



ONE HEALTH: A CONCEPT FOR THE 21ST CENTURY

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**1st International Symposium Biosafety and
Biocontainment, February 9, 2011**



- Recognizing the inter-connectedness between human, animal, and ecological health, the OHI seeks to increase communication, collaboration, and cooperation across a wide variety of disciplines including human medicine, veterinary medicine, public health, microbiology, ecology, and others.
- <http://www.onehealthinitiative.com>



OUTLINE

- A Very Brief History of One Health
- One Health Case Study:
Q Fever in the Netherlands
- One Health in Academia
- One Health in Government
- One Health in Biomedical Research
- Take Home Messages



A VERY BRIEF HISTORY OF ONE HEALTH



ONE HEALTH IN THE 18TH CENTURY

- Dr. Edward Jenner and Vaccination
- Variolation
- The lore about cowpox and milkmaids



THE COWPOX EXPERIMENT

MAY 1796



- Pus from Sarah Nelmes
- Scratched into arm of 8 year old James Phipps



THE BEGINNINGS OF VETERINARY MEDICINE

- Pope Clement XI instructed his physician, Dr. Giovanni Maria Lancisi, to do something about rinderpest
- Rinderpest is a highly lethal viral disease of cattle that was devastating the human food supply



ANIMAL DISEASE CONTROL MEASURES

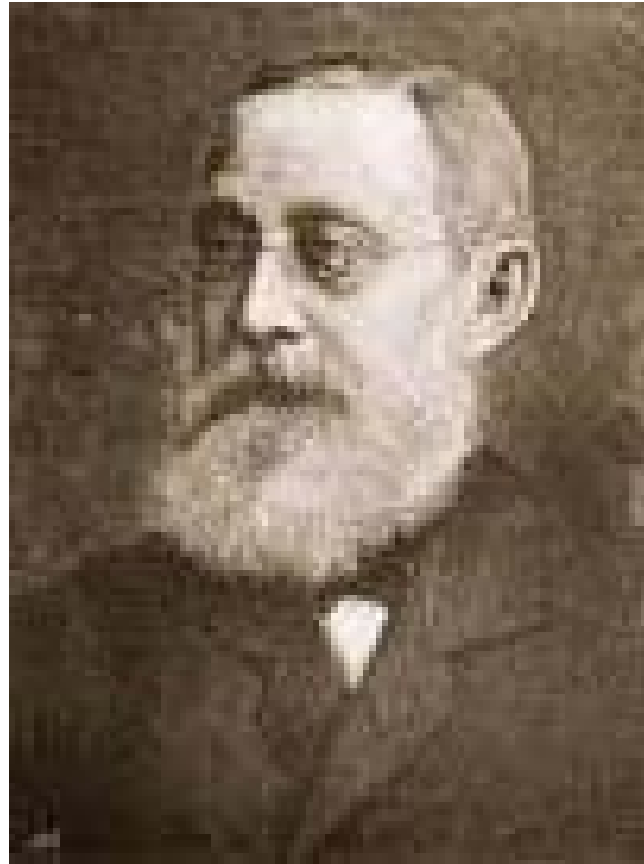


- Lancisi recommended that all ill and suspect animals be destroyed.
- Principles were a milestone in controlling the spread of contagious diseases in animals.



ONE HEALTH IN THE 19TH CENTURY

- Rudolf Virchow (1821-1902), a German physician and pathologist said, “between animal and human medicine there are no dividing lines--nor should there be.”
- Coined term “zoonosis.”



MEAT INSPECTION PROGRAMS

- Virchow's father was a butcher.
- Animal experiments on life cycle of *Trichinella spiralis* in porcine muscular tissue.
- Used data to advocate for raw meat inspections.
- Cysticercosis and tuberculosis in cattle.



SIR WILLIAM OSLER



- Osler received his medical degree from McGill university
- Went to Berlin to work with Virchow
- Returned to Canada in 1874
- Est. veterinary pathology as an academic discipline in North America



LOUIS PASTEUR



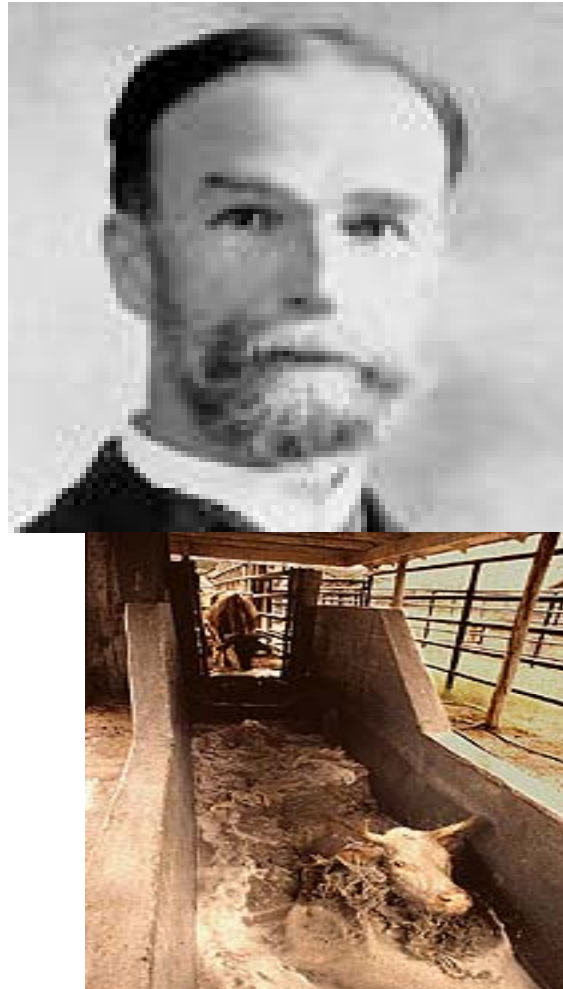
- In 1880, studying chicken cholera.
- Discovered that old liquid cholera culture didn't kill the chickens
- Saw analogy with smallpox vaccine
- Successfully applied principle to rabies



MD-DVM TEAM EFFORT LED TO A BREAKTHROUGH DISCOVERY

- Theobald Smith, MD (pictured) and F.L. Kilbourne, DVM discovered cause of cattle fever
- *Babesia bigemina* was transmitted by the cattle tick.

