



College of Agriculture,
Food and Environment

Veterinary Diagnostic Laboratory

Food Security & Animal Health: *The Global One Health Role of Veterinary Diagnostic Laboratories*



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Outline

- Notable epidemics in history
- What is One Health?
- Food insecurity
 - The classic One Health problem
- The important role of veterinary diagnostic medicine in One Health
- Challenges

Notable Human Epidemics

- Plague – 50M deaths Europe 14th century
- Smallpox – 500M deaths 20th century
- Spanish flu – 100M deaths 20th century
- Malaria – 1M deaths annually 21st century, *may have killed half the people who have ever lived!*
- Others
 - Typhus
 - Cholera
 - Polio
 - HIV/AIDS
 - Ebola

Why Talk About these Diseases?

- Only one has been eradicated (Smallpox)
- At least one could become lethal again (Influenza)
- Many have no treatments and most have no vaccine
- Two of these diseases still cause 2M deaths annually
- Most have been around for millennia

What about antimicrobial resistance (AMR)?

- **Tuberculosis** – ~480,000 cases of multi-drug resistance worldwide today
- **Malaria** – multi-drug resistance Southeast Asia
- **HIV** – Anti-viral therapy, up to 40% drug resistant
- **Influenza** – Anti-viral therapy resistance 2% and increasing

Wellcome Trust Report on AMR 2016

- Superbugs will soon kill more humans than cancer
- Currently, 700,000 deaths each year
- Estimated 10M deaths annually by 2050
- \$100T USD of lost human productivity

AMR is the most important health challenge for the next 4 decades!

The Conquest of Infectious Diseases: Who Are We Kidding?

Ruth L. Berkelman, MD; James M. Hughes, MD
Article, Author, and Disclosure Information

FULL ARTICLE

References

Comments



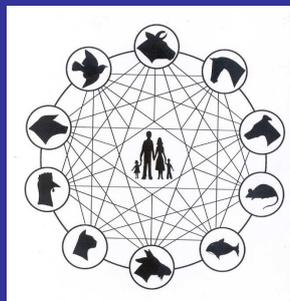
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The 20th century has seen unprecedented scientific progress and so it is ironic that as the century draws to a close, scientists and clinicians must learn to deal with emerging new infectious agents whose existence in human beings was proved only in the past few years [1].

Almost a quarter century ago, the Surgeon General of the United States testified to Congress that it was time to close the book on infectious diseases [2]. The wide use of effective antibiotics, the potential for universal vaccination for many major childhood illnesses, and success stories, such as the eradication of smallpox in 1977, encouraged the perception that infectious diseases had been conquered.

The stark reality is that infectious diseases are the leading cause of death worldwide [3] and remain a leading cause of illness and death in the United States [4]. Human immunodeficiency virus (HIV) infection, pneumonia, and influenza rank among the 10 leading causes of death in the United States. Lyme disease has become the leading vector-borne disease with more than 50 000 cases reported since 1982, many resulting in chronic disability. Old diseases such as tuberculosis and measles long thought to have been under control have recently re-emerged in the United States.

What is One Health?





A collaborative global approach to understanding risks for human and animal health (including both domestic animals and wildlife) and ecosystem health as a whole.



Aim of One Health:

To improve health and well-being through the prevention of risks and the mitigation of effects of crises that originate at the interface between humans, animals and their various environments.



Centers for Disease Control and Prevention
CDC 24/7: Saving Lives, Protecting People™

The CDC **One Health** office recognizes that the health of people is connected to the health of animals and the environment. It is a collaborative, multi-sectoral, and transdisciplinary approach—working at the local, regional, national, and global levels...



