilized to establish market re-

wards for innovations that can be implemented broadly, and such solutions were proposed by the delegates as possible solutions to accelerate the development of diagnostics.

The need for easily accessible data and biobanks to support and strengthen the development and evaluation of diagnostic tests were also highlighted. Even though sharing of data and samples is of critical importance, ethical and legal aspects present potential obstacles that need attention. A final point that was debated was whether we really should test for every imaginable disease. Multi-testing could very well lead to unnecessary treatment while our limited resources could perhaps be used in more effective ways.

To be able to combat infectious diseases on a global level, it is critically important to get infectious disease and diagnostic development and implementation on the political agenda. This awareness needs to happen on a global scale! We need education on infectious diseases and we should also encourage civil engagement. A global health initiative “*The Uppsala Agreement on Health*” and an international platform to promote such an initiative was enthusiastically proposed by the delegates.

Recommendations to action

The main outcome of the workshop was the sharing of experiences and perspectives on the relevance and path forward to implement effective and useful diagnostic tools for infectious diseases. The discussions focused on building a common ground by identifying obstacles, bottlenecks, strengths, and possibilities in the development of new, efficient, reliable, user friendly, and

low cost diagnostic tools. Three major concrete and seemingly tractable actions to accelerate the development were articulated:

A. The Uppsala Agreement on Health

The workshop participants suggest a global initiative on health (analogous to the Paris agreement on climate change). If global leaders could agree on common goals for diagnostic development, treatment strategies and funding schemes, the importance of these questions would be put in the political spotlight. This would lead to education of policy makers as well as the public and increase global awareness with increased resource allocations for this endeavour.

B. Funding for a broad implementation

The need for alternative, long-term and broad funding models was identified and highlighted. Global, interdisciplinary, and joint funding are different options, with the introduction of market entry rewards as a possible catalyst for drug companies to engage in developing new diagnostic tests and drugs to combat infectious disease. One important question asked was: what financial model would work for products or tests that are not produced in large quantities?

C. Open access

Something which is perhaps evident for everyone working with diagnostics and infectious disease is the need for easy and open access to data and samples to facilitate research, validation, and to shorten the time needed for assay development.

Further Reading

FIND website: www.finddx.org

Gates Foundation website: www.gatesfoundation.org

WHO website: www.who.int/diagnostics_laboratory/en

New Medicines and Vaccines

Monitor Safety in Emergency Situations?

Rebecca Chandler*, Uppsala Monitoring Centre

* rebecca.chandler@who-umc.org

Aim

The aim of this workshop was to address whether current recommendations and guidance are enough to ensure that new medicines and vaccines used in the treatment and prevention of emerging infectious disease threats are adequately monitored for safety and to define the elements required in the establishment of a “reasonable minimum” pharmacovigilance system for rational and safe use of medicines in these circumstances.

Background

New medicines and vaccines are often deployed for treatment and prevention efforts in countries under threat from an increased risk for infectious disease threats. However, there is a considerable concern that, these countries, have all too limited pharmacovigilance resources to meet the challenges of monitoring the safety of these new medicinal products upon widespread use.

Under “routine” circumstances, the amount of knowledge about new medicinal products at the time of introduction to public use is limited. Clinical trials, designed to investigate both the efficacy and safety of products, are performed using a relatively small sample of participants; these include specific inclusion and exclusion criteria, and have limited participant follow-up times. Central to the safety surveillance of medicines in the post-marketing period is spontaneous case reporting, as this allows for the early detection of rare, unexpected, suspected adverse drug reactions. Risk management plans/risk

evaluation and mitigation strategies are implemented by the marketing authorization holders at the time of approval to minimize the risk from known safety concerns, to collect important missing information on populations not included in clinical trials, and to further characterize effectiveness and safety through observational studies.

Emerging infectious disease threats, however, typically do not afford the luxury of “routine circumstances”. The knowledge base at the time of introduction of a new medicine or vaccine may vary from fully completed clinical trial programs to only “proof of concept” data. Furthermore, given that such diseases disproportionately affect lower- and middle-income countries, there is direct introduction of new medicinal products into countries with limited pharmacovigilance resources and less advanced health care systems.

The absence of a robust pharmacovigilance system, able to detect and respond to safety concerns about a new medicine or vaccine, may lead to detrimental effects on the public confidence in public health campaigns required for the treatment, prevention, and/or control of emerging infectious diseases. However, sustainable pharmacovigilance systems are far more than simply the collection and analysis of adverse event reports: they rely on a public awareness of drug safety, a culture of reporting suspected adverse drug reactions, as well as not only communication within the local context but also the sharing of safety data on a global scale.



Inspirational speaker Dr. Wiltshire Johnson, Director of the Pharmaceutical Board of Sierra Leone shared a developing country perspective on what happens when new vaccines and medicines are introduced into countries with little means of monitoring for adverse effects.

Invited inspirational speakers for the workshop were Nils Feltelius from the Swedish Medical Products Agency and Wiltshire Johnson from the Pharmacy Board of Sierra Leone. Their presentations described the experiences of monitoring medicine safety during the H1N1 pandemic in Sweden and the Ebola outbreak in Sierra Leone, respectively. Hearing each of their stories together, it was clear that, no matter the amount of pharmacovigilance resources a country has, there are challenges we all face when responding to public health emergencies.

Main conclusions

Medicine safety, or pharmacovigilance, needs to be incorporated as an essential component of One Health. One Health is defined as an integrative effort of multiple disciplines working locally, nationally, and globally to attain optimal health for people, animals, and the environment. Pharmacovigilance is not traditionally associated with the concept of One Health despite the

fact that the medicines can confer both benefits and harms to humans, animals, and the environment.

The absence of pharmacovigilance from the One Health dialogue may be because it is typically considered to lie within the regulatory framework rather than as a public health exercise. One Health is most associated with emergencies and the tragedy of pandemics. We need to expand and redefine the notion of pharmacovigilance, from being a bureaucratic requirement, to an integral part of the response to infectious disease threats.