<http://www.ars.usda.gov/is/timeline/tick.htm>



ONE HEALTH WANED IN THE 20TH CENTURY

- Medicine and veterinary medicine went separate ways.
- Barriers in academia, government agencies, research, and industry were built over time.
- Support for animal disease research waned.
- Medical knowledge advanced dramatically.
- Increasingly reductionistic approach to disease.



ONE HEALTH IN THE 21ST CENTURY

- Emerging disease outbreaks triggered the realization that human, animal, and environmental health are linked.
- Human population pressures, intensive agriculture practices, consumption of bush meat, importing and dumping of used tires, air travel, and a global trade in exotic animals.



ZOONOTIC DISEASES



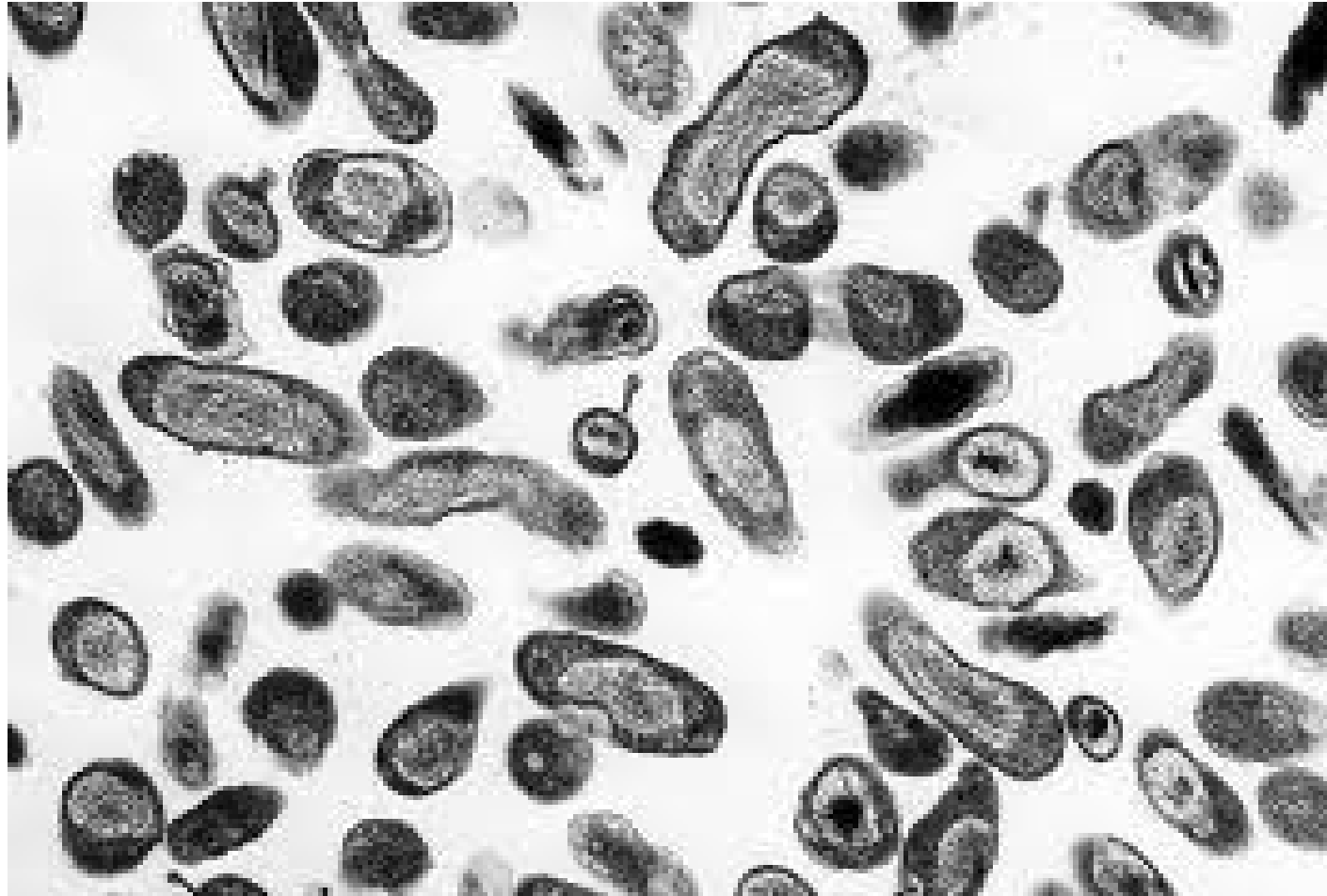
[:: view large map ::](#)



