

ONE HEALTH

Engaging in a Multidisciplinary Approach

Comments by

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for the

BIO International Convention - One Health Day

June 4, 2018 Boston, MA

The Concept of One Health

The concept of One Health is not really new, considering the fact that 2,500 years ago it was **Hippocrates** who

“urged physicians to consider...

- **where their patients lived,**
- **the foods they ate,**
- **the waters they drank,**
- **their lifestyles, and**
- **the seasons of the year.”**



One Health Defined

"One Health is the collaborative effort
of multiple disciplines
- working locally, nationally, and globally -
to attain optimal health
for people, animals, and our environment."

AVMA One Health Initiative Task Force 2008



Why One Health?

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- Worldwide, nearly 75 percent of all emerging human **infectious diseases** in the past three decades originated in animals.
- **Climate change**, increased CO2 levels, land-use changes, resource scarcity, decreased biodiversity, loss of pollinators, dams and irrigation projects, air and water pollution, and encroachment into wildlife habitat are just a few of the items impacting the ecosystem which in turn affects the health of humans and animals.
- The **world population** is projected to grow from 7.4 billion in 2016 to 9 billion by 2050... further increasing humanity's ecological footprint.
- To provide adequate **healthcare, safe food** and **safe water** for the growing global population... a collaborative and trans-disciplinary approach is needed (e.g. agricultural scientists, anthropologists, economists, educators, engineers, entomologists, epidemiologists, hydrologists, microbiologists, nutritionists, physicians, policy makers, public health professionals, sociologists, and veterinarians ... working together!).
- The **human-animal bond** beneficially impacts the health of both people and animals... a unique role in the scope of One Health.



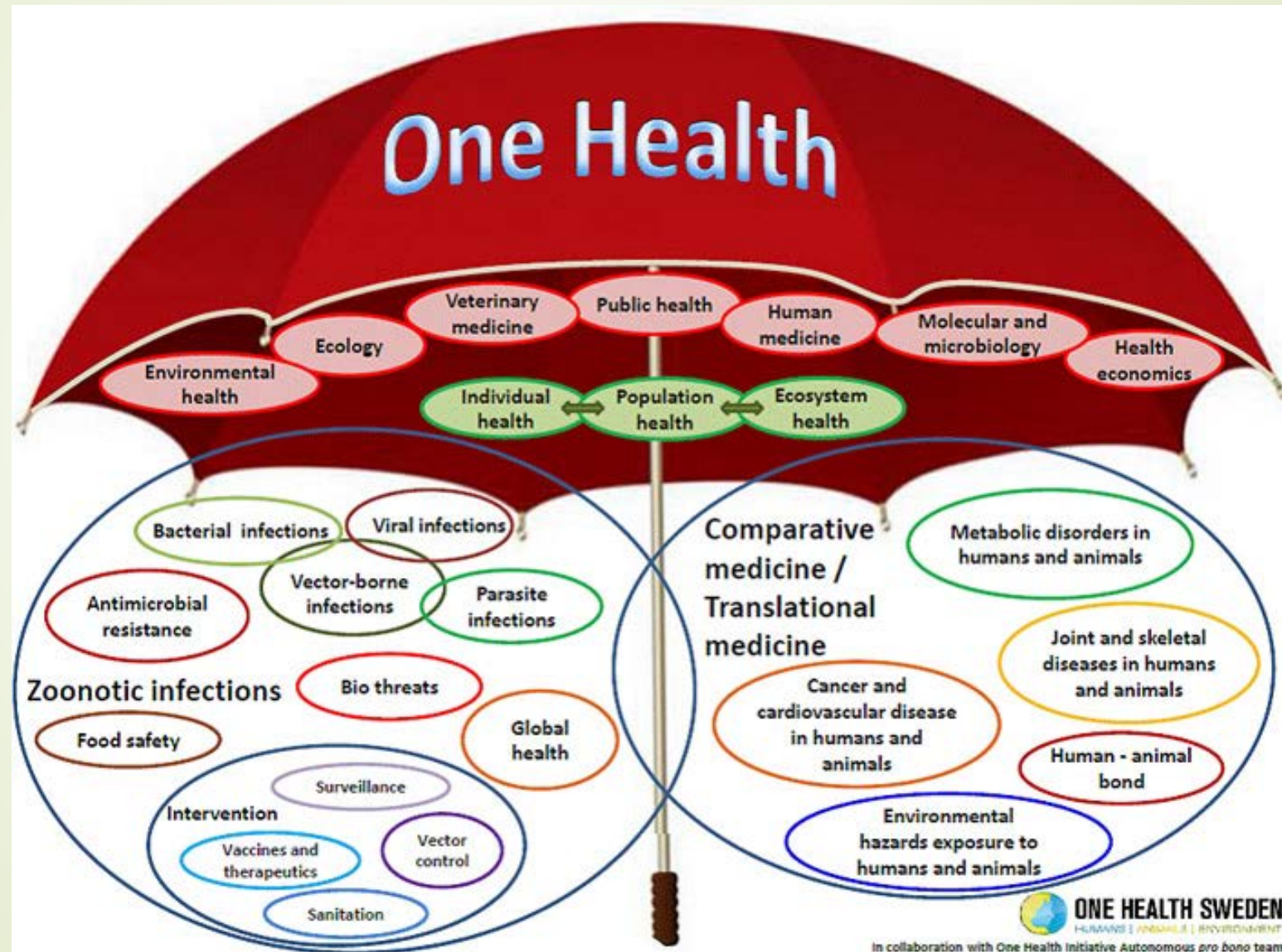
Mission Statement:

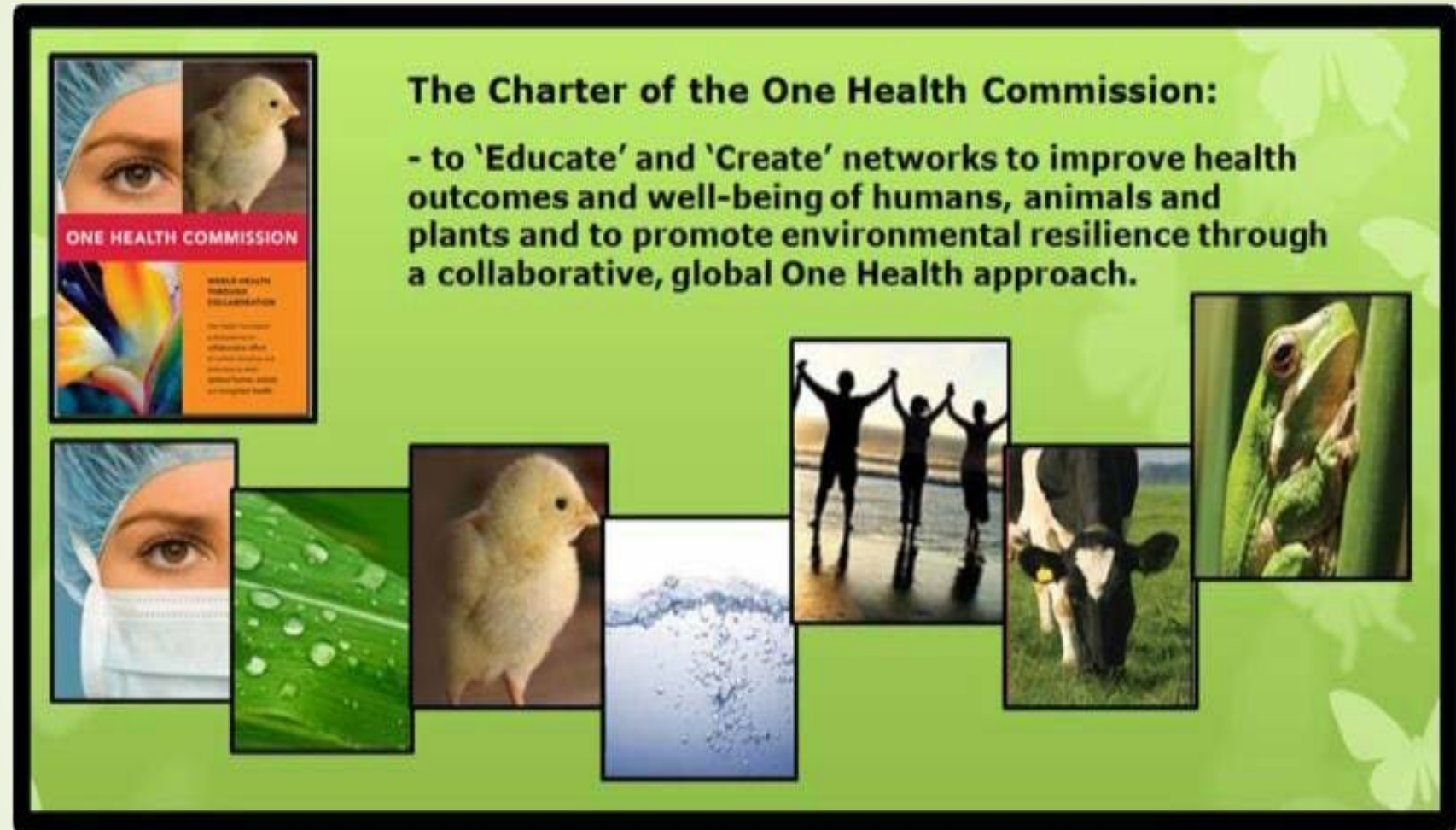
Recognizing that human health (including mental health via the human-animal bond phenomenon), animal health, and ecosystem health are inextricably linked, One Health seeks to promote, improve, and defend the health and well-being of all species by enhancing cooperation and collaboration between physicians, veterinarians, other scientific health and environmental professionals and by promoting strengths in leadership and management to achieve these goals.

One Health Initiative Website: <http://www.onehealthinitiative.com/mission.php>

(The One Health Initiative Autonomous *pro bono* team (OHI) was co-founded in 2006.)

Scope of 'One Health' as per the One Health Initiative





One Health Commission Website: <https://www.onehealthcommission.org/>

(The One Health Commission is a globally focused organization dedicated to promoting improved health of people, domestic animals, wildlife, plants and the environment. It is a 501(c)(3) organization, chartered in Washington, D.C. on June 29, 2009.)



Mission: The One Health Platform is a strategic forum of stakeholders and a One Health reference network that aims to enhance understanding of and preparedness for the current and future outbreaks of zoonoses, emerging infectious diseases in humans and animals, and antimicrobial resistance, including the ecological and environmental factors which impact on these diseases.



**Creating a healthy future for
humans, animals and their
environments.**



The One Health Platform website: <http://onehealthplatform.com/>

(The One Health Global Network Webportal was established in 2011)

Setting the stage...

One Health video clip (3.0 min): <https://www.youtube.com/watch?v=2pyLm2j3xI&feature=youtu.be>

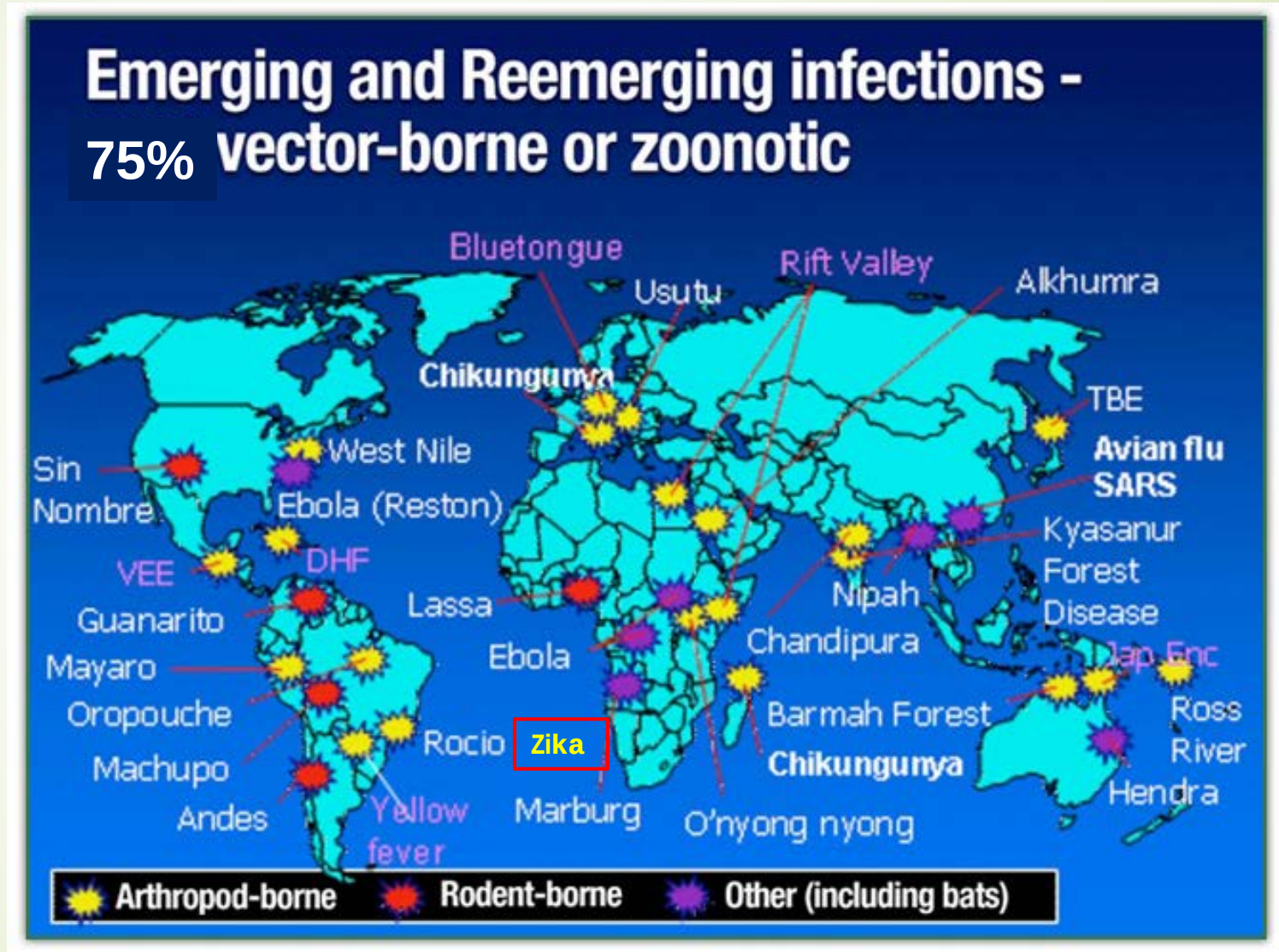
CDC One Health video clip (2.5 min): <https://www.youtube.com/watch?v=TG0pduAYESA>

Additional information is available from the PBS documentary entitled *Spillover* (55.56 min): <http://www.pbs.org/spillover-zika-ebola-beyond/home/>



Emerging & Re-emerging infections

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Zika Virus – Exemplifies “One Health”

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The One Health approach brings together entomologists, physicians, veterinarians, virologists, wild life biologists, environmental experts, universities, governments, public health organizations, world health organizations, just to mention a few... all seeking to help address the following needs:

- Zika virus infection is usually asymptomatic or causes mild illness (e.g. fever, rash, muscle/joint pain), however, CDC has recently concluded that Zika virus infection during pregnancy can cause **microcephaly** and other severe fetal brain defects. Association with autoimmune-like illnesses such as Guillain-Barre syndrome is under investigation.
- Commercial vaccines and specific antiviral drug treatment for Zika virus infection are needed. Funding for basic research and vaccine/drug development is required.
- Diagnostic tests for Zika virus (e.g. blood, urine or saliva samples) need to be developed and then approved by the FDA.

