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LOOKING AHEAD TO 2040: SYSTEMS FOR REPORTING, MONITORING, AND ANALYZING ANIMAL HEALTH DATA

**Global Conference on Biological Threat Reduction
30 June-2 July 2015
Paris, France**

Dr. Tammy Beckham
Director, Institute for Infectious Animal Diseases
Texas A&M University System



Good morning. I appreciate the opportunity to join you at the Global Conference on Biological Threat Reduction and I'm pleased to present a perspective on the future of systems for reporting , monitoring, analyzing and sharing animal health data.

Overview of Presentation

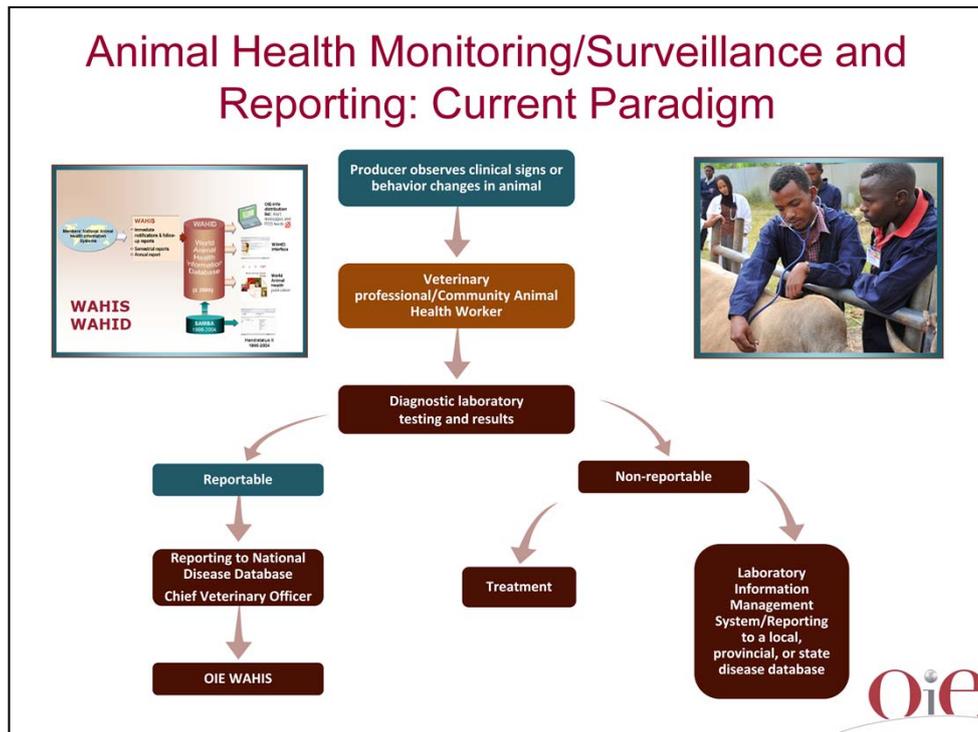
- Current Paradigm
- Technology Revolution
 - Near Term Opportunities/Challenges
 - Longer Term Technologies that are on the Horizon
- Challenges
- Next Steps
- Conclusions

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In today's presentation, I'll give a brief overview of the current paradigm that describes global animal health monitoring & surveillance. I'll then quickly turn to look at how the technology revolution is impacting and will be impacting the manner in which we collect, store, analyze and share information in the coming years..

Animal Health Monitoring/Surveillance and Reporting: Current Paradigm



The current paradigm for collecting, animal health data is heavily dependent on the veterinarian and/or community animal health worker making a visit after they have been notified by the farmer and/or producer that there is a sick animal or animal demonstrating clinical signs. The veterinarian visits the farm, submits samples to the laboratory if needed and those results get reported along different pathways depending on whether it is a reportable disease or non reportable disease.