ONE HEALTH CASE STUDY: Q FEVER IN THE NETHERLANDS



Q FEVER CAUSED BY BACTERIA
COXIELLA BURNETII



Q FEVER IN LIVESTOCK



Birth products are highly infectious

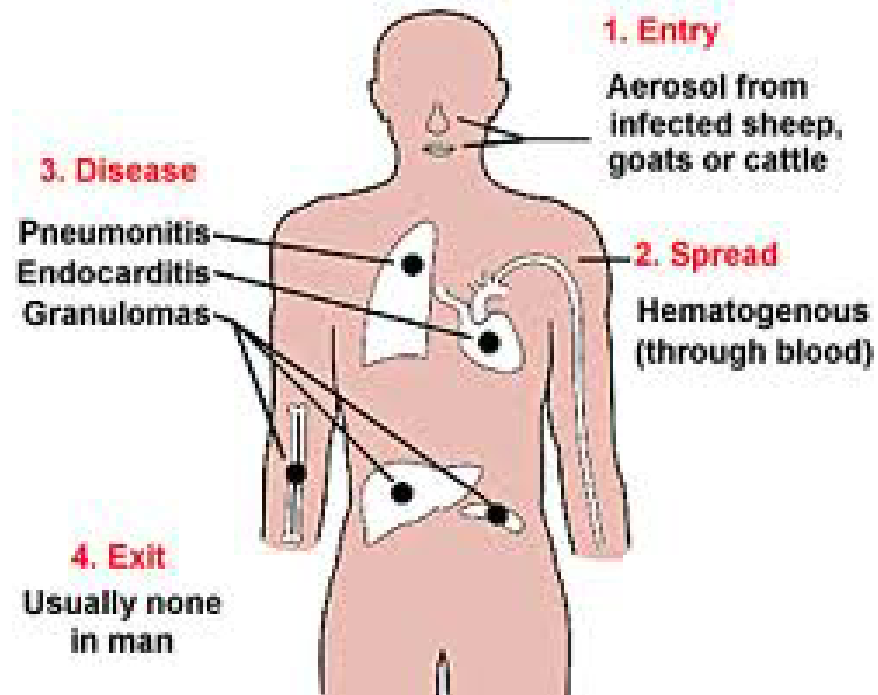
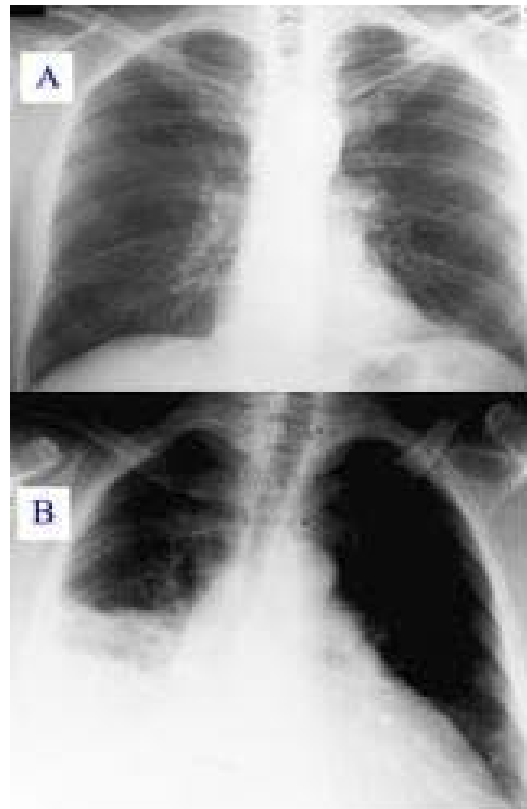


Can also spread by ticks



Infection manifests as spontaneous abortion

Q FEVER IN HUMANS

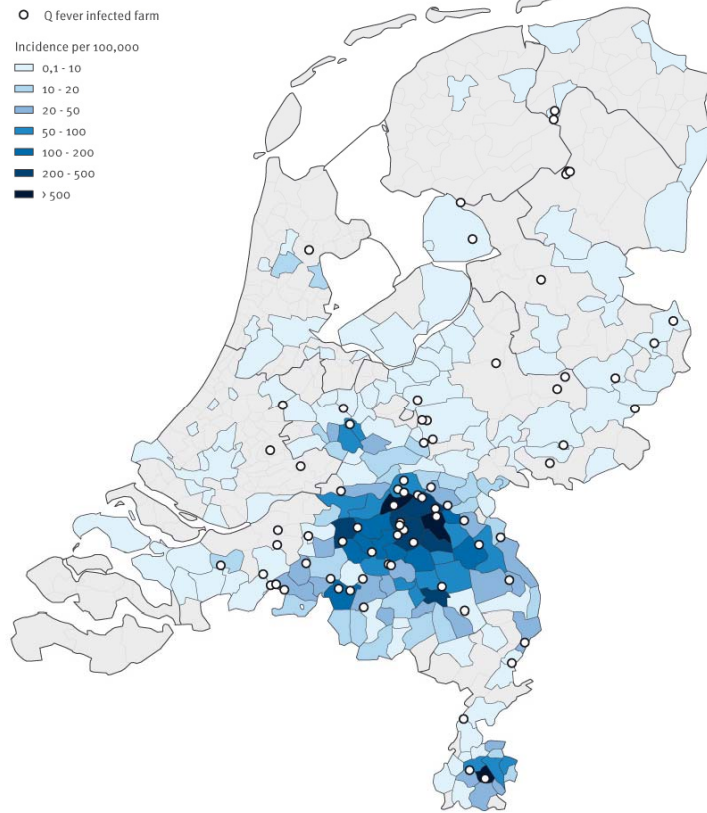


Pneumonia can lead to ARDS



INCIDENCE OF HUMAN Q FEVER AND INFECTED GOAT AND SHEEP FARMS IN NETHERLANDS, 2009

FIGURE 2
Incidence of human Q fever by municipality (n=2,357) and locations of Q fever infected dairy goat and dairy sheep farms, the Netherlands, 2009



Map compiled by Ben Bom, Expertise Centre for Methodology and Information Services, RIVM.

HOSPITAL ADMISSIONS FOR Q FEVER

TABLE

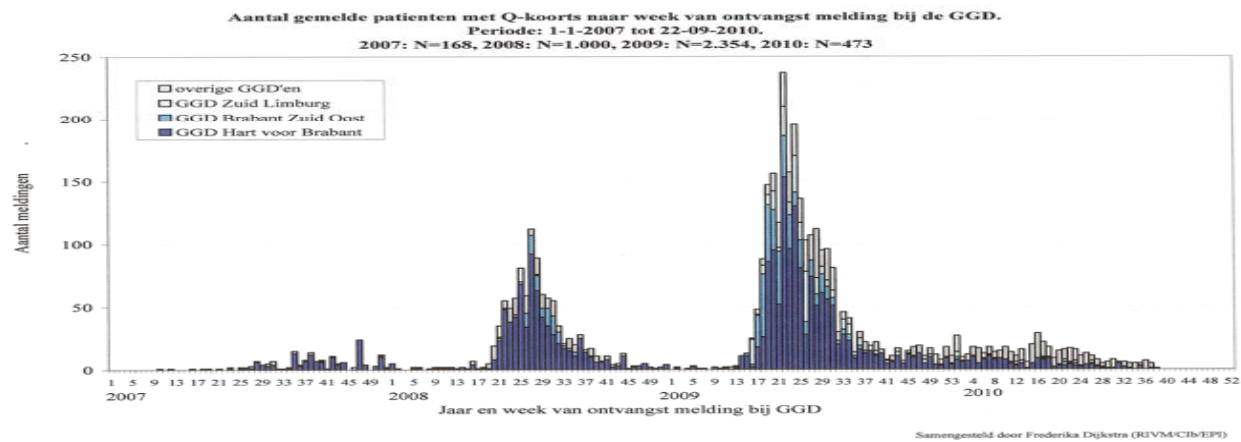
Hospital admissions for Q fever by year of notification, the Netherlands 2007-2009