Zika Virus – Exemplifies “One Health” cont’d

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- Mosquito (*Aedes* genus) vector control needs focused intervention (e.g. removal of water-containing sources; insecticide sprays; utilizing genetically engineered mosquitoes to suppress the mosquito population); risk communication/education to help the public avoid mosquito exposure.
- Enhanced surveillance systems are needed; take advantage of apps via smartphones; collecting and analyzing data to assist with public health strategies.
- Determining whether there are non-human reservoirs for Zika virus needs to be established; studying the viral strains may help explain why the virus has demonstrated the capacity to spread exponentially in the human population in the Americas.
- Medical care of new born infants with microcephaly is needed which means assessing the medical infrastructure at local and national levels; financial commitment; government engagement; policy development at local, national, international levels.



A few examples of Mosquito borne diseases



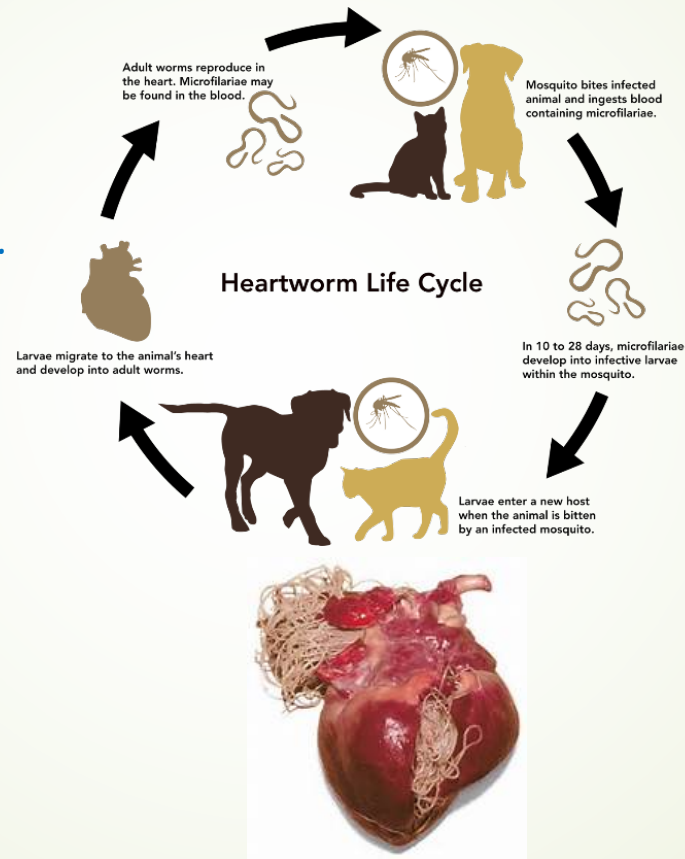
Aedes aegypti mosquito transmits Dengue, Chikungunya, **Yellow fever**, and Zika viruses.



Asian Tiger (*Aedes albopictus*) transmits West Nile virus, Equine Encephalitis virus.



Culex tritaeniorhynchus transmits Japanese encephalitis virus.



Mosquito transmitted *Dirofilaria immitis* heartworm larvae. (*Aedes aegypti*, *Aedes albopictus*, *Aedes canadensis*, *Aedes sierrensis*, *Aedes trivittatus*, *Aedes vexans*, *Anopheles punctipennis*, *Anopheles quadrimaculatus*, and *Culex quinquefasciatus*.)



Mosquito transmitted Zika virus can cause microcephaly.



Anopheles sp. transmits **malaria** (*Plasmodium falciparum*).

Lyme Disease is on the rise...

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Ixodes tick (deer tick) nymph



Rash may or may not develop.



Lyme Disease is caused by a spirochete - a corkscrew-shaped bacterium called ***Borrelia burgdorferi*** transmitted by Ixodes ticks.

Shorter winters and increased temperatures enhance tick survival.

Lyme disease is a **Nationally Notifiable Disease** to the CDC.

<https://www.cdc.gov/nndss/>

Primarily people & dogs get Lyme Disease but other animals can become infected (horses, deer, cattle, cats (rarely) and mice). Known as the “great imitator” because it mimics other diseases.

People: flu-like illness (fever, chills, sweats, muscle aches, fatigue, nausea and joint pain); early & chronic forms; Lyme carditis.

Dogs and horses: shifting leg lameness, swollen joints, lethargy, fever and anorexia.

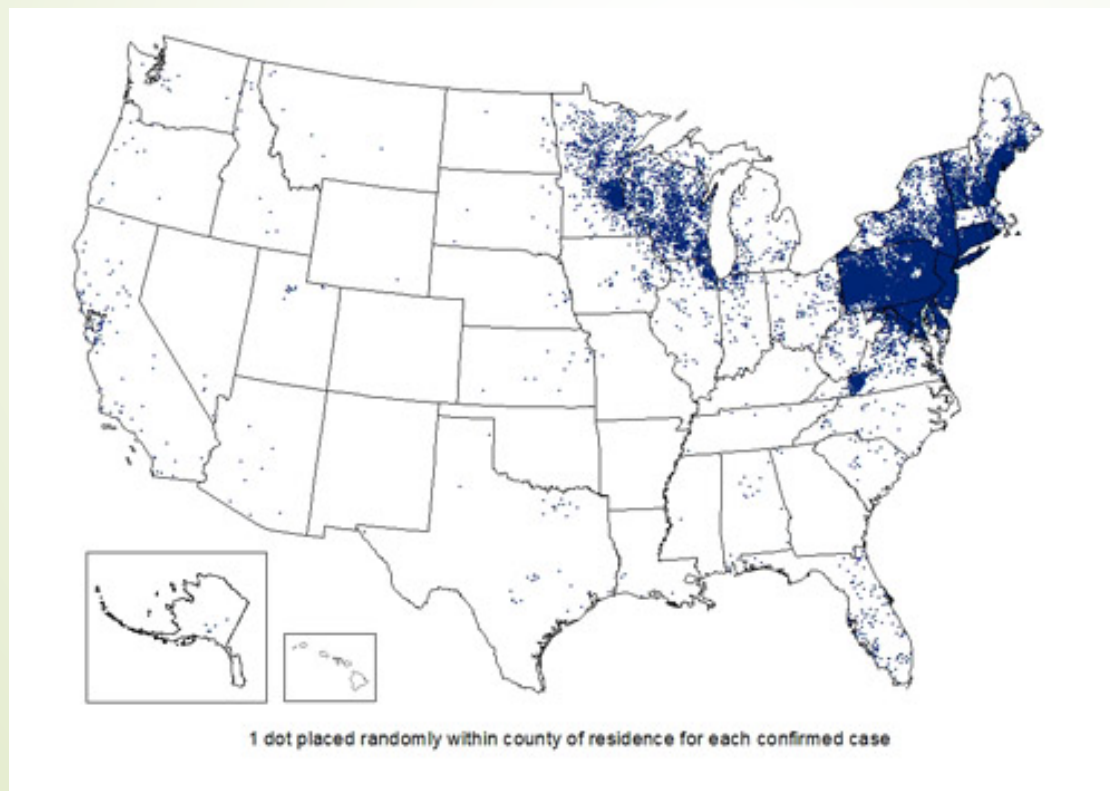
Prevention: a vaccine is available for dogs.