Current Paradigm

- **Strong veterinary services within country**
 - Defined policies for reporting of animal health data
 - Robust animal health programs
 - Trained and educated animal health workforce
- **Robust network of veterinary diagnostic laboratories**
 - Trained/accredited laboratories (local, regional and reference laboratories)
 - Trained veterinary diagnostic personnel
- **OIE**
 - Standard setting body
 - PVS helping to strengthen Veterinary Capacity and ties with public health sector
 - Twinning projects
 - One Health



OIE

The current paradigm is dependent on a strong veterinary services component and a strong laboratory network with an associated workforce.

To this end, the OIE is working with member countries through the PVS tool to help establish levels of performance, identify gaps and establish priorities and strategies for strengthening their veterinary services.

Animal Health Data Collection: Current Paradigm

- **Challenges:**

- Limited Veterinary Services

Resources

- Fewer field veterinarians

- Methods of data transfer

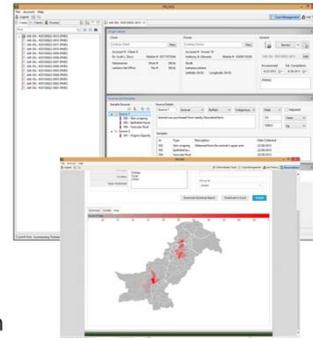
- Spreadsheets, phone, email
- Laboratory Information Management Systems
- Data standards and interoperability of systems

- Lack of real time data and situational awareness

- Leads to difficulty with early detection of emerging diseases
 - Clinical signs but with laboratory “negatives”
- Limited data sharing among veterinarians in the field
- Delayed actions and control measures

Px ID	Rectal temp	Stool	Behavior	Appetite	Body condition	Hydration	Ambulation	Respiratory	Skin	Additional notes
1234	1234	123	123	123	123	123	123	123	123	
1234	1234	123	123	123	123	123	123	123	123	
1234	1234	123	123	123	123	123	123	123	123	

Stool consistency	Behavior	Appetite	Body condition	Hydration	Ambulation
1. normal	1. normal	1. normal	1. normal	1. normal	1. normal
2. semi-formed	2. lethargic	2. diminished	2. gaunt	2. slight dehydration	2. lame
3. diarrhea	3. stupid	3. anorexic	3. thin	3. severe dehydration	3. down
4. diarrhea with mucus	4. moribund				



Some of the challenges associated with the current paradigm include limited veterinary services, and lack of information technology solutions that allow for efficient integration, collection and, analysis, of data. These limitations often result in a lack of situational awareness and delay in time to detection of emerging and/or zoonotic diseases.

Information Technology Revolution



- Globally available technologies are revolutionizing the manner in which animal health and welfare data is collected, integrated, analyzed, shared and disseminated to stakeholders
 - Veterinarians, community animal health workers, animal owners and producers, and federal, provincial, state, local animal health authorities
- Offer substantial opportunities for enhancing global animal and ecosystem health
 - Power to collect, filter, process and present data from multiple sources
 - Increases situational awareness, enhances decision making and provides greater ability for early detection and control of animal diseases

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- But today we are witnessing an information technology revolution. Technology developments are not only changing the way that we perform daily activities such as banking, talking with our friends, sharing special moments, and staying up to date on current events, they are also changing the manner in which animal disease data and information is collected, integrated, reported, analyzed, shared, and disseminated to stakeholders. These new technologies offer substantial opportunities for enhancing animal, public and ecosystem health across the globe.

They give us the power to collect, filter, process, and present data that can allow for earlier detection of disease, enhance decision making, and increase our situational awareness.

Technology Innovations

- Revolutionizing Technologies
 - Remote data collection
 - Mobile technologies (m-health)
 - Smartphones, mobile phones, tablets, personal digital assistants (PDAs), global positioning systems (GPS) devices
 - Online data entry/import tools
 - Remote sensing/collection devices
 - Radio frequency identification devices (RFID), identification/barcode readers, biosensors
 - Data Management Systems
 - Laboratory Information Management Systems (LIMS)
 - Animal health and data management software, geographic information systems (GIS), movement databases



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For the purpose of this talk, I have grouped the technological innovations that are revolutionizing animal health data collection and utilization into four broad categories: The first two are remote data collection and data management systems.