Year of notification	Notified cases	Admitted to hospital			Percentage admitted (95% CI)	
		Yes	No	Information missing		
2009	2,357	459	1,869	29	19.7%	(18.1-21.3)
2008	1,000	207	785	8	20.9%	(18.4-23.5)
2007	168	83	83	2	50.0%	(42.4-57.6)

CI: confidence interval.



Q FEVER EPIDEMIC CURVE 2007-2010



http://www.rivm.nl/cib/binaries/epicurve%20Q-koorts_tcm92-59728.pdf



THE DUTCH GOVERNMENT RESPONSE TO THE CRISIS

- Nationwide hygiene protocol for all goat and sheep farms.
- Animal movement restrictions.
- June 2008, Q fever became a notifiable disease.
- Slaughtered over 50,000 dairy goats on 55 farms.
- Mandatory vaccination campaign of goats (but vaccine doesn't completely protect against infection—reduces amount of bacteria in milk and afterbirth).
- Bulk milk monitoring on farms with > 50 dairy goats or sheep.
- If farm tests positive, people living within 5km are notified.

Scientific American. "Tough lessons from Dutch Q fever outbreak."

March 3, 2010. <http://www.scientificamerican.com/article.cfm?id=tough-lessons-from-dutch-q-fev>



DUTCH GOVERNMENT INVESTIGATION

- Overall response was slow and uncoordinated.
- Ministry of Agriculture had initially denied the role of dairy goat farms in causing human cases of Q fever because of lack of scientific proof of causality.
- Ministry of Health considered clustering of human cases around farms with high abortion rates as sufficient proof.
- Concerns of commercial confidentiality hindered outbreak investigation.
- Unable to do epidemiologic studies until Q fever became notifiable disease in 2008.
- Dutch government did not call agriculture industry to account for its responsibility in the crisis.

http://www.rivm.nl/cib/binaries/VWS100511A_tcm92-71615.pdf



THE CHALLENGES AHEAD

- Bacteria persist in environment as spores.
- Wild animals other than small ruminants (goats, sheep) and ticks may play a role in disease spread.
- Human population and animal population densities may pose long term problems.
- Animal production methods may play a role in disease persistence.
- Much is still unknown about Q fever. Requires an interdisciplinary research approach.
- Research with organism is difficult and obtaining *C. burnetii* DNA is challenging.