Treatment: typically antibiotics (e.g. doxycycline) are prescribed for people, dogs and horses.

<https://www.niaid.nih.gov/diseases-conditions/lyme-disease>

Lyme disease, cont'd

- 1. Lyme disease CDC: <https://www.cdc.gov/lyme/index.html>
- 2. Data and Statistics (Tables, Graphs, Maps): <https://www.cdc.gov/lyme/stats/index.html>
- 3. County-level Lyme Disease data (Excel spread sheet):
<https://www.cdc.gov/lyme/resources/ld-case-counts-by-county-00-15.csv>



**Reported Cases of Lyme Disease
United States, 2016**

Emerging Diseases of Global Health and Agricultural Concerns – Links Between Animal and Human Health

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Middle East Respiratory Syndrome (2012)



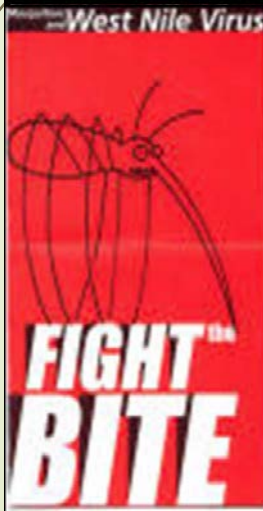
Ebola Outbreak (2014; 2018)



Severe Acute Respiratory Syndrome (2003)



Avian Influenza A (H7N9) (2017)



West Nile Virus (1999)



Bovine Spongiform Encephalitis (1986)



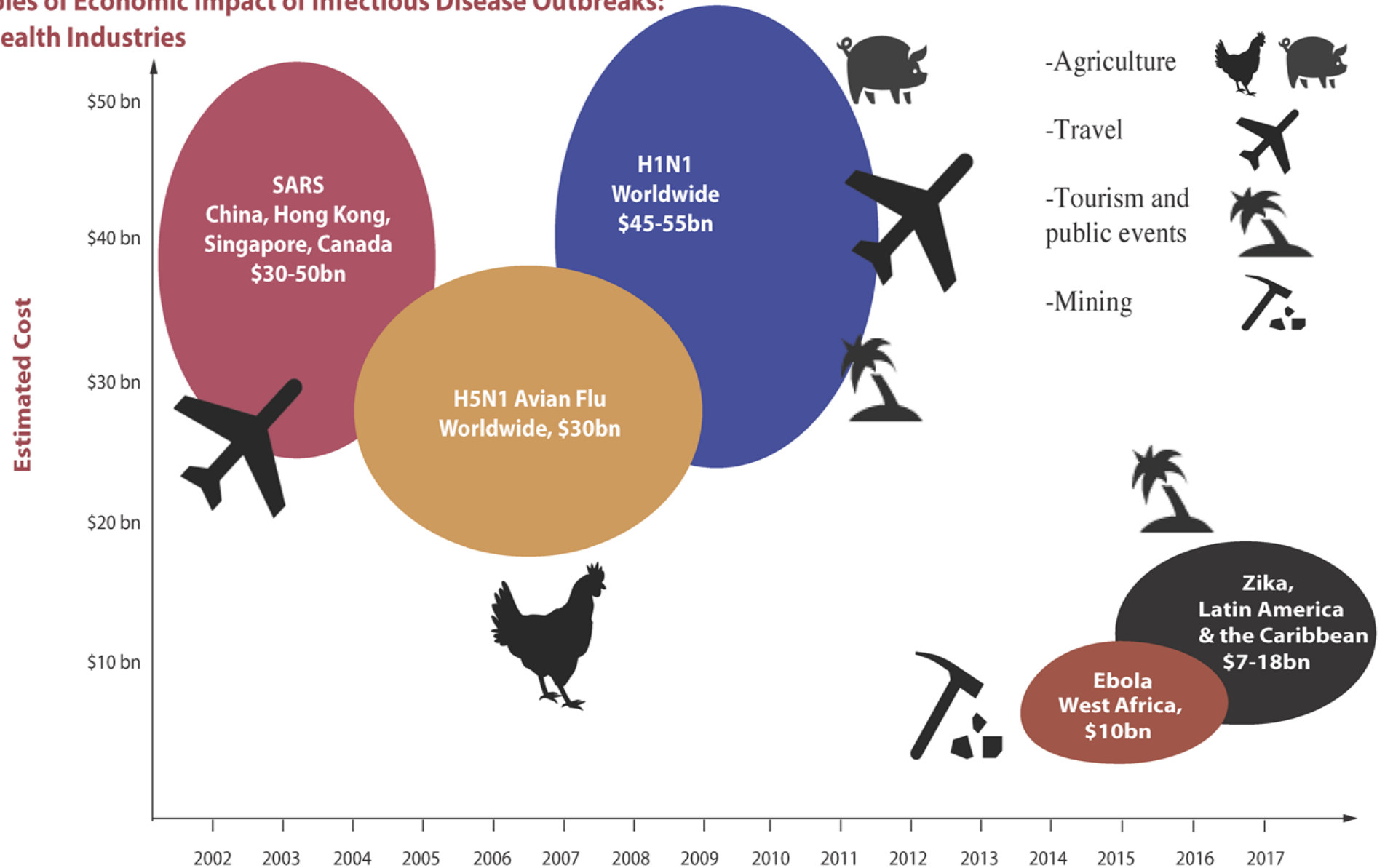
Escherichia coli –O157:H7 (1998)



H1N1 Influenza (2009)