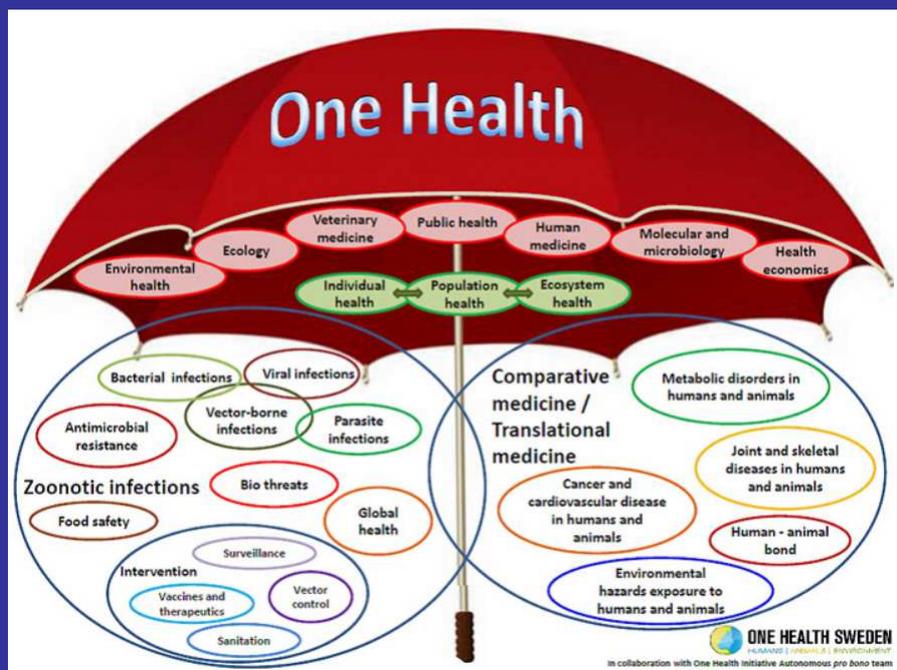
One Health
Global Network
Webportal

Aim of One Health:

To improve health and well-being through the prevention of risks and the mitigation of effects of crises that originate at the interface between humans, animals and their various environments.



The One Health concept is a worldwide strategy for expanding interdisciplinary collaborations and communications in all aspects of healthcare for humans, animals and the environment.





Vision Statement:

One Health is dedicated to improving the lives of all species—human and animal—through the integration of human medicine, veterinary medicine and environmental science.



One Health Initiative Supporters

- Over 100 international organizations/universities
- Over 1100 leaders in One Health worldwide
- <http://www.onehealthinitiative.com/>

Anthropocene Era?

- Are we in a Holocene or Anthropocene era?
- Have human beings permanently changed the planet?
- What does this have to do with health?
- 50% of all species disappearing in one lifetime.

Anthropocene Impacts

- Ecological pressures and growing populations of people bringing animal pathogens closer to humans.
- People represent 750B pounds exceeding the historical biomass of any species on the planet by 100x
- Historically, this is the key ingredient for major epidemics

People and Animals Closely Interconnected

- Livestock contribute to the livelihoods of 70% of the world's poor.
- Worldwide, roughly 800M deprived people rely on livestock for their health and well-being.
- Animal agriculture supports farmers, consumers, traders and laborers in developing countries.

One Health Success Stories

- **First Flexible Coil Balloon Expandable Intracoronary Stent Development for Humans, 1989**
 - ✓ Veterinary pathologist Peter Anderson, DVM PhD provided proof-of-concept in pigs at the University of Alabama.
- **Orthopedic surgeons (veterinarian and physician) research hip and knee replacement methods for dogs as a model for humans, 2009**
 - ✓ Veterinarian James Cook, DVM PhD, Columbia College of Veterinary Medicine, University of Missouri working with physician Sonny Bal, MD JD MBA, Columbia College Medicine leading to successful joint replacements in animals and humans.
- **Veterinarians and physicians prove that *Helicobacter pylori* leads to gastric cancer, 2011**
 - ✓ Dr. James G. Fox, DVM MS, mouse model of disease, Massachusetts Institute of Technology on a team of physicians and scientists.

One Health In Action

Rift Valley Fever

The world's first vaccine for humans and livestock is being developed



Scientists are working on a revolutionary vaccine for Rift Valley Fever which works on humans and animals. Image: FEJ/IFRS/Activity Ng'oma



Name: [Dr George M Warimwe](#)
[MRCVS](#)

Titles: Principal Investigator,
Group Leader, Group Head /
PI, Fellow, Member of
congregation and
Supervisor

Location: Kilifi, Kenya

Division: Tropical Medicine

Group: [Virus](#) Epidemiology and
Control

Food Insecurity

The ultimate One Health problem?