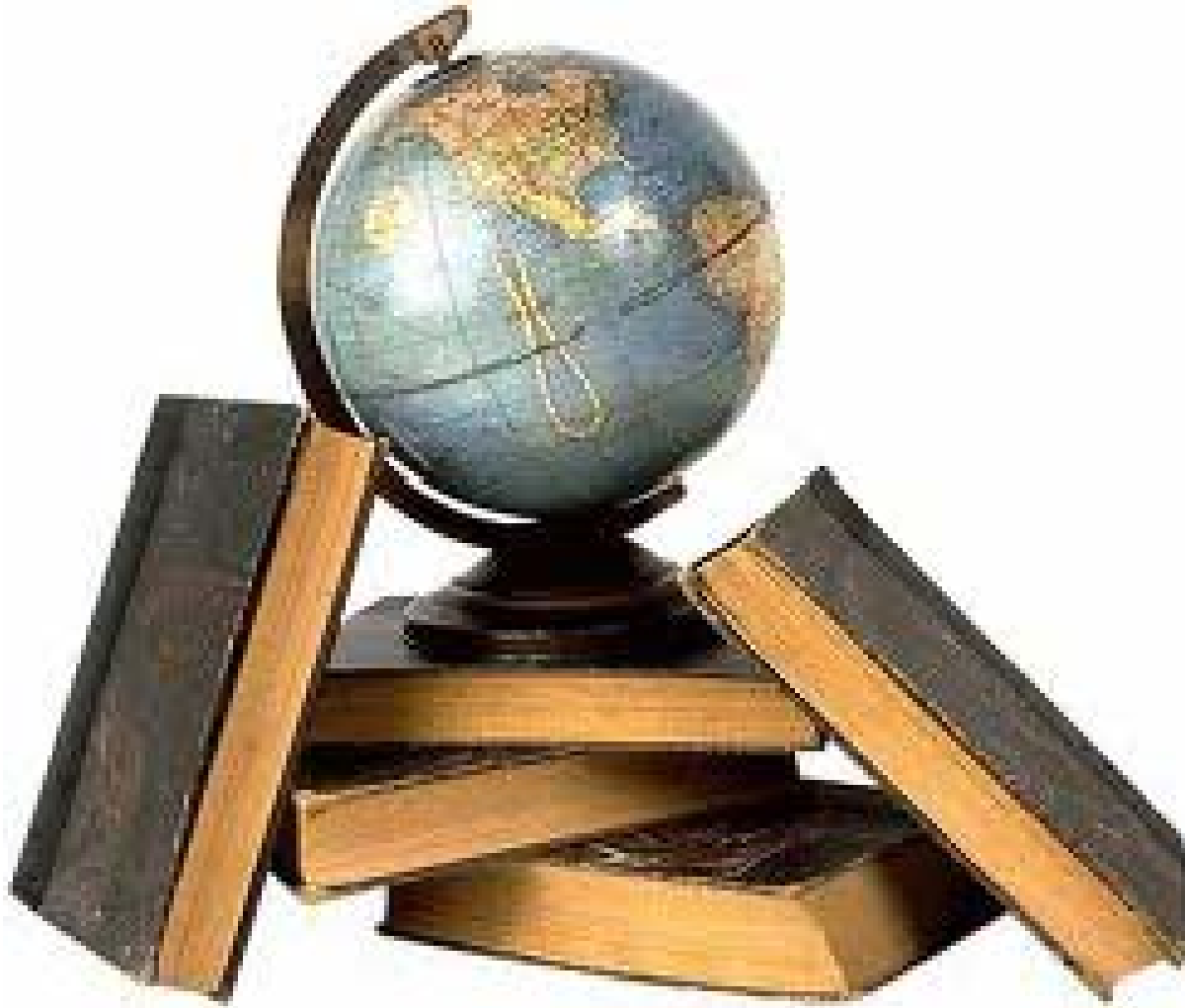


LARGER ONE HEALTH ISSUES

- Human population anticipated to increase to 9 billion people by 2050.
- Demand for affordable meat and dairy products will increase and will require economies of scale—and the need for intensive agriculture.
- Mission of Department of Agriculture is to protect and advance agriculture.
- Mission of Department of Health is disease surveillance and control.
- Different missions. Different goals. When zoonotic disease outbreaks occur, difficulties ensue.



ONE HEALTH IN ACADEMIA



ONE HEALTH IN ACADEMIA

- More than 4X as many accredited medical schools compared to veterinary medical schools.
- In U.S.:
 - 125 accredited medical schools
 - 29 veterinary medical schools
- Globally:
 - 2161 accredited medical schools in 172 countries
(Foundation for Advancement of International Medical Education and Research, 2009)
 - 471 colleges of veterinary medicine and animal sciences in 109 countries. Majority have either not been evaluated by AVMA or do not have comparable standards. (AVMA Educational Commission for Foreign Veterinary Graduates (ECFVG) Veterinary Schools—not necessarily a comprehensive list)



U.S. BUREAU LABOR STATISTICS

- Approximately 661,400 MDs working in 2008. 84% practice in solo, group, or hospital settings. (<http://www.bls.gov/oco/ocos074.htm>)
- Approximately 59,700 DVM/VMDs working in 2008. 80% in solo or group practices. Approximately 1300 employed in federal government.
- (<http://www.bls.gov/oco/ocos076.htm>)



ONE HEALTH IN GOVERNMENT

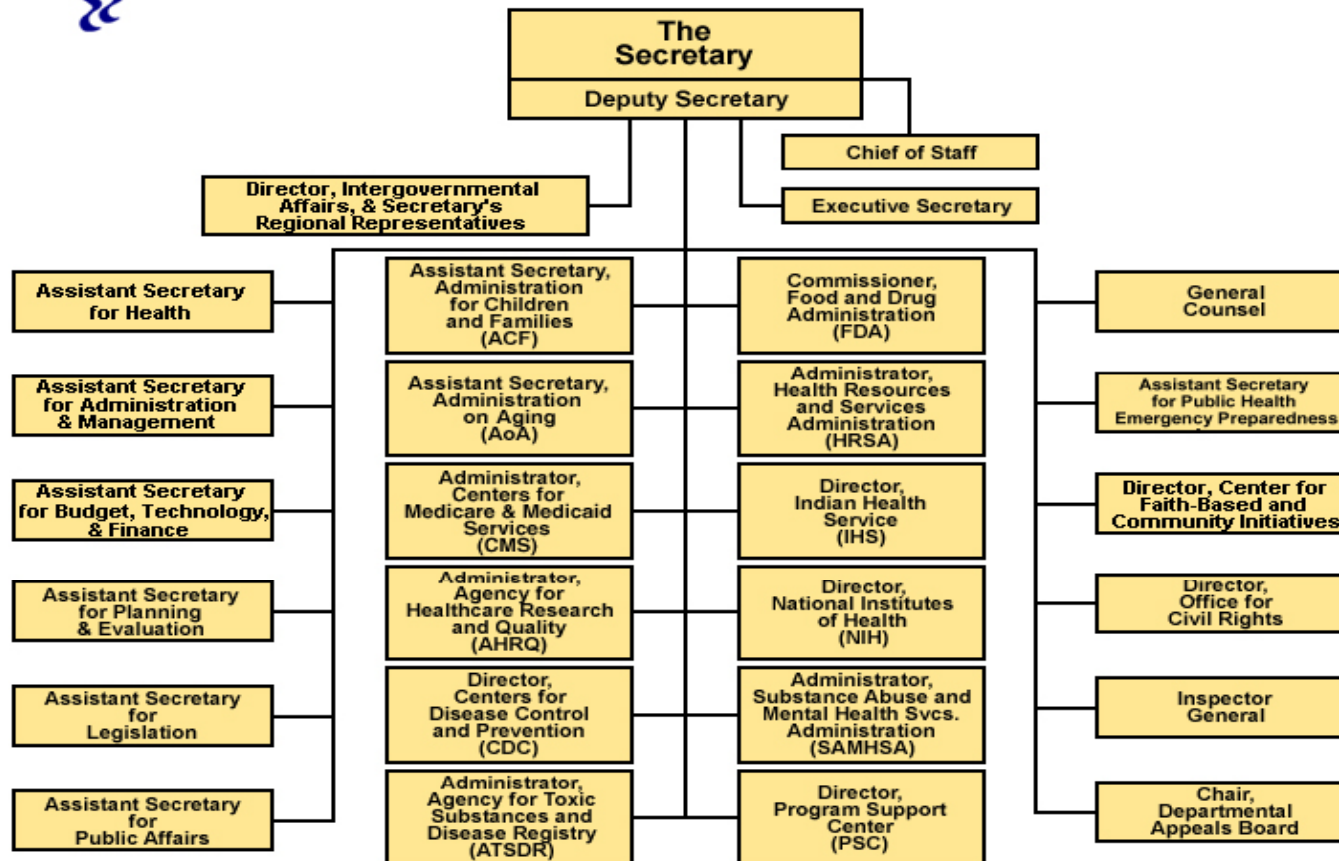


U.S. FEDERAL HUMAN HEALTH INFRASTRUCTURE

- U.S. Department of Health and Human Services (DHHS) is lead agency at federal level.
- U.S. Department of Homeland Security (DHS) is involved in human health.
- U.S. Department of Defense (DoD) helps in times of crisis.