- 1) Remote data collection is and can occur through a variety of mobile technologies –otherwise known as m-health technologies. These include smartphones, mobile phones, tablets, PDAs, global positioning systems as well as online data entry tools and remote sensing devices.
- 2) Electronic health or e-health technologies such as laboratory information and Animal health and data management software systems make up the second broad group.

With the growing availability of reliable internet connections, m-health and e-health technologies are being increasingly utilized to capture and analyze animal movements, management and production data, premises identifications, animal identifications, diagnostic test results and much more. Their capabilities offer user-friendly, low-cost, and low-maintenance options for collecting, storing, and

analyzing trends in animal health, movements, and management.

In addition, the mobile technologies offer/allow for for bi-directional communication with these veterinary stakeholders, providing a platform for timely sharing of important animal disease information and events.

OPTIONAL: Rapid advances in mobile technologies and applications have created new opportunities for capturing animal health data from veterinarians, community animal health workers, animal owners/producers, and farmer.

According to the International Telecommunication Union (ITU), there are now over five billion wireless subscribers; and over 70% of them reside in low- and middle-income countries. In addition, the Groupe Speciale Mobile (GSM) Association reports commercial wireless signals cover over 85% of the world's population, extending far beyond the reach of the electrical grid ⁽²⁾.

Technology Innovations

- Revolutionizing Technologies

- Diagnostics

- Point of Care (POC) testing
 - Pen-side and chute-side tests
 - Tele-diagnostics
 - Remote monitoring or diagnosis of health

- Online Media

- Traditional Media
 - Online news, libraries, references
 - Social Media
 - Facebook, Twitter, Instagram, Wikis, blogs, discussion forums, citizen science, crowd sourcing



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Penside diagnostics, including those linked to GPS and remote data transmittal devices are also beginning to revolutionize the manner in which animal health data, more specifically diagnostic test results are captured and transmitted. Lateral flow devices for FMD and other diseases are currently utilized at a high rate in some of the OIE regions. As the use of these types of devices increase and they become more readily available, it will be of utmost importance to ensure that there is a mechanism for capturing results into formalized animal health databases.

Traditional media venues such as newspapers, radio, and television have long been used to communicate health information to the public, and although still utilized heavily in many regions, a new form of messaging has emerged: social media. Social media (twitter, facebook), unlike traditional media formats, is a multi-directional method with the potential for not only disseminating important health messages to veterinarians, animal owners/producers, and the public; but also gathering this same type of information for analysis by veterinary and public health officials.

Near Term Technologies: Opportunities

- Mobile Devices
 - Data collected in “real time”
 - Increased situational awareness
 - Earlier time to detection
 - Increases role of first responder/producer
 - Enhance situational awareness of first responder
 - Direct line to veterinary professional and/or community animal health worker
 - Syndromic/emerging disease surveillance
 - Useful for data collection and reporting at multiple levels
 - Producer, Veterinarian



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Mobile devices offer an incredible opportunity to engage farmers, producers, community animal health workers as well as veterinarians in global surveillance. It increases the role of the first responder. With these devices, data can be collected in real time, resulting in increased situational awareness and the ability to communicate timely, important animal health information back to the end user.

As mentioned in yesterday's talks, technology leaps have resulted in outstanding cell service and cellular infrastructure throughout many developing countries – sometimes even better than in cities throughout Europe and the United States.