How do we integrate pharmacovigilance into One Health?

Pharmacovigilance needs to be transformed from a science to a culture. We need to explain what pharmacovigilance means and devise ways to make it less remote from the grass roots, by moving it from the regulatory departments,



Dr. Mats Lindblad of the Swedish Food Agency, Dr. Fernanda Dorea of the Swedish Veterinary Institute and Dr. Eren Zink of Forum for Africa Studies, Dept. of Cultural Anthropology and Ethnology at Uppsala University present brief conclusions from their workshops, organized around the concepts of Prevent, Detect and Respond.

where it is confined now, to the communities. We need to reach out and build trust, creating the feeling and understanding that monitoring patient safety is an important part of healthcare, and this is more than just counting reports of adverse effects. Rather than being seen as an add-on or afterthought, pharmacovigilance should be viewed as an *integral part of healthcare*. The ideal scenario is one where people will not need to be prompted to report adverse effects of medicines or vaccines, but will do so spontaneously.

There are financial aspects too. Safety monitoring is often perceived as a distant scientific activity, but we need to acknowledge that there are important political and financial aspects to it too.

The resources currently devoted to pharmacovigilance activities, particularly in low-income countries, are insufficient. If we are not willing to allocate adequate resources, nothing will change, and there is a cost to doing nothing. A

system based solely on market forces will not work, because emergencies may not happen or they may happen somewhere other than expected, which means countries will never be motivated to invest.

Another challenge is making sure that risk is correctly understood. Statistics and probability are difficult to grasp, and funders are not willing to put money into an initiative until the risk is apparent. We need to find a way to explain the benefits of *investing in prevention strategies*. It is imperative to communicate risk probability clearly and to calculate the financial burden of emergency events, should they occur. Short-term thinking and investment – and the two rather different assessments of risk from the ministries of health and the ministries of finance – are hampering a One Health approach.

Prevent

How do we implement risk minimisation strategies for expected adverse drug reactions, ADRs? These are some of the requirements:

- a plan in place for all stakeholders;
- scientific knowledge of the medical product;
- political engagement: we need to get the decision-makers on board;
- industry engagement: we need to stop seeing the pharma industry as the ‘bad guys’ whose only interest is money. Industry play an important role in promoting education, funding research and increasing awareness of medicine safety;
- resources: funding and people;
- good communication practices;
- tools to reach communities;
- a new word for ‘pharmacovigilance’: it is too complicated and obscure, some people might dismiss it altogether. We should call it patient risk / patient health / patient safety, that may give it extra driving force;
- training and education: we need to bring the pharmacovigilance mindset into our medical and veterinary educational systems and develop a higher level of health literacy; it cannot be something we think about only during emergency responses, it has to become integral to the thinking of a country’s health system.

Detect

In emergency situations, with multiple clinical trials running simultaneously, it is hard to identify ADRs. The workshop discussed how to

employ resources in the best way to detect unexpected ADRs, and highlighted the need for the following:

- inter-organizational approach: collaboration between private sector and governments;
- training and education;
- focused and targeted communication strategies, especially aimed at the young population: children can help change communities' attitudes and shape the future;
- NGO advocacy;
- innovation and creativity in technology development and use, while recognizing the risks of technological advances resulting in the 'lost skills' of clinicians;
- community reporting: use local resources to facilitate/increase reporting directly from patients and communities, allowing them to assume responsibilities ('health literacy');
- mobile technology: use phones to keep in touch with people in rural areas, develop and employ mobile apps for reporting adverse effects, collaborate with IT companies to spread emergency notifications (as Red Cross and UN already do);
- bottom up approach, rather than other way around.

Respond

What are the challenges when responding to signals? Here are some of the issues that were discussed:

- need to achieve balance in risk-benefit communication: does the public need to be informed about a signal, and if so when?
- need for change in behaviour: if safety signals have been reported for a certain drug that many patients are used to, a cultural change is needed so that healthcare professionals will stop prescribing it
- importance of good communication to counteract misleading rumours that are spreading among the public
- need to identify response trigger: when do we need to take action? when is the number of signals 'enough'? when is the right time to act?

Where to begin?

As a starting point, it was suggested by the workshop that there be the development of a *global task force or global response team that could provide support to countries* in their monitoring of medicine safety at all three stages (prevention, detection, response) but particularly during emergencies.

Author's note

Within only a few weeks after the close of the 2017 Uppsala Health Summit, trouble for the first vaccine against dengue fever has arisen. This unfortunate development directly underscores the relevance and importance of the discussions which occurred in this particular workshop.

The incidence of dengue has grown dramatically around the world in recent decades, largely the result of changes in the relationship between humans and the environment. Regions with the highest burden of disease are Southeast Asia, Latin America and Africa. Dengvaxia is the first live attenuated tetravalent vaccine against dengue developed for direct introduction in these high dengue burden regions with less mature pharmacovigilance infrastructures.

A signal from the clinical trial program was an excess of cases of hospitalized and severe dengue cases in those receiving Dengvaxia in some subgroups of the youngest children. Immunization of individuals without prior natural exposure to dengue results in only short lived immunity which over wanes over time, making individuals at greater risk for severe disease upon re-exposure to the virus.

On 29 November 2017 the company behind the vaccine announced that their analysis of follow up clinical trial data had lead them to conclude that Dengvaxia should not be used in persons who have not previously been exposed to the dengue virus.

An immunization campaign of 9-year-olds with Dengvaxia in the Philippines which had been launched in April of 2016 has been halted, and a public inquiry into the circumstances surrounding the immunization policy decision and government negotiations with the company are underway.

The vaccine safety community awaits to assess the potential impact on the state of public confidence in vaccine programs worldwide.