FAO Definition: *Food Security*

“Food security is a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life”



- WHO works to promote the availability of safe, healthy, and wholesome food for everyone to improve food and nutrition security.

WHO Food Security Activities

- Antibimicrobial resistance
- Chemical risks
- Foodborne diseases
- Food hygiene
- Food technologies
- Codex Alimentarius Commission
- Nutrition
- Zoonoses



Food safety

العربية 中文 English Français Русский Español

The First International Food Safety Conference, 12-13 February 2019

"INFOSAN supports countries to manage food safety risks by sharing information, experiences and solutions."

— WHO Director General
Tedros Adhanom Ghebreyesus
12 February 2019
Addis Ababa, Ethiopia



© FAO 2019

On 12-13 February 2019, over 700 delegates gathered in Addis Ababa, Ethiopia for *The First International Food Safety Conference*, hosted jointly by the Food and Agriculture Organization of the United Nations (FAO), the World [Health Organization](#) (WHO) and the [African Union](#) (AU).

WHO Director-General Tedros Adhanom Ghebreyesus said that food safety "is everybody's issue" and that the conference was an opportunity to "learn, build and innovate", to create strong networks between countries and sectors. He also emphasised the importance of INFOSAN and reminded delegates that "INFOSAN supports countries to manage food safety risks by sharing information, experiences and solutions".

A follow-up event, the International Forum on Food Safety and Trade, which will focus on interlinkages between food safety and trade, is scheduled to be hosted by WTO in Geneva (23-24 April). The two meetings are expected to galvanize support and lead to actions in the key areas that are strategic for the future of food safety.



World Food Programme

- Food availability
- Food access
- Food utilization

World population and Food Insecurity

Max Roser (2016) – 'Future World Population Growth'. *Published online at OurWorldInData.org*. Retrieved from: <https://ourworldindata.org/future-world-population-growth/> [Online Resource]

The global population pyramid: How global demography has changed and what we can expect for the 21st century

April 18, 2019 by Max Roser

Our World in Data presents
This blog post draws on data and r

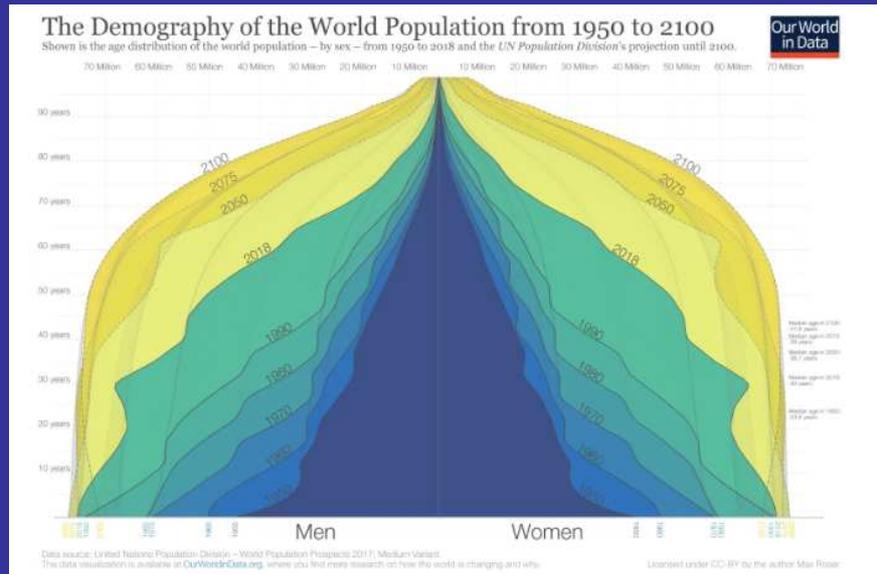
entries dedicated to specific topics.
ion Growth and Future Population Growth.