Near Term Technologies: Opportunities

- Pen-side tests (chute side assays)

- Implementation Opportunities

- Producer Level

- Local level diagnosis that may or may not lead to treatment

- Veterinary Professional

- Triage/Screening tool for faster diagnosis/presumptive diagnosis

- » For use as part of a diagnostic schema that includes reference laboratory and advanced diagnostics

- Faster time to treatment with positive result/known diagnosis

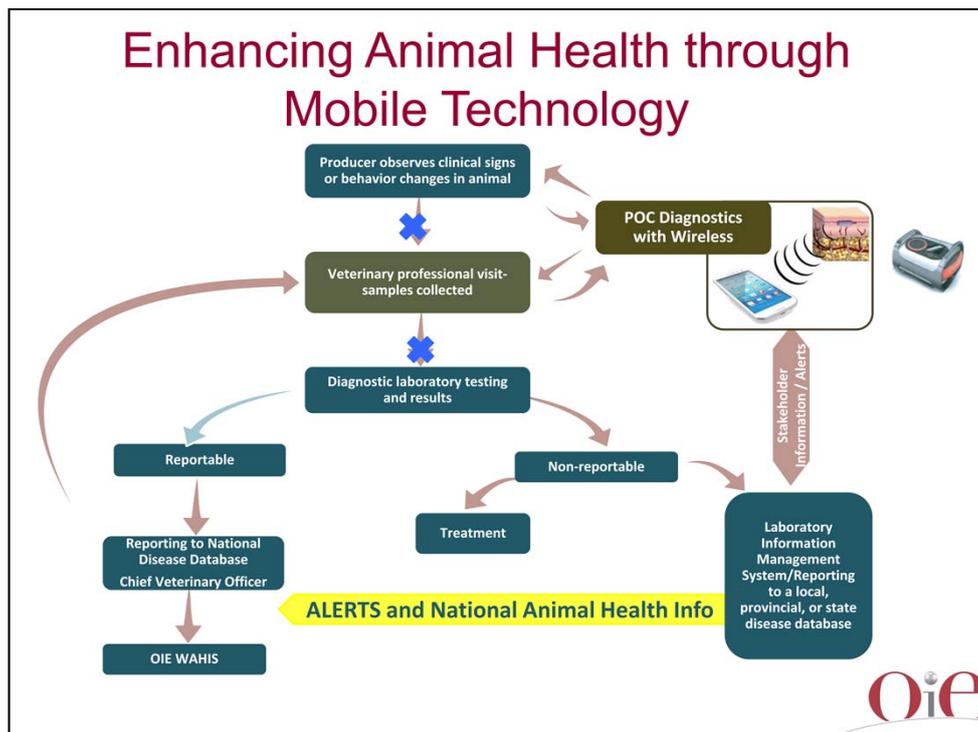
- » Negative test results more difficult to interpret/treat



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Likewise, The availability of pen-side tests (those basic tests as well as those equipped with GPS and wireless capabilities) to producers, and community animal health workers is changing the way that animal health data is captured and acted upon.

The question is, what is the advantage of utilizing these new technologies and what are the challenges associated with leveraging them to enhance awareness and animal health?



For example, if these technologies are made available to farmers, producers and other community workers, it will still be critical for the veterinarian to remain involved in animal health decisions. These technologies may allow for a more localized and rapid diagnosis—but it will still be critical that these data streams are captured and entered into national and global databases.



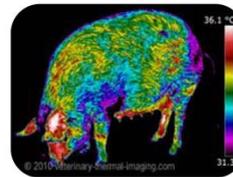
Technologies on the Horizon (Longer Term)

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While I've just covered many of the technologies that are here and now...but not yet fully implemented and leveraged, I'm now going to talk about some of those technologies that are more long term and on the horizon.

Technologies on the horizon: Longer Term

- Biosensors
- Infrared Thermography
- Drones



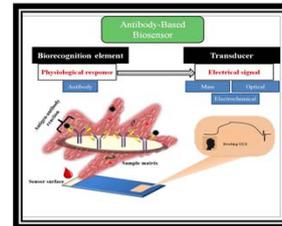
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Biosensors, infrared thermography and drones are three of those technologies.

