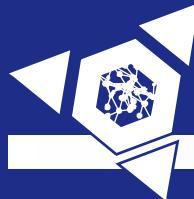




Improving Animal Health: Can It Influence Security?

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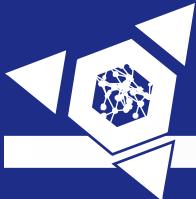
Melissa R. Finley, DVM, PhD, DACVIM
International Biological Threat Reduction
Sandia National Laboratories
May 13, 2008



Livestock and Human Development

- Livestock directly contribute to the livelihood of approximately 70% of the world's poor
 - Livestock serve as a source for economic development
 - Services that support livestock development also promote economic development
- Livestock provide an important source of protein for much of the world: eggs, meat, milk
- Livestock reflect higher societal status
- Companionship

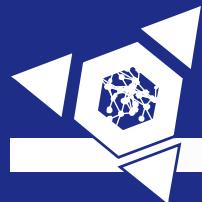




Role of Animals in Public Health

- **Livestock contribute to economic stability**
 - People with income can afford medical services and food
- **Livestock are a source of food and nutrition**
 - Immunosuppression: Malnutrition weakens the body's ability to fight disease
 - Malnutrition may stifle brain development
- **Livestock can be a source of pathogens that cause infectious disease**
 - Some animal diseases cross the species barrier and can infect humans (zoonoses)





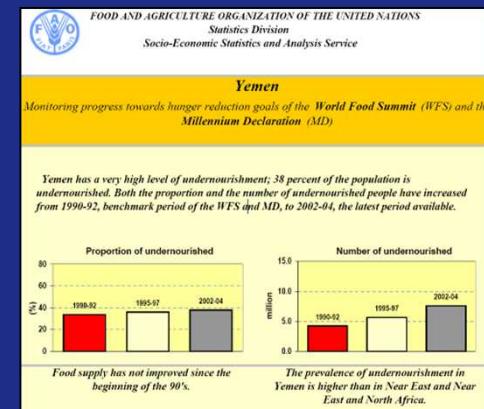
Improving Animal Health Will Improve the Food Supply

- **Improved animal health, well-being, and nutritional status will increase production capabilities and quantities, and economic returns**
 - Increased milk and egg production
 - Increased weight gain improves meat production
 - Enhanced food safety
- **Increased food supply and opportunities for economic development will improve public health and well being**
 - On April 15, 2008, the BBC reported that Iraqi militias were using food as a recruiting tool, using Hezbollah as a model
- **Elimination of specific livestock pathogens will allow countries to resume international trade**

Egypt – Dairy Directive Project (DDP)

PROMOTING IMPROVEMENTS IN THE DAIRY SECTOR TO PREVENT CHILD MALNUTRITION & ILLNESSES

From 2001 to 2004, ACDEVOC's Dairy Directive Project (DDP) worked throughout Egypt to prevent child malnutrition and the illnesses associated with contaminated and spoiled dairy products by promoting improvements in the dairy sector.

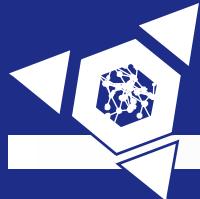




Improving Animal Health Will Improve Public Health

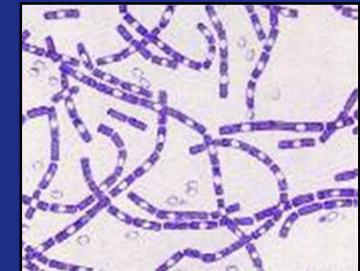
- Reducing infectious diseases in livestock will mitigate the risk of human infection with zoonotic pathogens
 - *Bacillus anthracis*
 - *Brucella abortus, B. melitensis, B. suis*
 - *Mycobacterium bovis*
 - *Nipah virus*
 - Highly pathogenic avian influenza viruses
- Eradication and control of certain livestock pathogens will reduce availability of agents in nature that can be maliciously acquired and disseminated
 - Foot and mouth disease virus
 - *Bacillus anthracis*
 - *Brucella spp.*
 - *Burkholderia pseudomallei*