CHALLENGES: U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES



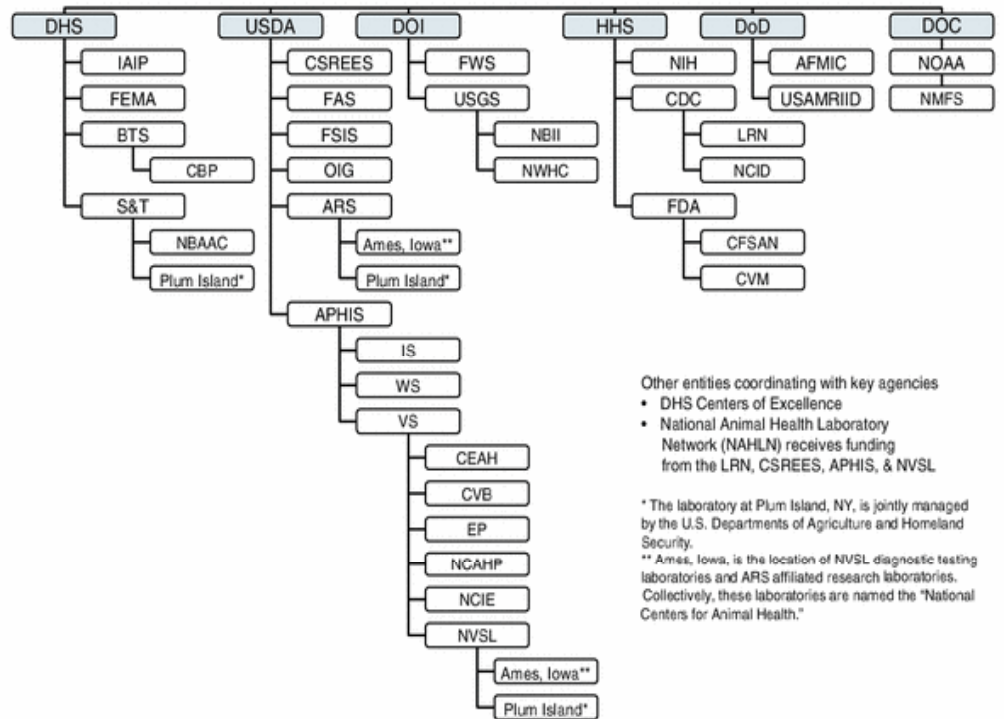
U.S. FEDERAL ANIMAL HEALTH INFRASTRUCTURE

- U.S. Department of Agriculture (USDA) Animal Plant Health Inspection Service (APHIS) is lead agency for livestock.
- U.S. Department of Homeland Security (DHS) now has parts of APHIS.
- U.S. Department of Health and Human Services (HHS) established National Center for Zoonotic, Vector-borne and Enteric diseases at CDC.
- U.S. Department of Interior (DOI) Fish and Wildlife Service is responsible for wildlife, endangered species, and wildlife imported into the U.S.
- U.S. Department of Commerce (DOC) oversees fisheries management.



CHALLENGES: U.S. FEDERAL AGENCIES ADDRESSING ANIMAL DISEASES

ANIMAL HEALTH AT THE CROSSROADS, NATIONAL ACADEMIES PRESS 2005, PAGE 36



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Other entities coordinating with key agencies

- DHS Centers of Excellence
- National Animal Health Laboratory Network (NAHLN) receives funding from the LRN, CSREES, APHIS, & NVSL

* The laboratory at Plum Island, NY, is jointly managed by the U.S. Departments of Agriculture and Homeland Security.

** Ames, Iowa, is the location of NVSL diagnostic testing laboratories and ARS affiliated research laboratories. Collectively, these laboratories are named the "National Centers for Animal Health."

FIGURE 2-1 Key federal agencies addressing animal diseases.



ONE HEALTH IN GOVERNMENT AGENCIES

- 1999 New York City West Nile Virus outbreak
- Two simultaneous outbreaks: one in animals and one in humans.
- Outbreak highlighted the importance of disease surveillance in wildlife and zoo animals.
- Animals were sentinels for human health but were largely ignored.