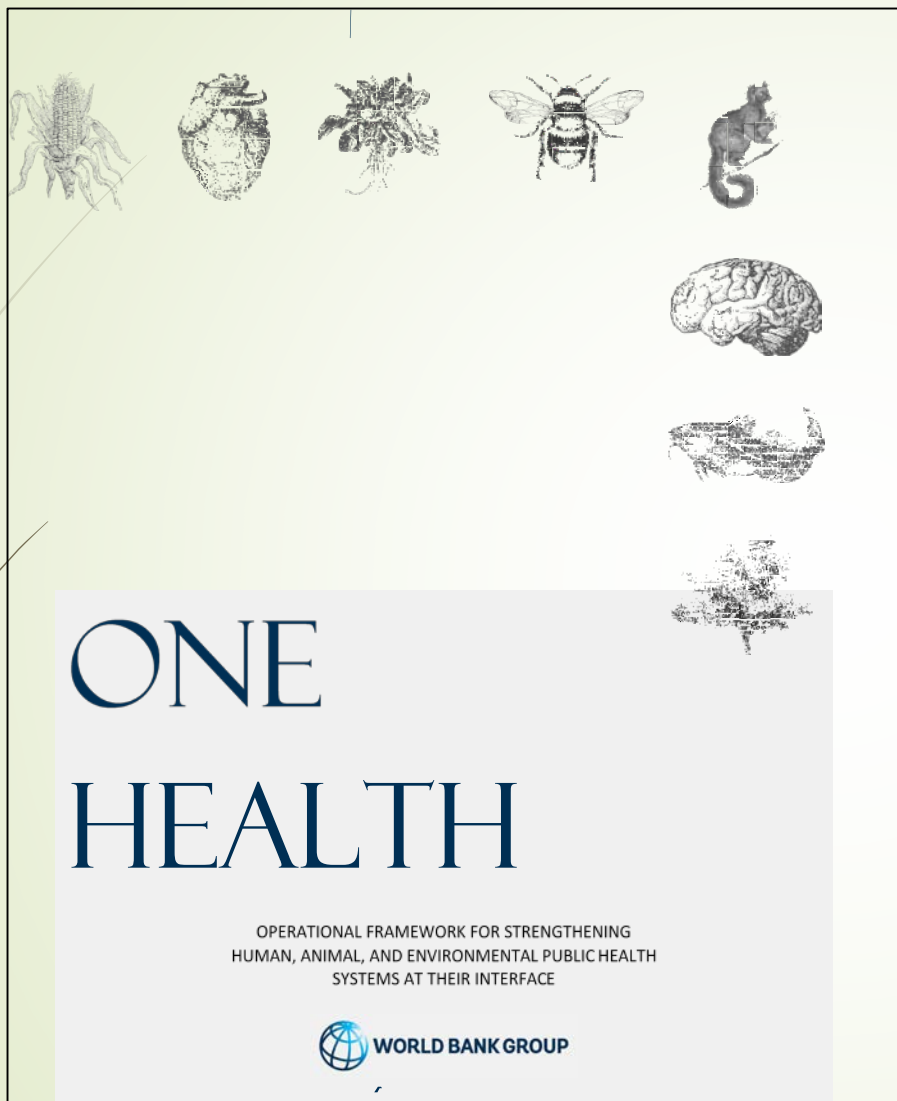


Examples of Economic Impact of Infectious Disease Outbreaks: Non-Health Industries



Figures are estimates and are presented as relative size. Based upon bio-era, World Bank, and UNDP data. Chart updated by EcoHealth Alliance.

[Slide credit: [World Banking on One Health](#), October 11, 2017 presentation by Dr. Tim Bouley at the [Uppsala Health Conference](#), Uppsala, Sweden.]



On 4/27/2018 the World Bank released their **“One Health Operational Framework for strengthening human, animal and environmental public health systems at their interface”**

The Operational Framework is intended as a guide for One Health operations, from project and program scoping and identification stages to design and implementation, including monitoring and evaluation, to help optimize investments.

<http://documents.worldbank.org/curated/en/703711517234402168/Operational-framework-for-strengthening-human-animal-and-environmental-public-health-systems-at-their-interface>



Transforming our world: The 2030 Agenda for Sustainable Development

‘All countries and all stakeholders, acting in collaborative partnership, will implement this plan.’

Many of these United Nations goals demonstrate a One Health approach.

S.2615 “Advancing Emergency Preparedness Through the One Health Act of 2018” A bipartisan bill.

- Introduced March 22, 2018 by **Senator Tina Smith (D-MN)** and **Senator Todd Young (R-IN)** to establish an interagency One Health Program.
- The framework would:
 - Advance workforce development related to prevention of and response to disease outbreaks in animals and humans.
 - Improve coordination between federal agencies who study human and animal health and the environment.
 - Advance scientific understanding of the connections between human, animal, and environmental health.

<https://www.congress.gov/bill/115th-congress/senate-bill/2615/text?q=%7B%22search%22%3A%22tina+smith%22%7D&r=18>

Animals as Sentinels

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Free lead testing event for dogs in Flint water crisis

http://www.mlive.com/news/flint/index.ssf/2016/04/free_lead_testing_event_for_do.html



Maggie, a terrier mix, is held by Michigan State University veterinary student Courtney Andries, of East Lansing, while veterinary technician Monica Reinke, of East Lansing, finishes drawing her blood during a free lead testing event for animals on Saturday, March 19, 2016 at the parish hall of St. Paul's Episcopal Church in Flint. The event was held by the Michigan State College of Veterinary Medicine amid Flint's water crisis.
Rachel Woolf | MLive.com

The test will not only check for lead but for other metals including copper, iron, mercury and zinc. More than 170 dogs have been tested during the previous three events.

Issues that can arise in dogs exposed to lead include the gastrointestinal system, with decreased appetite, vomiting and diarrhea.

Brain involvement can be impacted, with dogs becoming easily agitated or showing signs of seizures, along with a potential drop in red blood cell or abnormal development of cells.

Lead poisoning in Northern Nigeria 2010

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- Early 2010 ducks began to disappear in Zamfara, Nigeria no one thought it was important at the time.
- By May 2010 hundreds of children became sick (vomiting, headaches & seizures)... and many died. Cause unknown.
- Public health team sent in to investigate (CDC/Nigeria/WHO/ Doctors Without Borders/and an Animal-Human Interface Officer).
- Villagers reported $\frac{1}{4}$ of all children in their communities had died.
- Found unsafe levels of **LEAD** inside homes, in the water and in the soil... children had dangerous levels of lead in their blood.
- Missed the clue that the deaths of the ducks could have alerted health officials of the crisis earlier... **ducks were sentinels** of an environmental hazard.
- Recent mining for gold... no protective equipment; often brought rocks inside the homes to extract the gold; children were exposed to lead dust from the rocks.



Children sit on bags of lead-contaminated soil, which were removed from their village of Zamfara during cleanup.

Bottom Line: Largest known outbreak of Lead Poisoning in history!

355 cases: 163 deaths with 111 deaths of children.

White-nose Syndrome in Bats – loss of pollinators

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Research projects are focused on managing WNS - identifying a biological control agent for the fungus is key. UV irradiation may prove helpful.

Active collaboration with scientists, managers, lawmakers and the public is needed to address WNS via a **One Health** approach!

White-nose Syndrome (WNS) is a disease caused by the fungus *Pseudogymnoascus destructans*. The disease is estimated to have killed over six million bats in eastern North America since 2006, and can kill up to 100% of bats in a colony during hibernation. The disease is caused by a fungus from Eurasia, which was accidentally transported here by humans.