Technologies on the Horizon: Longer Term

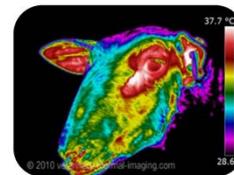
- Biosensors

- Compact analytical devices that incorporate a biological sensing element, either closely connected to, or integrated within, a transducer system that converts the biorecognition event into a measurable signal



- Infrared Thermography

- Mobile and Portable
- Common conditions can be recognized before clinical signs
 - Foot abscesses
 - FMDv, other high consequence diseases
- Development needed
- Proof of concepts needed



Oie

Biosensors are analytical devices that can incorporate a biological sensing element that converts a bio recognition event into a signal.

Potential Uses of biosensors include:

- Bacteriological Food Safety
- Veterinary Drug Residues
- Veterinary Viral Pathogens
- Monitoring animal fertility

Infrared thermography is a technology that has begun to be explored and has potential for use in recognizing a condition before clinical signs. Early results from FMDV studies with this technology were promising for its ability to detect infection before the onset of clinical signs.

Technologies on the Horizon: Longer Term

- Unmanned aerial vehicles (UAVs) or Drones
 - Fixed winged and multi-motor (low altitude)
 - Sensors on board
 - Larger areas or lower altitude for individual animal observations
 - Becoming smaller, cheaper and targeted to agriculture
 - Animal health/management utility
 - Help make operations run more smoothly
 - Identify sick animals
 - Thermal sensors for temperature
 - Detect heat status of breeding animals
 - Collect number from animal RFID tags
 - Sense livestock/wildlife in distress
 - Checking of feedbunks
 - Pasture conditions

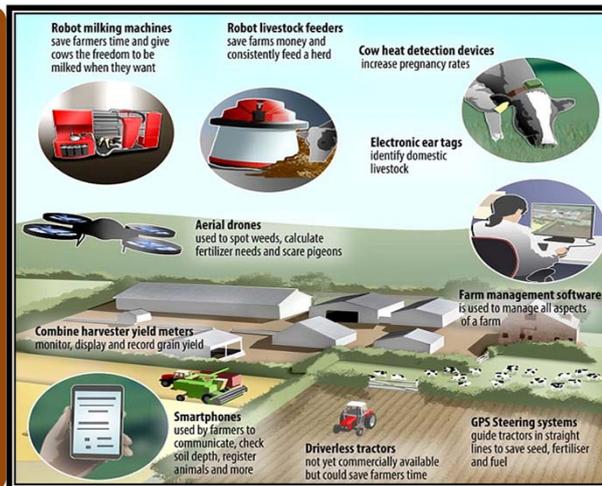


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UAVs/drones are becoming smaller and cheaper to utilize and are now being targeted to agriculture. Potential uses include identification of sick animals, checking on feedbunks, detecting heat status of breeding animals and sensing livestock and/or wildlife in distress.

Today's Digital World

- How will emerging technologies revolutionize how we collect and analyze animal health data
- How can we leverage them to enhance animal health situational awareness?
- What policies are required for integration of new tools?
- What infrastructure and support are needed?
- How will we ensure data confidentiality?



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So, in summary, we are witnessing a rapid development and utilization of technologies that can be and are being used to support animal health and welfare..... and as is so often the case, the development of new technologies often outpaces the rate at which we can develop policies to support their use and fully realize their potential.

Implementation of these tools and our ability to fully realize their power for supporting animal health will require that we address many of the questions on this slide and others that are not. For example, how can these technologies be best utilized to help enhance situational awareness and thus decrease our response time to events of animal and public health significance?

What infrastructure, training, and capacity building will be required? How do we ensure data confidentiality?

As many of these new information and communication technologies are developed to support animal health and welfare....., approaches for accessing, implementing, standardizing, utilizing, and harmonizing these systems will be needed.

Challenges



- Policy decisions
 - How are the test results and/or mobile reports gathered and used?
 - Difference between use in endemic and disease free situations
 - How are results captured for use in national animal health programs?
 - What are the implications of positive test results for the farmers?
 - What are the implications of positive test results on the markets?
 - What are the implications on trade?
 - Use of chute-side tests for reportable diseases?
 - Who uses them
 - How are they controlled (freely available/controlled/endemic diseases/reportable diseases)
 - What are the expectations of the stakeholders?
 - Use of mobile technologies for syndromic/clinical disease surveillance
 - What are the implications of reports and how do we ensure confidentiality of data?
 - How do we incentivize their use?
 - User friendly interface? Time to enter data?