In 1950 there were 2.5 billion people
expects a global population of 11.2
understand this enormous global tra

billion. By the end of the century the UN
pyramid below makes it possible to

Population pyramids visualize the d
of a given age; women on the right a
you find the numbers of older cohort
rates resembled a pyramid – this is

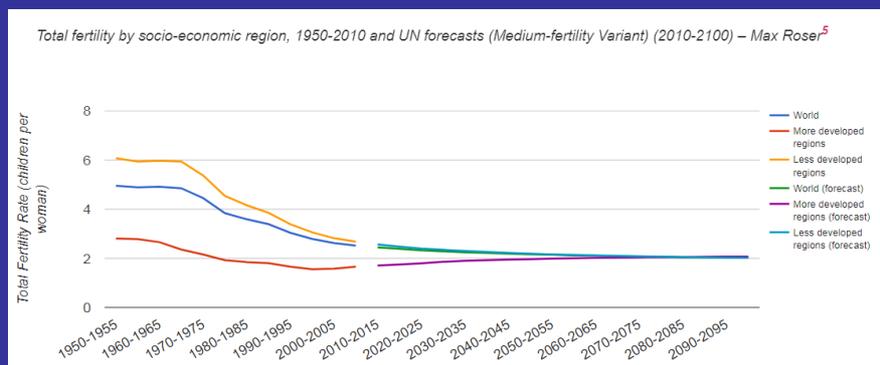
width represents the size of the population
ents the number of newborns and above it
structure of societies with high mortality
name.



Drivers of World Population Growth

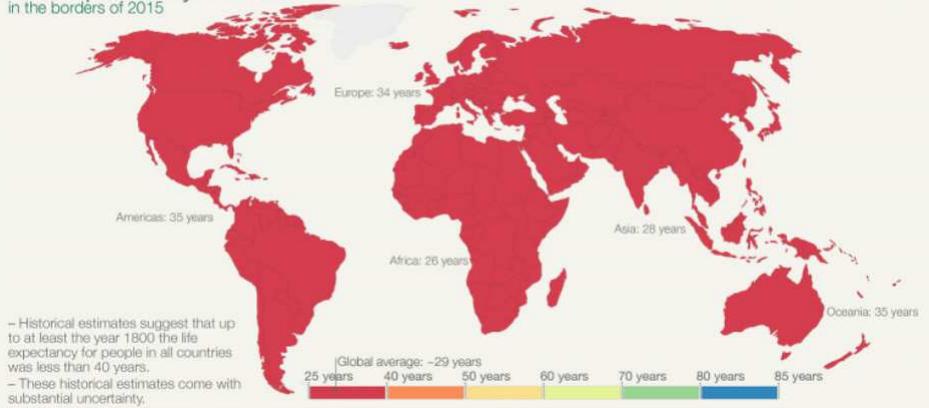
- Fertility rate (FR)
- Life Expectancy (LE)