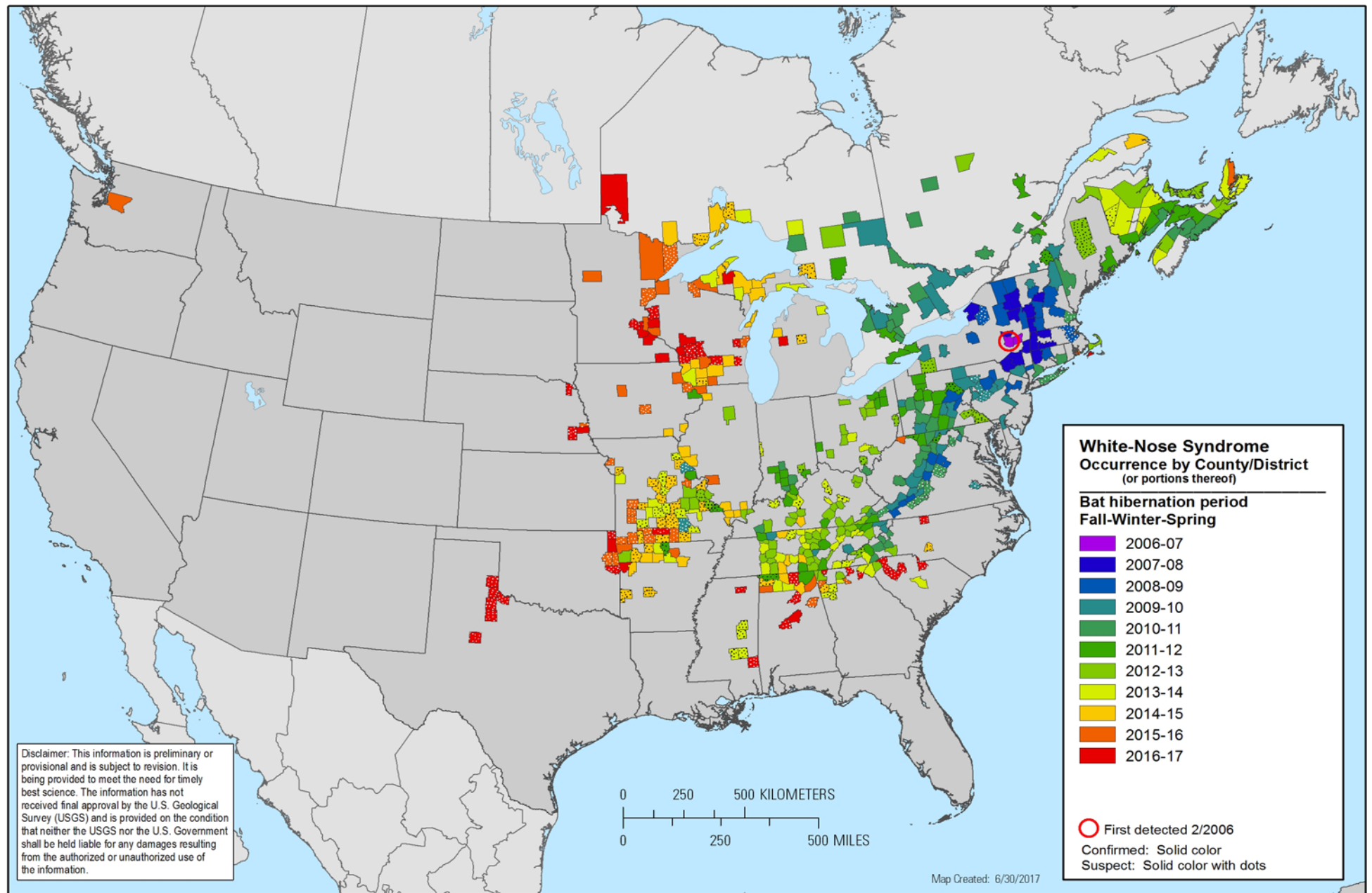
Bats are important for:

- a. **Pest control** - the primary predators of night-flying insects including many damaging agricultural pests.
- b. **Pollination** – from deserts to rainforests, nectar-feeding bats are critical pollinators for a wide variety of plants of great economic and ecological value.
- c. **Seed dispersion** – fruit eating bats scatter seeds helping to restore forests.

We can expect to see significant ecosystem changes in the coming years following the loss of the bat population!

https://www.nwhc.usgs.gov/disease_information/white-nose_syndrome/
<https://vimeo.com/76705033>

https://www.whitenosesyndrome.org/sites/default/files/resource/blehert_et_al_2008_wns_fungus_total.pdf



Citation: White-nose syndrome occurrence map - by year (2017). Data Last Updated: 6/30/2017. Available at: <https://www.whitenosesyndrome.org/resources/map>.

Honey Bees - Loss of pollinators continues.

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Honey bees in hive.



Varroa mites on a bee.



Nation's beekeepers lost 44% of bee colonies in 2015-16.

https://www.nass.usda.gov/Surveys/Guide_to_NASS_Surveys/Bee_and_Honey/#bee_honey

A variety of factors may be the cause: Pesticides (e.g. neonicotinoids), Nosema (a disease causing fungus), the Varroa mite, and changing land use patterns.

Varroa destructor is an external parasitic mite that attacks the honey bee *Apis cerana* and *Apis mellifera*. It feeds on the hemolymph, weakens the bee and enables infection by harmful pathogens such as viruses, bacteria or fungus to develop.

Colony Collapse Disorder – loss of worker bees with few dead bees near the hive; queen bee and brood remain. 10 years after the crisis began the losses are now down 27% from the 2016 data reports.

2015 the White House released a “National Strategy to Promote The Health of Honey Bees and Other Pollinators”.

<https://obamawhitehouse.archives.gov/blog/2015/05/19/announcing-new-steps-promote-pollinator-health>

Honey bees pollinate crops such as apples, cranberries, melons, broccoli, blueberries, cherries... and almonds depend entirely on honey bees for pollination. (<http://www.abfnet.org>) ~\$US168Billion/year.

Marine Environmental Sentinels...

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Healthy Green Sea Turtle



Healthy coral reef



Fibropapillomatosis in a Green Sea Turtle (can obstruct swimming, feeding, buoyancy, sight, and can lead to death). There is a strong link between this disease and the environmental health of the coastal habitat. [<http://www.cabi.org/isc/datasheet/82638>]



Unhealthy reef associated with oceanic acidification

[http://coralreef.noaa.gov/education/oa/resources/22-4_kleypas.pdf]

Climate Change...

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Paris Climate Conference 12-12-2015 - A global climate deal to limit global warming to $< 2^{\circ}\text{C}$.

Montreal Protocol 10-15-2016 – A global agreement to reduce use of hydrofluorocarbons (HFCs), powerful greenhouse gases.



More severe Tornadoes and Hurricanes



Floods



Melting Glaciers and Ice fields



Rising sea levels



Red Tide
Algae
Blooms



Vector
borne
diseases



Air Pollution



Wild Fires



Droughts





Courtesy of the NY Times

Atlantic Tropical Storms & Hurricanes in 2017

Tropical Storm Arlene, April 21 – rare to see in April

Tropical Storm Bret, June 19

Tropical Storm Cindy, June 20

Tropical Storm Don, July 17

Tropical Storm Emily, July 31

Hurricane Franklin, Aug. 6 Cat. 1 Veracruz, Mexico

Hurricane Gert, Aug. 13

Hurricane **Harvey**, Aug. 17 **Cat. 4** Texas Aug. 25

Hurricane **Irma**, Aug. 30 **Cat. 5** Caribbean Islands Sept. 6 & Florida Keys Sept 10

Hurricane **Jose** Sept. 5 **Cat. 4** stays along Atlantic coast

Hurricane Katia Sept. 6 Cat. 1 Veracruz, Mexico

Hurricane **Maria**, Sept. 16 **Cat. 5** Puerto Rico Sept. 19

Hurricane Nate, Oct. 4 Cat 1 New Orleans

Cat 1	74-95 mph
Cat 2	96-110 mph
Cat 3	111-129 mph
Cat 4	130-156 mph
Cat 5	>157 mph



SATELLITES HELP DETECT HARMFUL ALGAL BLOOMS

Large accumulations of algae can harm people and animals. NASA satellite data help detect, forecast and target responses to such harmful algal blooms.