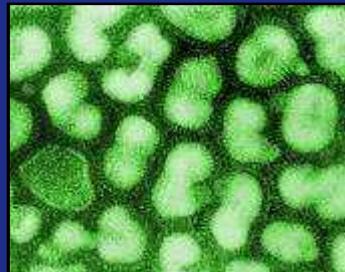


Zoonotic Potential of Animal Pathogens

- 60% of human pathogens are zoonotic
- 80% of animal pathogens are multi-host
- 75% of emerging diseases are zoonotic
- 80% of potential bioterrorism agents are zoonotic pathogens
- ***Nearly all new human (infectious) diseases originate from animal reservoirs***



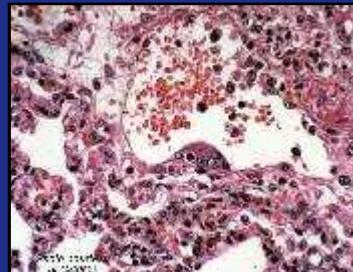
Bacillus anthracis



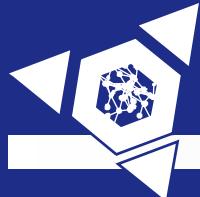
Avian influenza virus



SARS virus



Nipah virus in pig lung



Mechanisms for Improving Animal Health

- **Strengthening veterinary services**

- Human capital
- Early detection strategies
- Surveillance
- Rapid and reliable diagnostic testing
- Established control plans
- Prevention strategies



MEDICINE

Initiative Aims to Merge Animal and Human Health Science to Benefit Both

Medical and veterinary science are like siblings who have grown apart. But now, there's a flurry of efforts to reunite them. Proponents of this idea, called "one medicine" or "one health," say that breaking down the walls between the two fields will help fight diseases that jump from animals to humans, such as SARS and avian influenza, and advance both human and animal health.

rural areas, versus more than 140, mostly urban-based, schools of medicine.

The benefits of collaboration could go beyond zoonoses, says Jakob Zinsstag of the Swiss Tropical Institute in Basel. For instance, in Chad, Zinsstag has helped introduce joint vaccination campaigns for livestock and

humans, which has helped raise vaccination rates of hard-to-reach nomadic populations. In the United Kingdom, It's all connected. Human and animal medicine should grow closer together, One Health supporters say.



the Comparative Clinical

- **Promoting “one-health” concept**

- Integration of public and animal health sectors
 - **Combat zoonotic diseases**
 - **Enhance food safety**
 - **Improve characterization of newly emerging infectious diseases**

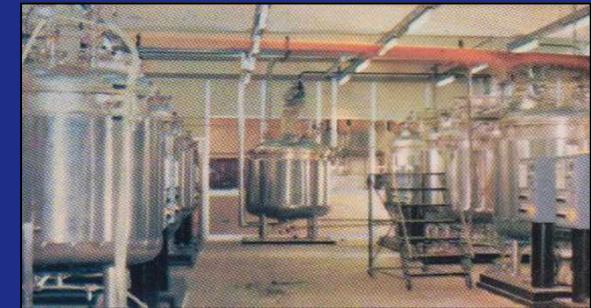
- **Improving livestock production**

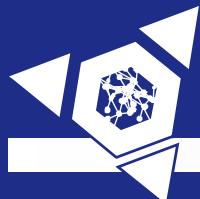




Precautions for Building Animal Health Capacity: “Dual-Use Dilemma”

- **Many of the tools, techniques, and equipment used to detect, diagnose, control, and prevent animal diseases are “dual-use” – they can be used for good or harm**
 - Transparent surveillance networks that support early detection
 - Laboratory diagnostic methods that promote viral and bacterial isolation and amplification
 - Vaccine manufacturing facilities that amplify and store large quantities of pathogens, and that have the equipment and skills to produce large volumes of pathogens
 - Research techniques that require amplification and/or genetic modification of pathogens





Precautions for Building Animal Health Capacity: “Dual-Use Dilemma”