World Fertility Rate

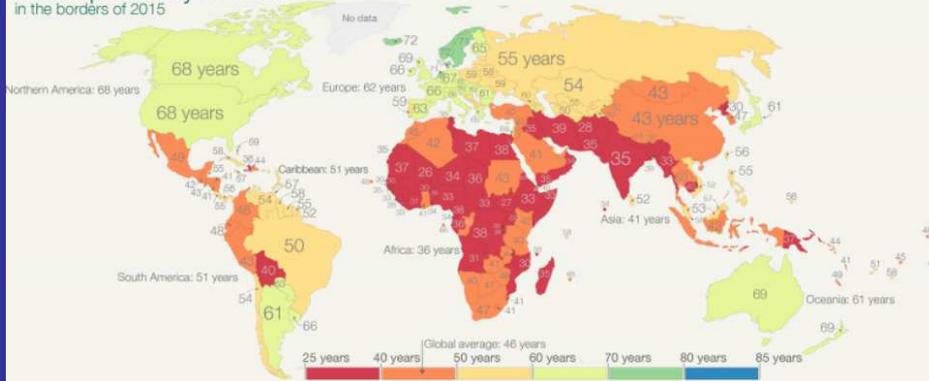


World Life Expectancy

Life expectancy in 1800
in the borders of 2015



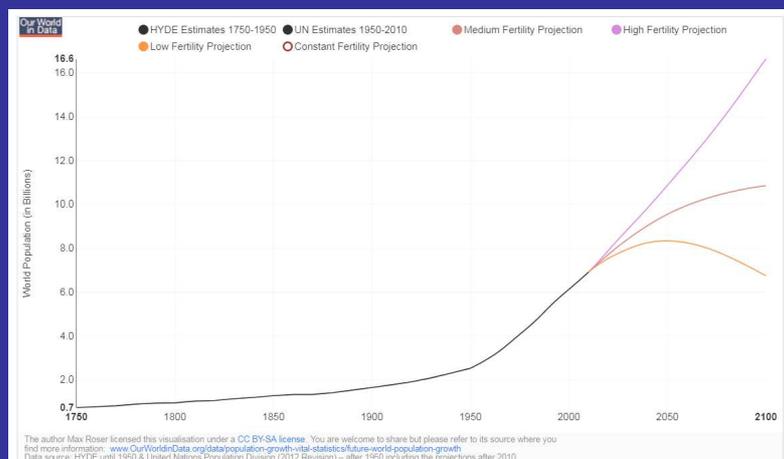
Life expectancy in 1950
in the borders of 2015



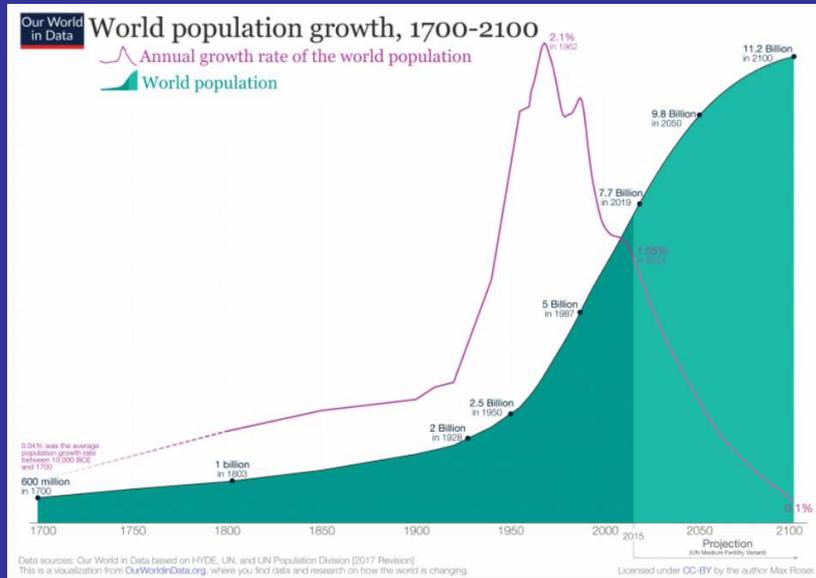
Life expectancy in 2015



Forecast of World Population Growth



World Human Population Growth



17 Organizations Fighting Hunger After a Global Increase



Past & Future Animal Food Production Growth

- Globally over the last 50 years—
 - Beef production has doubled
 - Chicken meat production has increased 10X
 - Carcass weights increased 20-30% all meat species
 - Egg and Milk production increased ~30%
- To feed 10B people by 2050?
 - Meat production must increase by 70%
 - Is this possible?

Philipp Thoma, B.Sc., Land, B.Biol.Sci. 2010 Sep 27; 365(1554): 2653-2667.

doi: 10.1093/oxfordjournals.oxfam.a0113123

Livestock production: recent trends, future prospects

Philipp K. Thoma*

Author information ► Copyright and license information ►

The important
One Health Role
of Veterinary Diagnostic
Medicine

Veterinary Diagnostic Laboratory *Promoting One Health*

- Clinical diagnostic assistance for practicing veterinarians and animal owners
 - Necropsy & histopathology service
 - Clinical pathology
 - Microbiology
 - Immunology/serology
 - Toxicology
 - Special services, e.g. high throughput sequencing, metagenomics, etc.