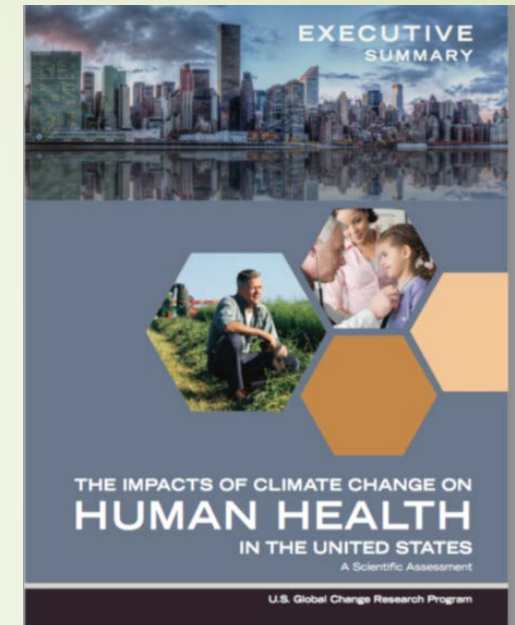
NASA's Global Precipitation Measurements (GPM) Disease Initiative and the Wilson Center - Vector and Waterborne Disease Workshop 5-17-2018

<https://www.youtube.com/playlist?list=PLzM1iiQhVrdEx2rUcIP16w93jGEhQ2oui>



	Climate Driver	Exposure	Health Outcome	Impact
 Extreme Heat	More frequent, severe, prolonged heat events	Elevated temperatures	Heat-related death and illness	Rising temperatures will lead to an increase in heat-related deaths and illnesses.
 Outdoor Air Quality	Increasing temperatures and changing precipitation patterns	Worsened air quality (ozone, particulate matter, and higher pollen counts)	Premature death, acute and chronic cardiovascular and respiratory illnesses	Rising temperatures and wildfires and decreasing precipitation will lead to increases in ozone and particulate matter, elevating the risks of cardiovascular and respiratory illnesses and death.
 Flooding	Rising sea level and more frequent or intense extreme precipitation, hurricanes, and storm surge events	Contaminated water, debris, and disruptions to essential infrastructure	Drowning, injuries, mental health consequences, gastrointestinal and other illness	Increased coastal and inland flooding exposes populations to a range of negative health impacts before, during, and after events.
 Vector-Borne Infection (Lyme Disease)	Changes in temperature extremes and seasonal weather patterns	Earlier and geographically expanded tick activity	Lyme disease	Ticks will show earlier seasonal activity and a generally northward range expansion, increasing risk of human exposure to Lyme disease-causing bacteria.
 Water-Related Infection (<i>Vibrio vulnificus</i>)	Rising sea surface temperature, changes in precipitation and runoff affecting coastal salinity	Recreational water or shellfish contaminated with <i>Vibrio vulnificus</i>	<i>Vibrio vulnificus</i> induced diarrhea & intestinal illness, wound and blood-stream infections, death	Increases in water temperatures will alter timing and location of <i>Vibrio vulnificus</i> growth, increasing exposure and risk of water-borne illness.
 Food-Related Infection (<i>Salmonella</i>)	Increases in temperature, humidity, and season length	Increased growth of pathogens, seasonal shifts in incidence of <i>Salmonella</i> exposure	<i>Salmonella</i> infection, gastrointestinal outbreaks	Rising temperatures increase <i>Salmonella</i> prevalence in food; longer seasons and warming winters increase risk of exposure and infection.
 Mental Health and Well-Being	Climate change impacts, especially extreme weather	Level of exposure to traumatic events, like disasters	Distress, grief, behavioral health disorders, social impacts, resilience	Changes in exposure to climate- or weather-related disasters cause or exacerbate stress and mental health consequences, with greater risk for certain populations.

Examples of Climate Impacts on Human Health



Source: U.S. Global Change Research Program

<https://www.globalchange.gov/about/highlights/2017-analyzing-rising-costs-climate-change-human-health>

Increased Threats to Food Security

Food security - as defined by the Food and Agriculture Organization (FAO): 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.

Food stability - the ability to obtain food over time.

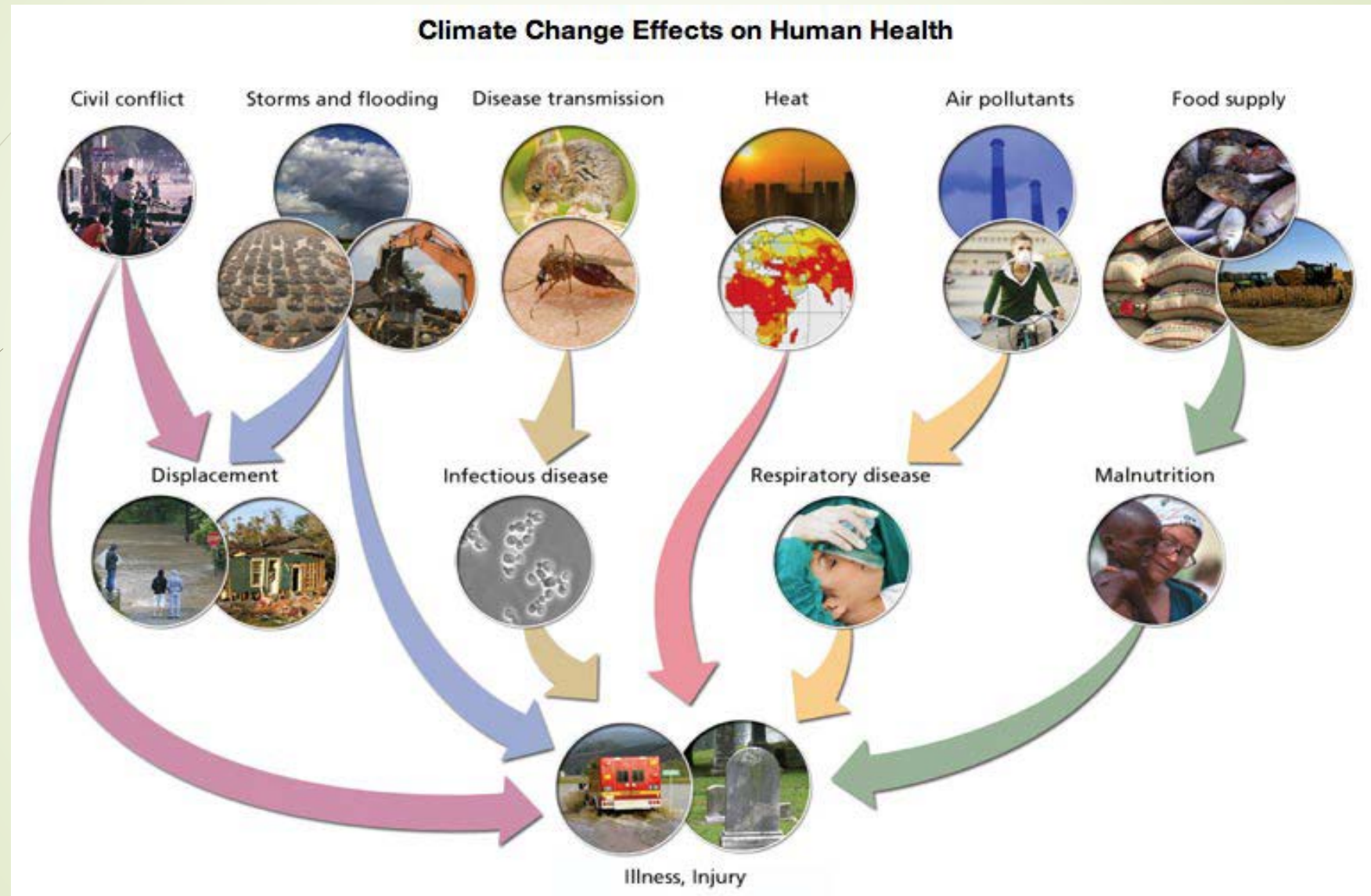
Food insecurity - can be transitory, seasonal, or chronic.