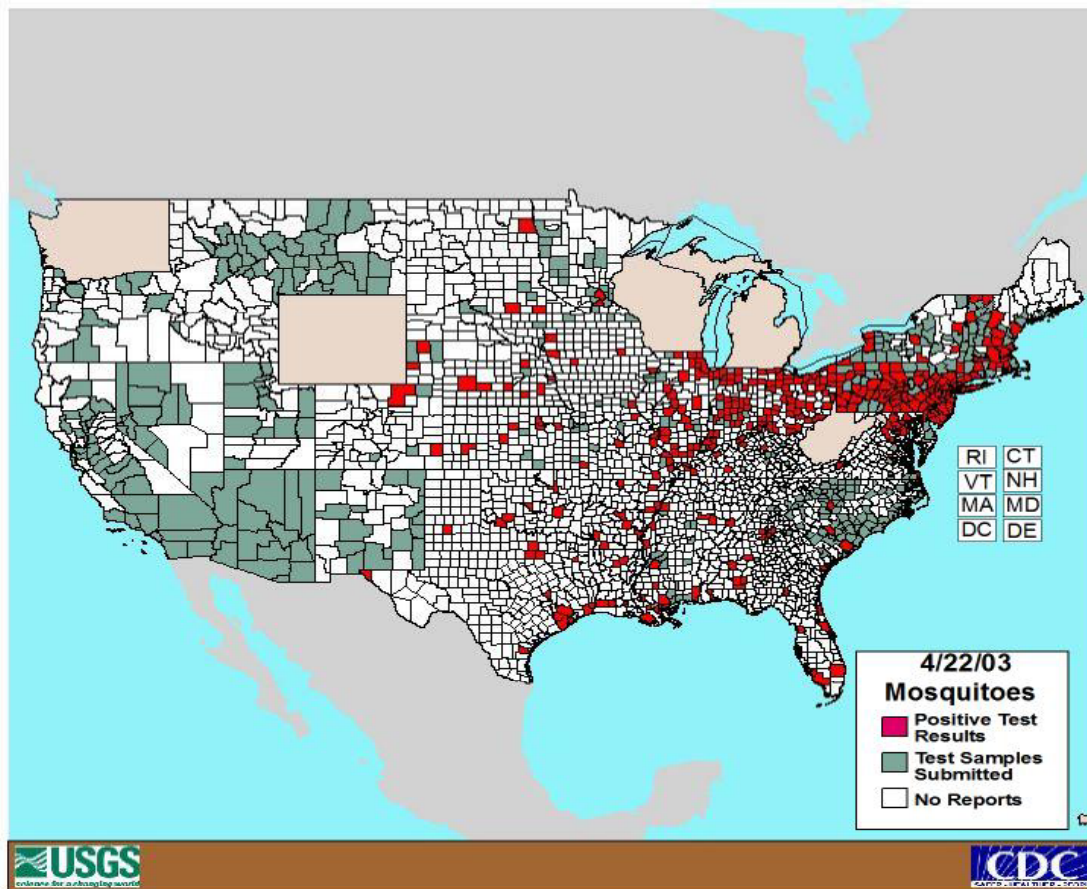
U.S. RESPONSE TO WEST NILE VIRUS

- In 1999, the CDC established ArboNET.
- A success story...



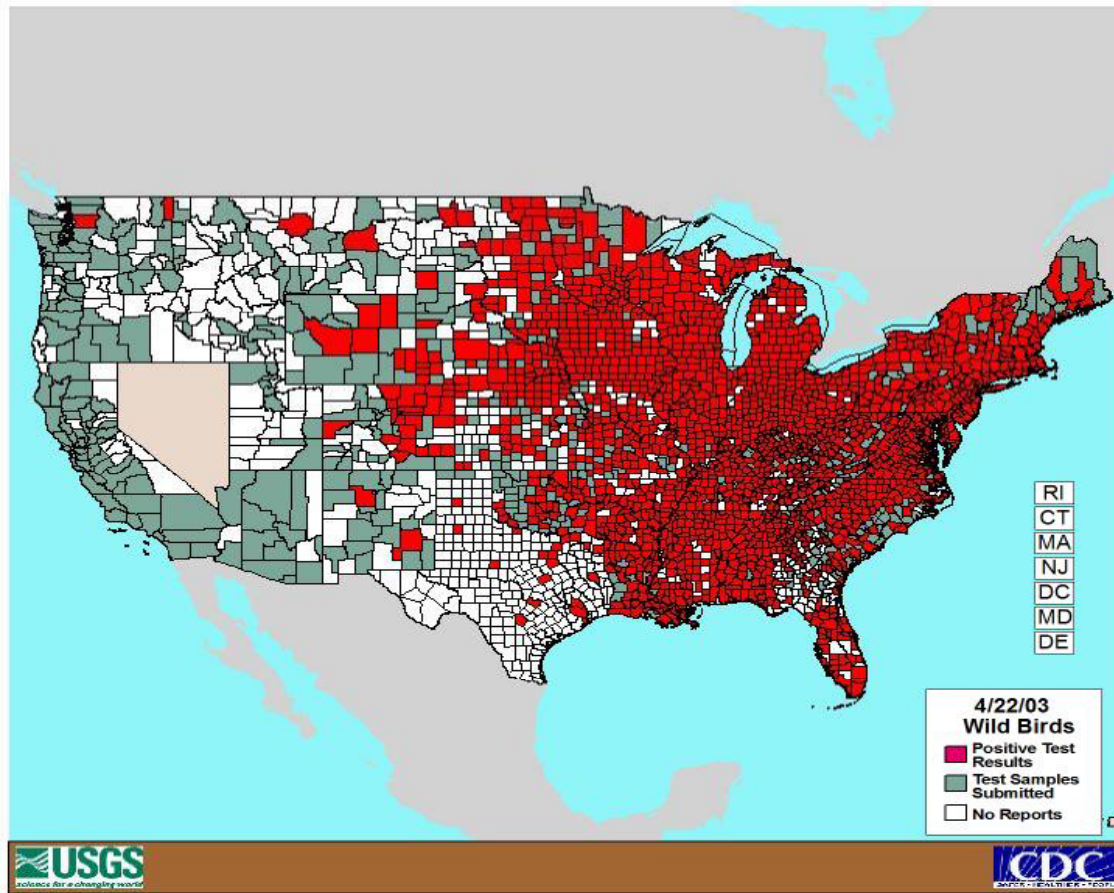
MOSQUITO WNV INFECTIONS 2002

[HTTP://WESTNILEMAPS.USGS.GOV/2002/USA_MOSQUITO_APR_22.HTML](http://westnilemaps.usgs.gov/2002/USA_MOSQUITO_APR_22.HTML)