Workshop E

Innovation and Big Data in Health Surveillance

Fernanda Dórea*, National Veterinary Institute, Sweden
Crawford Revie, University of Prince Edward Island

* fernanda.dorea@sva.se

Aim

The workshop aimed at identifying and prioritizing opportunities to achieve data-driven surveillance for decision-making in population health, within the One Health context. Participants were asked to identify opportunities to overcome the four groups of challenges listed above. The opportunities listed were then stratified and prioritized for each of the three main stages of tackling infectious disease threats: prevention, detection and control. Within each of these three main surveillance goals, participants were asked to identify the opportunities with the highest impact, that is, the highest potential to result in change which could overcome current challenges; and also the opportunities that could be most readily addressed.

Background

We live in a globalized, digital era: everything we do, from buying groceries at the local store or paying for dinner on vacation, to bringing our pets to the veterinarian, gets recorded in a database somewhere. How can we take advantage of the opportunities that big data offer to improve the health of populations in a One Health context?

The vast amount of data collected on not only people's behaviour, but also on our livestock and domestic animals and their impact on the environment, creates the opportunity to monitor indicators of population health in quasi real-time. *Incorporating pertinent data into a health surveillance system will allow us to move from reactive health response to pro-active detection, prevention and control.*

Capturing and analysing data is however challenging, expensive and potentially controversial. In the pre-conference report for this workshop, we identified four main challenges to overcome in order to build a data-driven surveillance systems of the future:

- *Technical challenges* to transform data into actionable information;
- *Operational challenges* to translate research into practice;
- *Normative challenges* such as cultural and ethical norms, and lack of public trust; and
- *Funding challenges*, related not only to research but in particular to innovation delivery.

Main conclusions

Issues related to *data access* were deemed the priority challenge when considering the potential impact on the field, across all stages of the surveillance continuum (*detection, prevention and control*). Data sharing was raised as one of the opportunities to be addressed, but discussions highlighted that this only solves the operational and normative challenges of data access. Many technical challenges remain, in particular challenges regarding the interpretation and validation of individual sources, and interoperability and integration of multiple ones. Opportunities to address these were also discussed, as detailed in this report.

Various opportunities that could be readily implemented were identified, and those chosen as priorities all related to the use of *currently available technical tools* to improve data capture and ma-



To kick off the discussion, moderator Crawford Revie, professor at the Atlantic Veterinary College at the University of Prince Edward Island asked the participants to think about what aspects of big data that they find most challenging in their work.

nipulation. For all the themes, detection, prevention and control, for instance, opportunities prioritized included paperless data collection, and more extensive analysis of historical data that are already available. Crowd sourcing apps were raised as a readily available opportunity for detection, and their use to deliver information back to the public was also highlighted as an opportunity for response. *Education and training* were also put forward as an opportunity with considerable potential, in particular given the need for cross-disciplinary training.

What is big data?

The concept of “big data” is not actually related to the size (“how big” a dataset is), but to the complexity of the task of processing a specific set of data. The common ground for those interested in big data analytics (BDA) is the demand for (cost-effective) technologies to extract information from raw data, in an evolving and complex context.

In a frequently cited paper, Doug Laney, then talking about E-commerce data, referred to big data as an explosion of data management chal-

lenges along three main dimensions: *volume*, *velocity* and *variety*. More recent reviews have added more “Vs” to this list of big data challenges by including: *veracity*, *variability*, *value* and *visualization*.

During the workshop, we asked the 46 participants to position themselves in the four corners of the room according to which aspects of big data were most challenging in their work: volume, velocity, variety or “other V’s”. The even spread of participants around all four corners of the room demonstrated how no single aspect of big data can be used to characterize the challenges faced, even in a focused subject area, such as health surveillance. While some participants spoke about difficulties in data access, others mentioned not having the technical resources to process available data. Institutions which currently access and process large amounts of data, spoke of the difficulties of deciding which data are valuable and validating the results of data processing.

More important than defining big data, therefore, is to recognize the processing and manage-



Dr. Jan Semenza, Acting Head of Section Scientific Assessment at the European Centre for Disease Control, and Dr. Kun Hun, Research Manager at IBM were invited to the workshop to illustrate the challenges and opportunities associated with Big Data Analytics in health surveillance.

ment challenges that result from any combination of the Vs listed above, and to move forward and overcome some of them. Even “beyond the hype of inflated expectations”, there is still agreement regarding the vast potential of big data to enhance decision-making processes. As Gandomi & Haider (2015) stated: “Big data are worthless in a vacuum. Their potential value is unlocked only when leveraged to drive decision making”.

Challenges and opportunities

Valuable input for the workshop was provided by two speakers who were invited to illustrate the challenges and opportunities associated with BDA in health surveillance.

Dr. Jan Semenza, ECDC, demonstrated the number of potential big data sources and BDA applications that can be employed for the surveillance of environmental and climatic precursors of epidemics, in order to strengthen prediction and prevention of disease outbreaks. In his conclusion, he stressed the fact that public health is still under-utilizing the potential of big data in health surveillance.

Dr. Kun Maggie Hu, IBM research, Almaden Research Center, emphasized the role of BDA to transform some of the present challenges into opportunities. BDA opportunities for data sharing and integration were exemplified through STEM (Spatio temporal epidemiological