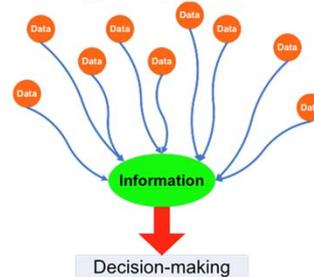


Some of the biggest challenges that we face will be the development of policies at a rate that supports utilization of these technologies. A sample set of policy decisions and/or questions is represented on this slide. For example, what are the implications of syndromic reports generated through mobile devices? How can we incentivize the use of mobile phones and other technologies to support global animal health?

How do we ensure when chute side tests are performed that the data is captured and the veterinarian remains involved health decisions regarding that animal and/or herd?

Challenges

- Data
 - Confidentiality
 - Big data- analysis
 - Generating useful information from a wealth of data
 - “Giving useful information” to the participants
 - Support for analysis, risk analysis, modeling, etc.
- Infrastructure
 - Wireless networks
 - Service for mobile devices
 - Costs of newer technologies



Cristobal Zepeda, USDA APHIS



Now that we have the ability to capture large amounts of data, how can we ensure confidentiality and how do we incentivize users by providing them useful information back?

Who will support the cost, infrastructure and training for new technologies?

Summary

- Veterinary/Agricultural enterprise has traditionally embraced new technologies slowly
 - Implications to impact trade
 - Resources to harness and implement new technologies
 - Lack of policies to support a change in paradigm for animal health
 - Example: U.S. lacks policy for use of penside lateral flow assays for FMD even though they have been validated and are in use in endemic countries



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As we know, the veterinary/agricultural enterprise has traditionally be slow to adopt new technologies.

Of course, some of the reasons for this include the implications of such data on trade, and as mentioned before, the personnel resources to support such technology development and utilization is often lacking.

Questions Remaining

- How do we adapt to ensure state-of-the-art animal health monitoring and services?
 - Cellular phones and smart phones are revolutionizing banking, human health and other daily activities in both developed and developing nations
- How do we ensure the next generation of veterinarians will be educated in and adopt newly emerging technologies?
- How do we ensure veterinary professionals remain the focal point of animal health?
- How do we ensure veterinary diagnostic laboratories continue to play a critical role?



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So, while we begin to evaluate the usefulness of currently available and newer technologies, we still have many questions to be answered?

How we we adapt to ensure state-of-the-art animal health monitoring? How will we ensure our next generation of veterinarians will be educated in and conversant in the value of utilizing the technologies? And how do we ensure that both veterinarians and laboratories continue to play a central role in global animal health surveillance and monitoring.

Summary



- Technologies offer substantial opportunities for enhancing animal, public and ecosystem health across the globe
- Technologies can be leveraged for disease reporting at the local, national, regional, and global levels
- OIE's support and/or involvement to promote the development, implementation, and integration of these technologies will be critical for establishing capacity for adoption and utilization
- Development of data standards and guidelines to enhance data quality, allow efficient data sharing, and allow for broader application of technologies within OIE Member Countries
- Continue to promote data sharing and integration with Member Countries and inclusion of public health authorities

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In summary,

These new technologies offer substantial opportunities for enhancing animal, public and ecosystem health across the globe. Harnessing existing and new technological advances in an effort to ensure timely and accurate disease information collection and dissemination will require resources, development of policy and standards, as well as training for individuals located throughout every level of veterinary services.

The OIE should work to develop standards and identify and implement incentives that encourage early reporting from both formal and informal data sources. Methods for incentivizing, incorporating and analyzing “informal” animal health reports within the WAHIS system should be enhanced with input including verification from OIE Member Countries.

Human/Animal and Ecosystem Surveillance