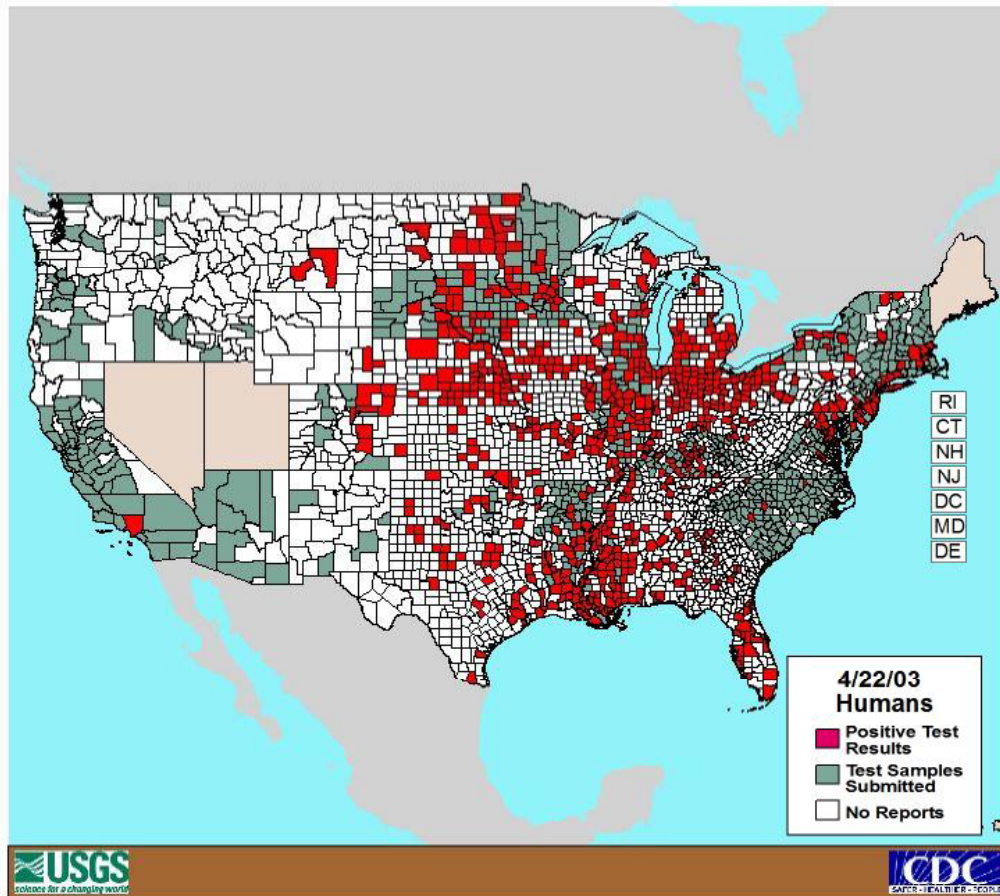
WNV POSITIVE BIRDS 2002

[HTTP://WESTNILEMAPS.USGS.GOV/2002/USA_AVIAN_APR_22.HTML](http://westnilemaps.usgs.gov/2002/USA_AVIAN_APR_22.HTML)



HUMAN WNV CASES 2002

[HTTP://WESTNILEMAPS.USGS.GOV/2002/USA_HUMAN_APR_22.HTML](http://westnilemaps.usgs.gov/2002/USA_HUMAN_APR_22.HTML)



ONE HEALTH IN BIOMEDICAL RESEARCH



FUNDING CHALLENGES IN ONE HEALTH RESEARCH

- U.S. Federal Funding for Human Health
 - DHHS NIH \$31.2 billion for medical research
- U.S. Federal Funding for Animal Health
 - USDA NIFA \$70 million for animal health, reproduction, breeding, genetics, nutrition.



MDS IN RESEARCH

- “The number of physician-researchers has declined dramatically since the 1980’s,” according to NIH director, Francis S. Collins, MD, PhD. (Dec. 2010)
 - (<http://www.nih.gov/news/health/dec2010/od-09.htm>)
- 1983: 18,535 MDs engaged in research; 1995: 14,340 MDs engaged in research; 2003: 14,521 MDs engaged in research. (Ley TJ, Rosenberg LE, “The Physician-Scientist Career Pipeline in 2005,” JAMA 2005; 294: 1343-1351 <http://jama.ama-assn.org/content/294/11/1343.full>)
- Efforts to increase MDs in research are underway. NIH loan repayment programs begun in 2002.



DVM/VMDs IN RESEARCH

- Shortage is dire, but no exact numbers available.
- 2004 NAS report found:
 - <1% veterinarians board certified in laboratory animal medicine.
 - <2% board certified in pathology.
 - In 2001, only 4.7% of all NIH grants funded for animal research were awarded to veterinarian principal investigators.
 - From 1995 to 2002, number of NIH funded grants using animals increased by 31%.
 - In 1998, estimated that 23 million mice and rats were used in research.
 - NCRP has 1 year grants for veterinary students to do research.

(National Need and Priorities for Veterinarians in Biomedical Research. NAS 2004 http://www.nap.edu/catalog.php?record_id=10878)



ONE HEALTH IN BIOMEDICAL RESEARCH

- Animals get cancer, heart disease, autoimmune diseases, metabolic diseases, and many other diseases that humans get. But most are not studied.
- Instead, we primarily use genetically modified rodents as models for human diseases.
- Veterinarians must be colleagues not subordinates.
- Jointly sponsored comparative clinical trials using new therapeutics.
- Joint clinical studies, especially involving immunosuppressed humans and animals.



ONE HEALTH RESEARCH EFFORTS

- USDA recently conditionally approved a vaccine to treat canine oral melanoma—the first therapeutic vaccine for the treatment of cancer in either animals or humans.



TAKE HOME MESSAGES

- Concept that human, animal, and environmental health are inextricably linked is not new.
- Considerable overlap between fields before 20th century.
- Explosion in scientific knowledge in 20th century has led to the development of intellectual silos and an increasingly reductionistic approach to health and disease.
- Difficulties with this approach are evident when a disease crosses species as seen with Q fever outbreak and other zoonotic disease crises.
- Challenges of 21st century demand that we reassess our institutions, priorities, and policies.



TAKE HOME MESSAGES

- One Health is a new paradigm in approaching health and disease.
- A One Health approach will become increasingly important as our population increases, our agriculture intensifies, our destruction of habitats worsens.
- Challenges in implementing a One Health approach:
 - Education Logistics and Numbers
 - Infrastructure Barriers
 - Funding Issues





○ Acknowledgements:

- Bruce Kaplan, DVM, Dipl. Aves (hon)
- Tom Monath, MD
- Jack Woodall, PhD

<http://www.onehealthinitiative.com>