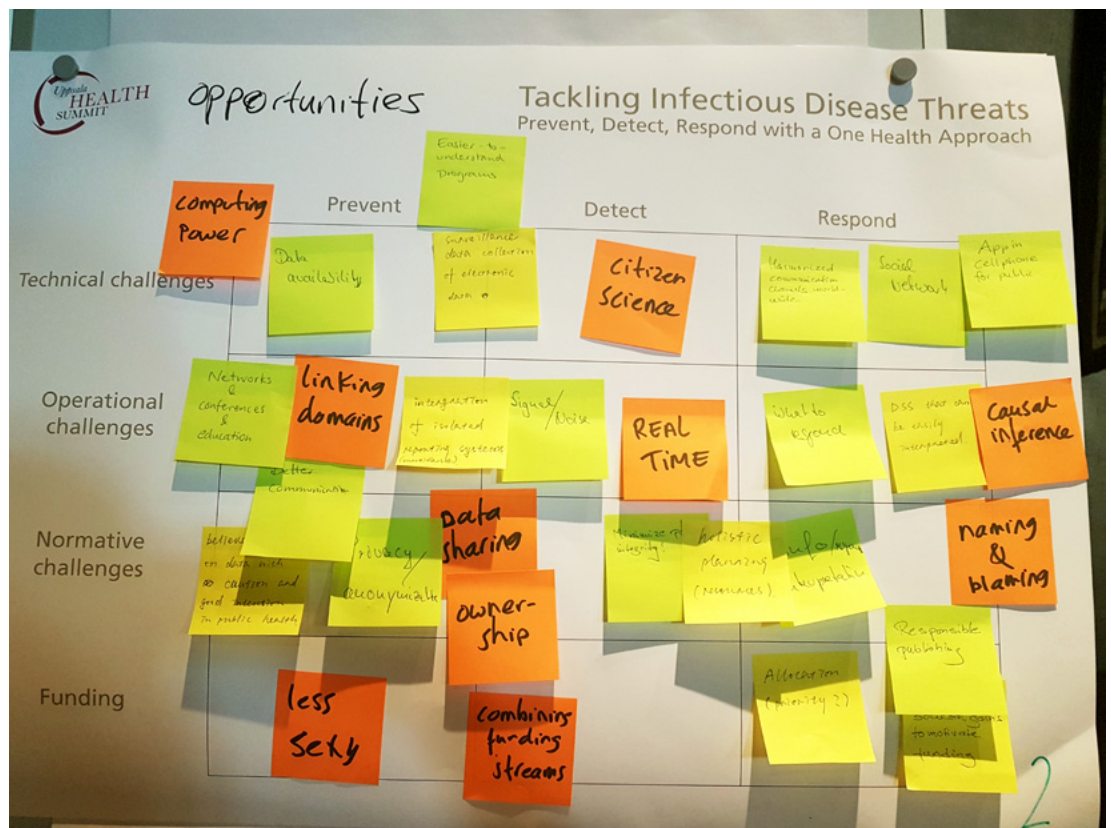


Figure 1. Opportunities matrix used for brainstorming. Results from one of the 7 tables.

modeller), an open source platform supporting community-driven public health disease models and simulations. Other examples of BDA applications in health surveillance that she listed included: the use of syndromic surveillance* for early detection and response to outbreaks; use of artificial intelligence and deep learning analytics for disease prediction and detection; and technologies to support dissemination, communication, education and governance.

Group brainstorming: How do we move forward?

Within each challenge theme, participants were asked to write down as many opportunities as they could think of, and place those along the disease control continuum (see Figure 1).

* The real-time (or near real-time) collection, analysis, interpretation and dissemination of health-related data to enable the early identification of the impact (or absence of impact) of potential human or veterinary public health threats which require effective public health action. (Definition from the project syndromic surveillance systems in Europe, Triple-S).

The general consensus was that most solutions that can strengthen disease control will support multiple goals. Surveillance goals are fluid, and can change over time depending on the hazard status in a specific population (absent, present, sporadic, eradicated).

Technical challenges

Transforming data into actionable information

Efficient, scalable and flexible technologies are required along the entire “big data value chain”: data generation, collection, transmission, pre-processing, storage and analysis. Extracting valuable – and validated – information from already available data was the main theme of the opportunities listed under prevention. In particular, learning from past outbreaks using simulation and modelling, and combining data under a One Health-integrated surveillance system. The issues of *data access* were often brought up, with participants suggesting that if data collected by research and governments were made accessible, cost-free or at a low price, we could gain more insights from them through widespread research.

Data collection was the most common theme within disease detection. Several of the opportunities listed shared the common idea that people could provide *more individualized data, if the right tools were created for that purpose*. Examples are medical advice apps, which help people get the information they need, while also collecting data valuable to assess population health. Crowd-sourcing apps, citizen science, and “fitbit for all” were some of the listed ideas within this theme.

Access and analysis of social media data was also mentioned. Issues of data access were also brought up, but for efficient detection the issues were more focused on timely access. Syndromic surveillance was highlighted here, but the methodology suffers from, rather than solves, all the previously listed issues of access, timeliness and lack of interoperability.

Issues of *data integration* were commonly listed in both prevention and detection. Many participants considered the main challenge to be that *most datasets are not structured following data standards*, therefore interpretation is difficult to automate, and in particular difficult to integrate with data originating from other systems. Discussions highlighted that the problem is not a lack of available data standards, but rather their *lack of adoption*.

When discussing disease response, challenges and opportunities listed were mainly related to communication and, as for detection, timeliness. Many of the previously identified opportunities were repeated here, highlighting the overall workshop conclusions that the separation of surveillance goals may be artificial, and that a data-driven decision support system will strengthen all stages of disease control. For instance, if crowd-sourcing apps were widely used to collect information from people seeking health advice, the same apps could be used to provide information back to the users about the actions needed to protect their own health or that of their animals. These could include, for instance, response measures during an outbreak. The same two-way communication channel model was proposed for social media. The analysis of historical data to understand disease patterns would also be beneficial for disease response, and the construction of decision support systems was listed as an opportunity by more than one group.

For all surveillance goals, the items related to analysis tools focused on the need for surveillance officials to not only have access to the right tools, but also be capable of using them. “Efficient people and technology”, as one captured note summarized. The need for more training was repeatedly listed, but also the need for tools to be more accessible to domain experts: user-friendly and available in local languages.

Operational challenges and opportunities

Solving the technological barriers to extracting information from big data is only the first step into a framework of evidence-based decision making. How do we make this technology accessible to the right institutions? How do we operationalize health surveillance so that the right data can be accessible, the right methods employed, and the outputs made accessible and understandable to the right stakeholders?

When discussing operational challenges, and trying to contextualize them with the surveillance goals of disease prevention, detection and response, the same overall themes were brought up. That is, issues listed under detection were mainly related to how data can be acquired and accessed; prevention challenges and opportunities were mostly associated with the barriers to making sense of those data; and response challenges listed were related to the *process of decision making*.