- **Early detection**

- Transparent surveillance networks may reveal reliable sources of pathogens to those who intend to acquire agents for malicious development and dissemination

- **Many surveillance networks are widely available on the internet**

- Location of outbreak
- Number of animals affected
- Species affected
- Strain identified
- Laboratory conducting diagnostic testing

The Global Foot-and-Mouth Disease Surveillance & Modeling Laboratory (FMD Lab)

The Global FMD Modeling and Surveillance Laboratory (FMD Lab) is part of the Center for Animal Disease Modeling and Surveillance (CADMS), and is led by Dr. Mark Thurmond. The FMD Lab develops models and systems for global FMD surveillance, which include the FMD BioPortal web-based system and FMD-related data from the FMD World Reference Laboratory, Purbiog, the OIE, the FAO, and other national and international sources.

Laboratory personnel include faculty, adjuncts, postdoctoral fellows, graduate students, and computer analysts and programmers. Interests and expertise include mathematical, Bayesian, and epidemiological modeling, clinical and laboratory diagnostic methods for FMD, computer and geographic information systems, infectious disease epidemiology, economics, and international veterinary medicine. The laboratory is supported in part by the state of California, through the University of California and the Agricultural Experiment Station. Collaboration and support has been provided by livestock industries, commercial companies, national laboratories, other academic institutions, government agencies of the U.S. and other countries, and international organizations and laboratories.

Laboratory Objectives

- Capture and disseminate FMD and FMD-related data and information.
- Develop FMD databases.
- Develop models for real-time FMD surveillance.
- Develop diagnostic and detection systems for use in surveillance.
- Map regional and global distributions of FMD and of FMD risk.
- Develop models to predict disease movement and transmission.
- Develop spatio-temporal prediction models for molecular changes in the virus.
- Develop anomaly detection surveillance systems.
- Assess risks of FMD associated with management practices and other factors.
- Model competing strategies for biosecurity, control, and eradication.
- Utilize web portal technology to route information and models in real time.



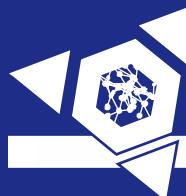


Foot and Mouth Disease Surveillance: WRL

- The University of California Davis, in collaboration with the World Reference Laboratory (WRL) for foot and mouth disease, has established a internet-based surveillance system for this disease



Data from World Reference Laboratory, 2000-2007



Highly Pathogenic Avian Influenza Surveillance: OIE

Oie Highly pathogenic avian influenza, India		Print	Close			
<i>Information received on 15/01/2008 from Dr Pradeep Kumar, Secretary to the Government of India, Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture, New Delhi, India</i>						
Summary						
Report type	Immediate notification					
Start date	04/01/2008					
Date of first confirmation of the event	15/01/2008					
Report date	15/01/2008					
Date submitted to OIE	15/01/2008					
Reason for notification	Reoccurrence of a listed disease					
Date of previous occurrence	02/08/2007					
Causal agent	Highly pathogenic avian influenza virus					
Serotype	H5N1					
Nature of diagnosis	Laboratory (basic), Laboratory (advanced)					
This event pertains to	a defined zone within the country					
Related reports	<ul style="list-style-type: none">• Immediate notification (15/01/2008)• Follow-up report No. 1 (09/02/2008)• Follow-up report No. 2 (28/03/2008)• Follow-up report No. 3 (08/04/2008)• Follow-up report No. 4 (01/05/2008)					
New outbreaks						
Outbreak 1	Rampurhat, Nalhati, Mayureswar, Rampurhat, Birbhum, WEST BENGAL					
Date of start of the outbreak	04/01/2008					
Outbreak status	Continuing (or date resolved not provided)					
Epidemiological unit	Village					
Affected animals	<i>Species</i>	<i>Susceptible</i>	<i>Cases</i>	<i>Deaths</i>	<i>Destroyed</i>	<i>Slaughtered</i>
Birds	819078	35525	35525	66566	0	
Affected population	backyard poultry mainly in small and marginal farms in three villages. Note by the OIE's Animal Health Information Department: This information is a sum up of outbreaks occurring in three villages.					
Outbreak 2	Balurghat, Balurghat, Dakshin Dinajpur, WEST BENGAL					
Date of start of the outbreak	07/01/2008					
Outbreak status	Continuing (or date resolved not provided)					
Epidemiological unit	Farm					
Affected animals	<i>Species</i>	<i>Susceptible</i>	<i>Cases</i>	<i>Deaths</i>	<i>Destroyed</i>	<i>Slaughtered</i>
Birds	80201	261	261	79940	0	
Affected population	a small farm with a capacity for about 2000 birds					
Summary of outbreaks	Total outbreaks: 2					
Total animals affected	<i>Species</i>	<i>Susceptible</i>	<i>Cases</i>	<i>Deaths</i>	<i>Destroyed</i>	<i>Slaughtered</i>
Birds	899279	35786	35786	146506	0	