Veterinary Diagnostic Laboratory *Promoting One Health*

- Regulatory testing
 - Facilitate movement of animals in markets, slaughter, sales, shows—local, regional, national, & international
 - Examples
 - Brucellosis
 - Bovine tuberculosis
 - Johnes disease
 - Bovine viral diarrhea

Veterinary Diagnostic Laboratory *Promoting One Health*

- Teach college-level courses
- Food animal extension education and seminar series for veterinarians, producers and animal owners
- Invited lectures
- Residency programs
- Mentoring undergraduate and graduate students

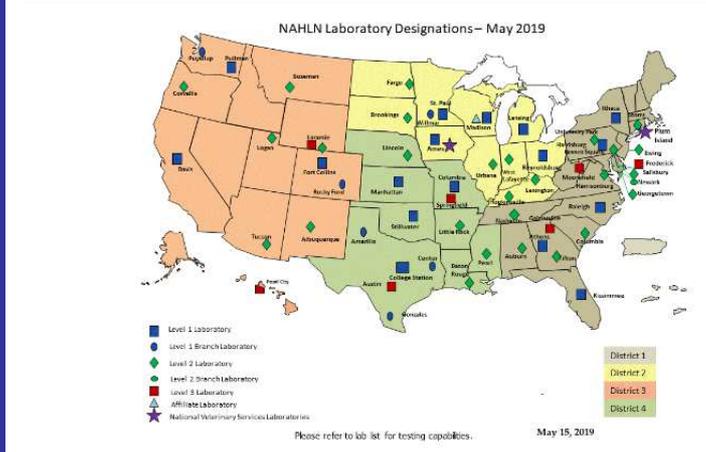


Veterinary Diagnostic Laboratory *Promoting One Health*

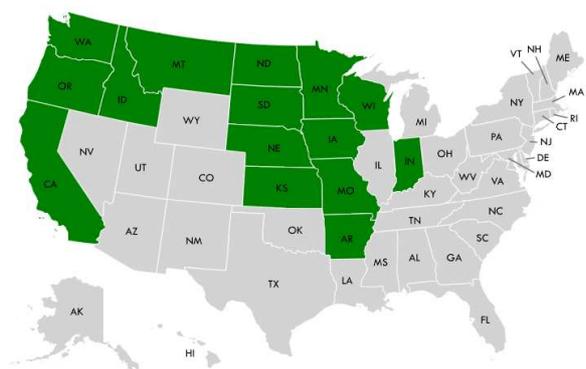
- National veterinary diagnostic laboratory network participation
 - In the US, known as the National Animal Health Laboratory Network (NAHLN)
 - Fully accredited by the American Association of Veterinary Laboratory Diagnosticians
 - Accredited to the ISO 17025 standard as recommended by the OIE

National Animal Health Laboratory Network (NAHLN)

Last Modified: May 17, 2019



HPAI 2014/15 Confirmed Detections



211 Commercial Flocks	21 Backyard Flocks
50,400,000 Birds Affected	6/16/15 Last Detection Reported

National Bio-Agro-Defense Facility (NBAF)



Veterinary Diagnostic Laboratory *Contributions to One Health*

- **Diagnostic testing**-- reduced mortality and morbidity improves food production and preserves human-animal bond.
- **Regulatory testing**-- animals move freely in the markets.
- **Early warning**-- animal diseases, earliest response, best outcome.
- **National laboratory network member**--provide testing in the face of catastrophic outbreaks.
- **Antimicrobial resistance monitoring**-- optimal antibiotic therapy.
- **Applied research**-- develop and validate new diagnostic methods.
- **Zoonotic disease confirmation**-- improved human health.
- **Teaching and continuing education**-- veterinarians, producers and animal owners advances animal health knowledge

Veterinary Diagnostic Laboratory *Contributions to Food Security & Safety*

- Increased meat production
- Reduced death loss and higher carcass quality
- Improved quality and wholesomeness of food products
- Improved food safety

Challenges toward maintaining Food Security and Safety

- Globalization of commerce increases risks to animal health and thus, food security.
- Threat of bioterrorism.
- Increased incursion of humans and domestic animals into wildlife habitats.
- Lack of integration of all pieces and parts of the system.
- The need to work more closely with allied health professions, re One Health.