The issues of *education and training* were brought up even more strongly when discussing operational barriers. Participants suggested that *creating common interests between fields such as computer sciences and health sciences, could facilitate exchange of technical knowledge to promote data-driven surveillance methods*.

Here, more emphasis was also placed on local and field operations – how to empower field workers with the right tools for data collection, using these tools to feed information back to them in formats that they can understand, and training them to take decisions and execute actions based on the evidence delivered back to them. *Investing in education and training not only in central disease control bodies, but also in local staff, and even placing technical support within local teams*, were some of the ideas highlighted.



Nathalie Persson Andrianasitera, Programme Coordinator at the International Foundation for Science.

Data integration barriers were again a common theme, this time focusing not on the problems of data format and interoperability, but on the actual physical distribution of data among various owners and databases, with however little incentive for individual actors to share.

Validation of analyses outputs were vigorously addressed both in disease response, and when considering how the lessons learned after disease response should be used to act on prevention.

Normative challenges and opportunities

Legal and ethical frameworks need to be established, with norms that set the usage boundaries when processing data for surveillance. The difficulty of addressing this issue translated into a lot of notes on the challenges, and few ideas for solutions when compared to the previous sessions. Participants listed challenges such as the generation gap, lack of legal support for data exchange, and differing agendas among data owners.

One of the barriers mentioned is that legislators lack domain-specific knowledge. This highlights the need for communication, which was as particularly emphasised when considering the barrier to public support. As one participant put it: “we are already surveilled in many other activities of our everyday life, such as shopping”. **If consumers will allow retailers to collect and store so much of their personal information, yet not the public institutions who are responsible for safeguarding population health, then the issue is a lack of public trust in the protection of their data confidentiality, or a poor understanding of the benefits.**

The solutions proposed were: *anonymization* of data; *better communication* to allow the public and legislators to trust that personalized information is not being used against individuals, or even kept at all; *education of legislators*; and funding for work to *build legal and ethical frameworks that support data capture and integration*.



Uppsala Health Summit always provides plenty of opportunities for networking. The summit 2017 offered possibilities for meeting colleagues around theme tables during the coffee-breaks or signing up for match-making sessions. In the picture: Johanna Takkinen (ECDC) and Monique Van Der Hoeven (ZonMw, Netherlands).

Funding and opportunities

In health surveillance, the value of outputs can be hard to measure, particularly as we move from disease response towards prevention. Participants suggested that if we could quantify the infection cases prevented, or the costs of response saved, it would be possible to establish a “pay for result” financing model.

A common comment was the potential of BDA to increase the benefit-cost ratio of health surveillance, by allowing more information to be extracted per amount of input (data) available. Our failure, it was suggested, is in quantifying this gain and using it to inform funding decisions. In communicating surveillance expenditure, this should not be seen in terms of costs, but rather as investments resulting in gain. These gains are both in terms of societal value, as well as saved costs in disease response.

When discussing the costs of data, some ideas listed included the responsibilities of data owners and the creation of incentives or legal obligations for them to share data. This covered a range of owners from individual people, to big companies such as Facebook and Microsoft, up to researchers and journals. It was suggested that funders should become the data owners, and that scientific results – papers as well as data – should be-

come public (a trend already being more widely seen in many countries over the past 3–5 years).

Regarding the costs of the technology, both for development and adoption, participants discussed the need for better prioritization when allocating resources. The cost of investing based on the wrong priorities, or investing in “cheaper” solutions that may prove non-sustainable or even insecure in the long run, were some of the issues mentioned. One group suggested the idea of hackathons, gamification and prizes for innovation specifically applied to big data analytics for health surveillance.

Improving infectious disease surveillance using big data analytics: priorities

A strong and almost unanimous pattern emerged from all discussion tables: *the use of already available technical tools, in already available data, represents a readily available potential we should be tapping; while the highest impact in advancing big data analytics for health surveillance will be achieved if we address issues of data integration and outputs validation.* “Data integration” in this context refers both to technical issues of interoperability and operational issues of data sharing.

Technical solutions already available could be used to improve data collection and support

better detection, such as the idea of citizen science apps described above, or larger adoption of paperless data collection tools. *To aid prevention, a lot of insights for disease control can be gained from data which is already available.* Why are we not doing it? According to the discussions, because of lack of funding, lack of training of health analysts to employ the available tools, and poor communication or incentives to ensure that tool developers make interfaces that cater for the needs of health officials and are easy to use. *Education and training provided by central bodies to local field staff, and channels of communication reaching both down to field-workers, and up to regulators* were the main opportunities suggested. The same tools proposed for better data capture, such as medical apps, could benefit communication, as suggested.

The group concluded that *the single biggest barrier to gaining insights from data, in particular in real-time during response, is data access and integration.* Moreover, even though automated systems can process raw data and generate more usable information, as the amount of data processed grows, so does the volume, variety and velocity of *generated outputs.* Gaining insights from all this information, for disease prevention but most especially during fast response in case of outbreaks, will demand machine-assisted methods to filter, validate and prioritize outputs; as is the case in dealing with alarms generated by syndromic surveillance systems.

The need to “break the barriers of siloed data” was mentioned as the priority measure for data access and integration. The lack of standardized data was repeatedly mentioned as a barrier for data processing and interpretation. As the discussion around this issue matured, however, more and more participants agreed that it is unrealistic to expect data standardization, as

in fact many standards are already available in health (e.g. INSPIRE, inspire.ec.europa.eu), and are still not used regardless. Data interpretation is a challenge that can be addressed with BDA, rather than being just a barrier to it. Ontologies, for instance, allow domain experts to create a knowledge model that is understandable by both humans and machines. Using this model, computers can then reason with data without relying on their codification into specific standards. This ensures data interpretability, and perhaps even more importantly, interoperability among different data sources.