Highly Pathogenic Avian Influenza Surveillance: OIE

Control measures

Measures applied	<ul style="list-style-type: none">Stamping outQuarantineMovement control inside the countryScreeningNo vaccinationNo treatment of affected animals
Measures to be applied	<ul style="list-style-type: none">Disinfection of infected premises/establishment(s)Dipping / Spraying

Diagnostic test results

Laboratory name and type	High Security Animal Disease Laboratory, Bhopal (National laboratory)			
Tests and results	Species	Test	Test date	Result
	Birds	haemagglutination (HA) test	15/01/2008	Positive
	Birds	haemagglutination inhibition test (HIT)	15/01/2008	Positive
	Birds	real-time PCR	15/01/2008	Positive
	Birds	virus isolation	15/01/2008	Positive
Laboratory name and type	National Institute of Virology, Pune (National laboratory)			
Tests and results	Species	Test	Test date	Result
	Birds	real-time PCR	15/01/2008	Positive

Map of outbreak locations

Location of current outbreaks



Click on map to zoom in.



Infectious Disease Diagnostics in the Laboratory

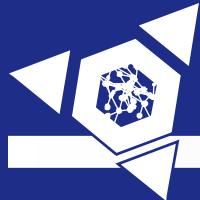
- **Many laboratories rely on conventional, microbiological techniques to diagnose infectious diseases**
 - Bacterial culture
 - Viral culture
- **Many facilities then place the amplified pathogens in long-term storage**
 - Often, these agents in storage are vulnerable to theft and misuse (laboratory biosecurity not at all practiced universally)
- **Staff in these facilities possess the expertise and means to isolate and amplify bacterial and viral isolates, dual-use skills that could be exploited**





Building Capacity Securely

- **Surveillance networks**
 - Minimize transparency when possible
 - **May be difficult because of international health regulations and standards**
 - **Perhaps surveillance of diseases most at risk of bioterrorism use could be conducted over limited-access web sites and servers**
 - Link increased surveillance capacity to efficient control efforts
 - Implement preventative strategies, not only detection strategies
- **Laboratory capacity building**
 - Utilize modern molecular tools, antibody-based serological testing, and reliable rapid antigen detection methodologies to minimize isolation and amplification of pathogens
 - When amplification is necessary, implement strict lab biosecurity policies
 - **Physical security**
 - **Personnel reliability**
 - **Pathogen inactivation**
 - **Pathogen control and accountability**
 - **Pathogen consolidation to central facility**
 - **Other laboratory biosecurity management systems**



Conclusions

- **Improved animal health can complement global public health projects**
- **Maintaining disease-free livestock populations supports national economic development**
 - Increased employment opportunities
 - Increased animal production
 - Increased food supply
 - Increased food safety
 - Increased trade opportunities
- **Enhancing animal health will improve security of individual households, and strengthen national and regional stability**
- **Building animal health capacities is fundamental to improving public health, security, and stability, BUT...**
 - Need to recognize that, in some cases, strengthening public health can increase the risk of bioterrorism
 - Public health capacity building must incorporate biosecurity measures so that terrorists interested in maliciously acquiring, developing, and/or disseminating infectious disease are not the beneficiaries of enhanced public health