Challenges for Veterinary Diagnostic Medicine

- Government investment in budgets for many veterinary diagnostic laboratories is declining.
- In light of government funding cuts, laboratories must explore alternate sources of income:
 - Partnering with industry/universities for funded research
 - Partner with Ministries of Health and industry to conduct zoonotic disease/insect surveillance
 - Utilize laboratory faculty/technical staff to build training programs and provide consulting services.
 - Develop new diagnostic testing methods such as microbiome assays, metagenomics, genomic markers.
 - Promote the financial and health benefits of your laboratory

Return on Investment for Veterinary Diagnostic Laboratories

Preventive Veterinary Medicine 151 (2018) 5–12

Contents lists available at ScienceDirect

Preventive Veterinary Medicine

journal homepage: www.elsevier.com/locate/prevetmed

Economic impact of university veterinary diagnostic laboratories: A case study

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ABSTRACT

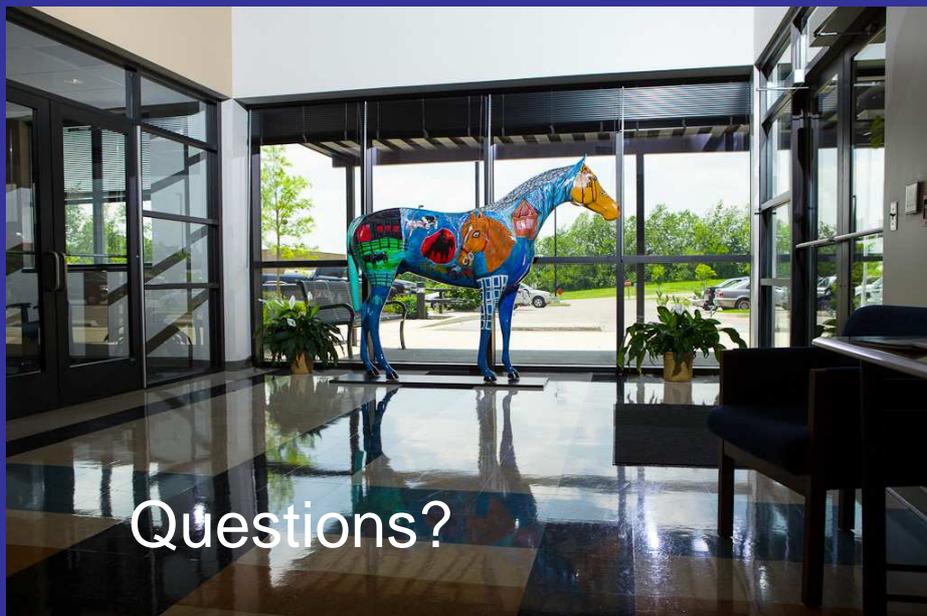
Veterinary diagnostic laboratories (VDLs) play a significant role in the prevention and mitigation of endemic animal diseases and serve an important role in surveillance of, and the response to, outbreaks of transboundary and emerging animal diseases. They also allow for business continuity in livestock operations and help improve human health. Despite these critical societal roles, there is no academic literature on the economic impact of VDLs. We present a case study on the economic impact of the Iowa State University Veterinary Diagnostic Laboratory (ISUVDL). We use economic contribution analysis coupled with a stakeholder survey to estimate the impact. Results suggest that the ISUVDL is responsible for \$2,162.46 million in direct output, \$2,832.45 million in total output, \$1,158.19 million in total value added, and \$31.79 million in state taxes in normal years. In an animal health emergency this increases to \$5,446.21 million in direct output, \$11,063.06 million in total output, \$4,523.70 million in total value added, and \$124.15 million in state taxes. The ISUVDL receives \$4 million annually as a direct state government appropriation for operating purposes. **The \$31.79 million in state taxes in normal years and the \$124.15 million in state taxes in an animal health emergency equates to a 795% and 3104% return on investment, respectively. Estimates of the economic impact of the ISUVDL provide information to scientists, administrators, and policymakers regarding the efficacy and return on investment of VDLs.**



Dr. James H. Steele

Father of Veterinary Public Health

“We must have good animal health to
have good public health!”



Questions?