This workshop highlighted the potential for BDA to advance disease prevention, detection and control if the technologies already largely exploited in other fields are used to inform health surveillance. Evidence-based decision making in a One Health context requires access to data from a multitude of sources, which can provide health signals from the environment, as well as animal and human populations. Lack of access to data sources in a timely manner can be a barrier to efficient disease response, but as highlighted, these can be opportunities, rather than barriers, to the use of BDA. Siloed data which cannot be analysed concomitantly in real time can, however, be analysed retrospectively to understand the underlying drivers of past infectious disease threats events, and prevent future outbreaks. Data interoperability can be improved by the application of BDA and the development of ontologies.

An interdisciplinary approach, education and communication were highlighted as the solutions to promote accessibility to tools, and the creation of legal and funding frameworks to support this in the long term.

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Whose Priorities Count?

Empowering Scientific Capacities for Locally Relevant and Sustainable Solutions

Eren Zink*, Uppsala University, Forum for Africa Studies, Dept. of Cultural Anthropology and Ethnology

* eren.zink@sida.se

Background

Despite recent advances in reducing mortality and morbidity caused by infectious disease, the arguments for reinvesting in local, regional and global capacities for prevention, detection and response remain strong. Endemic diseases are a persistent drain on families and communities despite the global availability of biomedical solutions (e.g. tuberculosis, rabies, snakebites). Emergent diseases are spectacular and terrifying in their power to destroy human life and undermine human institutions across national and continental borders (e.g. the 2014 Ebola epidemic originating in West Africa). Meanwhile, the evolutions of antimicrobial resistance amongst bacteria, viruses and parasites is slowly but surely eroding the power of many of modern medical science's most important advances during the 20th and early 21st century.

Further complicating matters, the contemporary proliferation of global connections in trade, travel, and communication has not been matched by an equally impressive expansion in investments in research capacity in countries with fragile scientific infrastructures. Current levels of investment in the neglected diseases that primarily impact low and middle-income countries are at the lowest levels in 10 years, and these countries themselves make negligible contributions to research funding. And while some developing countries have made important advances in building local research capacity to prevent, detect and respond to infectious disease

challenges, usually with support from international and multilateral development organizations, their actual production of new knowledge remains within the frameworks of scientific and funding priorities identified by foreign organizations and scientists.

Capacity to prevent, detect and respond to the acute burdens of infectious disease require investments in scientific knowledge production across a wide spectrum of human health, veterinary, environmental and social science fields. It also requires investments in scientific capacities and infrastructures located close to the vectors that transport, and the populations that host, infectious disease.

Aims

Some 70 workshop participants from across the globe met in Uppsala Castle to draw upon their experiences and knowledge from government, civil society, international organizations, research and practice to identify and prioritise methods to more effectively detect, prevent and respond to infectious disease threats. The workshop identified

- Methods for empowering local scientists to more effectively address local and regional infectious disease priorities.
- Bottlenecks and blind spots that hamper local research priorities from receiving the attention that they deserve.
- Strategies to better align biomedical solutions with the local contexts in which infectious and zoonotic diseases continue to thrive.



Workshop moderator Professor Hanna Akuffo, Program Director at SIDA.

- Opportunities to build synergies and greater alignment amongst the competencies and resources located at local, national, regional and international levels.
- Mechanisms to mobilize local, regional and international funding to address emergent and endemic infectious diseases.

Arguments and Recommendations

Through a combination of inspirational talks, discussion, small group exercises, and individual polling, the workshop arrived at a robust set of recommendations for addressing the persistent challenges associated with empowering scientific capacities for locally relevant and sustainable solutions to infectious disease threats.

Build and sustain local research and local research capacities

The strongest recommendation arising from the workshop with nearly unanimous consensus was that *research funders should contribute to building and sustaining local research capacity to address infectious disease priorities in low and middle-income countries by focusing their support to local researchers together with contributions to local infrastructure and research training.*

This recommendation runs contrary to common practices of research funding whereby most international funding for research in low and middle-income countries remains in institutions located in wealthier countries.

International funders should adopt policies that require international research partners to align to and be driven by local priorities. An outcome of such a shift would be more equitable trans-boundary research partnerships.

A strong majority (65 %) of workshop participants supported a partial redirection of international financing for research on neglected infectious diseases such that it would be managed and distributed by local funding mechanisms. It was recognized that channelling funding in this manner should be accompanied by efforts to build capacity for identifying and prioritizing research needs at the subnational level, as well as strengthened financial accountability mechanisms.

Meanwhile, national academies of science should work with governments to implement



Dr. Charlie Weller, Head of the Vaccine and Epidemics Platform at the Wellcome Trust in conversation with Dr. Charles Masembe, Makerere University, Uganda.

strategies and funding mechanisms that encourage academic freedom and independent science. Locally important research topics can be encouraged by funders and governments by contributing resources to local funding structures that offer a mix of open and directed calls for research proposals.

Finally, whilst there was a strong consensus that strengthened local research capacities are essential for meeting the challenges of both endemic and emergent diseases, there was recognition that our conceptualizations of the local also require further reflection. In some instances, national institutions and organizations are treated as local, and in other instances the local refers to sub-regions, districts or communities. Furthermore, it is recognized that the local is rarely a homogenous entity, and positions and interests of local actors often diverge significantly.

Incorporate more diverse knowledges into evidence-based decision making

The workshop identified poor integration of knowledge from the local contexts where disease is endemic or emergent as a factor that impeded our ability to solve disease challenges. With

more than 85 % of workshop participants in agreement, we concluded that enhancements are required in evidence-based policy-making processes to include multiple stakeholders. Locally-based researchers must recognize politicians and civil servants as important targets for communicating research results and influencing the governance of health and infectious disease. Support for improved scientific journalism is a valuable tool for reaching these stakeholders, as well as the general public.

Beyond including international and national level stakeholders, there is a need to find new methods and tools for including insights and knowledges from local communities and institutions that may lack strong political influence at the national or international level, but nevertheless play an essential role in local level community processes. A clear majority of workshop participants argued for greater equity for holders of traditional, indigenous and local knowledges into evidence-based decision-making processes.

The workshop concluded that at present local researchers and public authorities often have difficulty to communicate their respective priorities to each other. This poor communication often arises when the respective parts only engage with each other near the end of a research or policy-making process. The workshop recommended that *researchers and policy-makers develop continuous dialogue processes that incorporate joint development, implementation and translation of research priorities and programmes.*

Finally, multidisciplinary and interdisciplinary approaches were identified as fundamental to achieving sustainable solutions to endemic and emergent health challenges. Social sciences were highlighted as underutilized and insufficiently incorporated into One Health approaches in general.

Incentives

The profit incentive alone is insufficient for catalysing and mobilizing new One Health solutions to endemic and emerging infectious diseases in countries where poverty rates are high. As such, the workshop identified a need to create a diversified incentive environment for encouraging new drugs, vaccines, diagnostics and social inno-

vations. One intended outcome would be a more equitable allocation of resources to research priorities that better reflects both the actual costs to health and well-being posed by specific challenges, and the scale of potential gains from specific investments.

Final conclusions

The greatest burden of infectious disease is currently concentrated in low and middle-income countries located in the tropical and sub-tropical zones of the Earth. These are the same regions that are most likely to give rise to emergent diseases with global reach. Meanwhile, research on infectious disease is largely donor-driven and carried out with financing from wealthy countries. Consequently, *resource allocation for research is often skewed towards addressing fears of future emerging threats rather than contemporary endemic disease challenges*. As one workshop participant wondered:

how can we expect to prevent, detect and respond to future crises when capacity is already lacking to solve those that already exist?

The workshop's answer is to call for a fundamental shift in power to identify research priorities, carry out research, and bring research-based knowledge into policy and practice from international funders and science partners, towards local researchers, policy-makers and communities. We aspire to a new balance in influence and resources that can serve as a foundation for equitable partnerships amongst local and international stakeholders committed to mitigating the challenges posed by the infectious diseases that are persistent and continuing threats to health and well-being. Long-term investments in equitable partnerships and local research capacities will be the bulwark from which future emergent disease outbreaks are overcome.

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Workshop G

Drivers and Constraints in the Use of Modern Typing Tools to Trace Foodborne Disease

Mats Lindblad*, National Food Agency
Catarina Flink, National Food Agency
Cecilia Jernberg, Public Health Agency of Sweden
Ann Lindberg, National Veterinary Institute

* mats.lindblad@slv.se

Aim

The aim of the workshop was to stimulate different stakeholders and disciplines to discuss the benefits of data sharing and the opportunities the new molecular surveillance tools, such as whole genome sequencing, WGS, are providing from an One Health perspective. The participants were to discuss the national and international possibilities and constraints in regard to sharing data, joint analysis and communication in outbreak investigations. The workshop started with an introduction to highlight the work done at EU level to facilitate cross-border sharing and communication and trace back investigations as well as an illustration of a recent example of a multinational outbreak investigation where WGS was applied as a tool. The workshop participants worked collectively to identify barriers which prevent the application of the available typing tools or the sharing of molecular and epidemiological data.

The focus areas of the workshop were:

- The legal constraints between the human, veterinary and food sectors and countries.
- Technical challenges and analysis normalization where different platforms and analysis softwares are used.

- Transition from old to new technology: will backward compatibility be lost and thereby the link to historical data?
- What is needed to reach the goal of real-time surveillance?

Participants of this workshop came from different countries and from various domains. Participants had varying experience in typing and data sharing which was reflected in the group discussions.

Background

Globally, infectious diseases cause approximately 22 percent of all human deaths, and are also a major burden to animal health. In addition, they cause an increased financial burden on health systems and society at large. The longer it takes before the causative agents are detected, the greater the consequences for the individual or the population. Foodborne infections can also have considerable implications for trade. Therefore, rapid national and international surveillance systems and methodologies for exchange and comparison of information on the worldwide spread of foodborne zoonotic pathogens are highly needed for tracing the origin of the source and to investigate complex outbreaks.



From left to right: Dr. Annemarie Green, Animal and Plant Health Agency, UK, Constance Walyaro, Talk ABR, Kenya, Dr. Sofia Boqvist, Swedish Agriculture University, Dr. Catarina Flink, National Food Agency, Sweden. Writing on the board: Dr. Carlos Das Neves, Norwegian Veterinary Institute.

Molecular typing methods for foodborne pathogens are beginning to be routinely applied worldwide, e.g. investigating foodborne outbreaks, identifying strains of foodborne bacteria with high virulence potential or resistance to antimicrobials.

However, the evolution of rapid sequencing technology as well as an increased capacity in bioinformatics has led to whole genome sequencing (WGS) methods becoming more and more feasible. The potential of WGS is now actively being considered in several areas including: pathogen characterisation and typing, outbreak detection and investigation, risk assessment and high-resolution molecular epidemiology.

In Europe, the European Centre for Disease Prevention and Control (ECDC) is hosting a molecular surveillance platform called The European Surveillance System (TESSy) molecular surveillance service (MSS) which is used for routine molecular surveillance linking up public health reference laboratories across Europe for real-time sharing of data from traditional molecular typing techniques for selected foodborne bacterial pathogens. In addition, a limited set of

additional information about the isolates (meta-data) can be shared, such as country of origin, age and gender, depending on the ability of each country. If multi-country clusters are detected, the countries concerned are informed and, when needed, ECDC can also provide support during the outbreak investigations. Recently, a possibility to share data on isolates from food, feed and animals has been added for cross sectorial comparison, in cooperations with the European Food Safety Authority and the European Union Reference Laboratories.

Main conclusions

Drivers:

- *Cost-efficient methods are available*

Cost-efficient methods for detection and typing are already available for several foodborne pathogens although experience of the routine use of whole genome sequencing, WGS, in outbreak investigations is still limited. Fortunately, these methods can be applied to multiple pathogens. The costs for WGS are steadily decreasing and thus will be more affordable to apply. Using WGS is improving the accuracy and effectiveness of disease surveillance. It will also facilitate whole genome sequencing



in future evaluation of prevention policies by enhanced assessment of diseases and drug resistance transmission dynamics with the final goal to make a difference for public health intervention.

- *Benefits of data sharing*
Some countries and organizations already have experience in sharing typing data (both old typing techniques as well as WGS data) especially from investigations of national and multinational food-borne outbreaks. Sharing of data in these investigations has been fruitful. The workshop participants pointed out that collection of this genomic data will not solely lead to more successful outbreak investigations but will also increase our knowledge on the epidemiology of pathogens/diseases, on the virulence properties and on antimicrobial resistance. In the long run, this information could probably be used not only for outbreak investigations but also for solving, what is today seen as, sporadic cases. In addition, for studies on source attribution, when estimating the contribution of different food categories or animal species as sources of human infections, WGS data makes it possible to assess the molecular diversity and circulation of strains within the food chain.

- *Existing communication and collaboration pathways*
The existing communication and collaboration pathways at the EU level and in the US are clear drivers for the development of typing and data sharing. Communication pathways, although long, have been developed. The European Food Safety Authority (EFSA), together with the European Union Reference Laboratories (EURLs), and ECDC, together with the public health agencies, have successively strengthened their collaboration in the field of molecular surveillance of foodborne diseases. A first step has been to initiate the possibility to share data generated using traditional molecular typing tools within the ECDC platform. The purpose of the joint ECDC-EFSA molecular typing database is to share comparable typing data in a common repository so that microbiological data from humans can be linked to similar data from animals, food and feed (Rizzi et al., 2017). In other words, at EU level there is a clear need and willingness to foster a multidisciplinary interpretation of the information arising from the combination of epidemiological and molecular pathogen characterisation data to guide public health action.

- *Need for harmonized methods*
There are different commercially high-throughput next generation sequencing (NGS) platforms available today, in addition to different bioinformatics pipelines for analyses of the sequence data, both in house pipelines and commercial software as well as free. What is needed in a laboratory for routine WGS application that have the goal to share the data is: (i) the adoption of appropriate quality assurance/quality control (QA/QC) measures; (ii) the development and harmonisation of SOPs; (iii) the establishment of database infrastructure; and (iv) the generation and dissemination of appropriate sets of genomic reference datasets. The choice of which typing scheme to be used for the respective pathogen could also be seen as a challenge. Specifically in outbreak investigations there is also a need for harmonization regarding clustering techniques, where different approaches are used today. Identification of SNP (single nucleotide polymorphisms) differences and different cgMLST (core genome MLST) schemes are available.

Challenges:

- *Trust and protection of interest*

The agreement of sharing molecular typing data between countries and sectors is a large step forward politically. Prior to any agreement, the involved partners need to be aware of and accept the necessity of sharing typing data. One of the challenges that now lies ahead specifically regards the epidemiological data, that is connected to the shared genomic data, thus to each and every isolate. Countries might have different priorities and interests in sharing this sensitive data. Thus, the hesitance from decision makers and the industry to participate in the collection, compilation and sharing of this data needs to be addressed with care. Countries and sectors have different priorities depending on other more urgent issues or health problems. The responsibilities of the different partners (decision makers, laboratories, IT resources) need to be clarified.

- *Legal aspects*

Today the epidemiological data shared is very limited, if any. There could be sensitive epidemiological data that will have to remain available only to the competent authorities, so releasing this sensitive data will not easily, or even necessarily, become a routine procedure. There could be several impediments for the free sharing of sequencing data.

The deposition of the microbial genomic sequence data in databases for public access

beyond the control of the owner of the data is more or less common practice today. However, legal obstacles are to be expected and a careful balance must be struck between the desirable complete openness from a food safety point of view and the privacy and related concerns that necessitate confidentiality.* Possibly a standard for encryption may need to be developed, to allow exchange of data to be limited to authorized parties only. Ignoring these issues is likely to considerably delay the successful large-scale implementation of WGS for public health at international level.

- *Resources and competence*

Collection, maintenance and sharing of genomic data demand both financial and human resources. Competence in the application of these laboratory techniques as well as in IT skills and bioinformatics skills are essential. Training of personnel is needed. The participants discussed how to solve the financial problems of setting up, training and maintenance and who could be responsible for this burden. The participants also acknowledged the imbalance with regard to the pace at which different individual countries will be able to change methodology to WGS, which specifically has a high establishment cost.

* See new EU legislation on personal data protection, in effect from 25 May 2018: <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016R0679&from=EN>

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Uppsala Health Summit 2018

Care For Cancer

Uppsala Castle, 14–15 June

Each year, more than 8 million people worldwide die from cancer, and over 17 million people get a cancer diagnosis. The number of new cases is projected to rise dramatically in the coming decades, especially in low and middle-income countries. While cancer still is one of our most deadly diseases, scientific breakthroughs open up for more patients to survive a cancer diagnosis. Incidence and prevalence are growing simultaneously, putting already strained health budgets under high pressure. Prevention is important, but can only solve part of the problem.

In May 2017, the World Health Assembly adopted a resolution, urging all member states to develop national cancer plans, emphasizing the need for access to early diagnosis, evidence based treatment and care.

Strained resources in all healthcare systems, and unequal access to treatments impose high demands on fair and effective healthcare governance and prioritizations. As the Economist put it in a recent article: “Science will win the technical battle against cancer. But that is only half the fight”.

Uppsala Health Summit 2018 will therefore convene on the theme **Care for Cancer**. Discussions will focus on how to open up opportunities for a growing number of patients worldwide, by making more efficient use of data, e.g. in publications, medical records, registries, biobanks, available tools for diagnosis and treatment, patients’ own reports and experiences, and other resources.

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Uppsala Health Summit
c/o Uppsala University
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