Threats to Food Security include:

- Climate change, including droughts, floods resulting in crop failures
- Declining numbers of farmers
- Massive bee die-offs
- Soil erosion
- Land development
- Plant pathogens
- Fertilizer dependence
- Civil conflict – decrease access to food
- Instability in markets – food price spikes
- Chokepoints in global trade



We are at an important crossroad to shift U.S. thinking... One Health can appeal to people at a personal level.

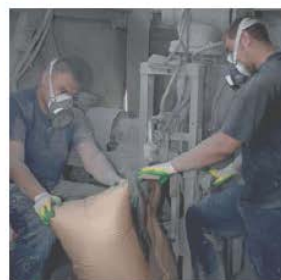




Solar Panels



Wind turbines



PREVENTING DISEASE THROUGH HEALTHY ENVIRONMENTS

A global assessment of the burden of disease from environmental risks

A Prüss-Ustün, J Wolf, C Corvalán, R Bos and M Neira

2016



Disease CAN be prevented through healthier environments!

The realization of just how much disease and ill health can be prevented by focusing on environmental risk factors should add impetus to global efforts to encourage preventive measures through all available policies, strategies, interventions, technologies and knowledge.

The analysis shows that 23% of global deaths (and 26% of deaths among children under five, which equates to 1.7 M deaths) are due to modifiable environmental factors – and therefore can be prevented... **e.g. reduce air pollution; access to safe water; access to basic sanitation; and access to clean fuel.**

Plants as Biomonitors for Human and Animal Health

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- Air quality is monitored for public health safety... Portland , OR discovered an unexpected source: **urban moss**.
- Moss lack true roots and absorb nutrients directly from the surrounding air.
- Where air quality is poor the moss will appear dull and stunted.
- 2016 the OR Dept. of Environmental Quality & U.S. Forest Service teamed up to identify the source of cadmium and arsenic contamination in the city... two glass manufacturing facilities.
- Once informed the manufacturers stopped using heavy metals and installed emission control devices.

<https://www.outsideonline.com/2076011/how-portlands-unusual-moss-uncovered-air-pollution-problem>





Translational Biology... advancing One Health.

- The **Institute of Medicine** (now the National Academy of Medicine)– Held a workshop in June 2015 entitled ***The Role of Clinical Studies for Pets with Naturally Occurring Tumors in Translational Cancer Research*** to examine the rationale and potential for an integrated comparative clinical trial approach to cancer drug development.

<https://www.nap.edu/catalog/21830/the-role-of-clinical-studies-for-pets-with-naturally-occurring-tumors-in-translational-cancer-research>

- **National Cancer Institute - Comparative Oncology Trials Consortium (NCI-COTC)**
Established to provide the infrastructure and resources needed to integrate clinical trials for pets with naturally occurring cancers into the development pathways for new drugs, devices, and imaging techniques for human cancers... while benefitting the lives of our pets.
- Currently **20 academic comparative oncology centers** are actively engaged in the NCI-COTC.

<https://ccrod.cancer.gov/confluence/display/CCRCOPWeb/Comparative+Oncology+Trials+Consortium>

Canine tumors share similarities with human cancers in histologic appearance, tumor genetics, biologic behavior, molecular targets, therapeutic response, heterogeneity, acquired resistance, recurrence, and metastasis.



Dr. Rodney Page, Director, Flint Animal Cancer Center Colorado State University & NCI-COTC member. He lead the partnership with the IOM Workshop.



Scottish Terriers are 19 more times more likely to develop bladder cancer (Transitional Cell Carcinoma - BRAF gene mutation) than the average dog breed, accounts for 2% of all canine tumors and can affect up to 20,000 pets each year; this rate is similar to that seen in humans.



Human-femur osteosarcoma

The gene expression profiles for canine and human osteosarcoma are indistinguishable, suggesting that findings from clinical trials for dogs with that type of cancer would be informative for human patients with osteosarcoma.



Canine-radius & ulnar osteosarcoma



Why do elephants rarely develop cancer? Possibly because they have at least 20 copies (40 alleles) of TP53 (encodes for the protein p53), a crucial tumor suppressor gene, while humans only have 1 copy (2 alleles)... a look at evolutionary-based medicine. (Abegglen, L. et al. JAMA 10-8-15)

NCI Funded Canine Supplements

“The answer to cancer may be walking beside us...”

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17 applications were received.

8 funded: scored in the Exceptional and Outstanding range.

https://www.youtube.com/watch?v=o2bYBJc_yKo 2 min

The 8 applications covered studies in all 6 canine tumors.

https://www.youtube.com/watch?v=Raif_9STMYM 26 min

Institution(s)	Project Leader	Canine Cancer(s)	Title or Aims
Baylor College of Medicine /U. Florida Vet Med College/ Texas A&M/Tech U. Denmark	Jonathan Levitt, PhD/ Alan Herron, DVM	Bladder, Mammary, Melanoma	Mutational load and predicted neoantigens in canine tumors and characterization of immune infiltrate and the tumor microenvironment
U. Colorado /Colorado State U. Vet School	Jill Slansky, PhD/ Steven Dow, DVM, PhD	B-Cell Lymphoma	Immune profiling and neoantigen discovery in canine B cell lymphoma
DFCI-HCC /Tufts University Vet Med School	Katherine Janeway, MD/ Cheryl London, DVM	Osteosarcoma	A multi-institutional approach to interrogate and improve immunotherapy outcomes in osteosarcoma
Purdue University /Duke University	Deborah Knapp, DVM/ H. Kim Lyerly, MD	Bladder	Advancing immunology in dogs with naturally-occurring invasive bladder cancer: a relevant model to improve immunotherapy across molecular cancer subtypes in humans
Roswell Park Cancer Inst. /Cornell U. Vet Med	Richard Koya, MD, PhD/Kristy Richards, PhD, MD	B-Cell Lymphoma	Immunogenic mutational load analysis for adoptive T cell therapy in canine B cell lymphoma
UC Davis /UC Davis School of Vet Med	Arta Monjazebe, MD, PhD	Glioma, Melanoma, Osteosarcoma	Evaluation of the tumor mutational landscape/neoantigens and immunophenotyping the tumor microenvironment in canine cancers
Ohio State U /OSU Vet Med School/TGEN	Peter Shields, MD/ Jeffrey Trent, PhD	Melanoma, Osteosarcoma	Immunogenomic profiling of canine melanoma and osteosarcoma
MD Anderson CC /Texas A&M	Amy Heimberger, MD/ Jonathan Levine, DVM	Glioma	Genomic and immunological canine glioma characterization

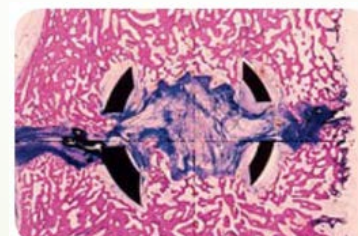
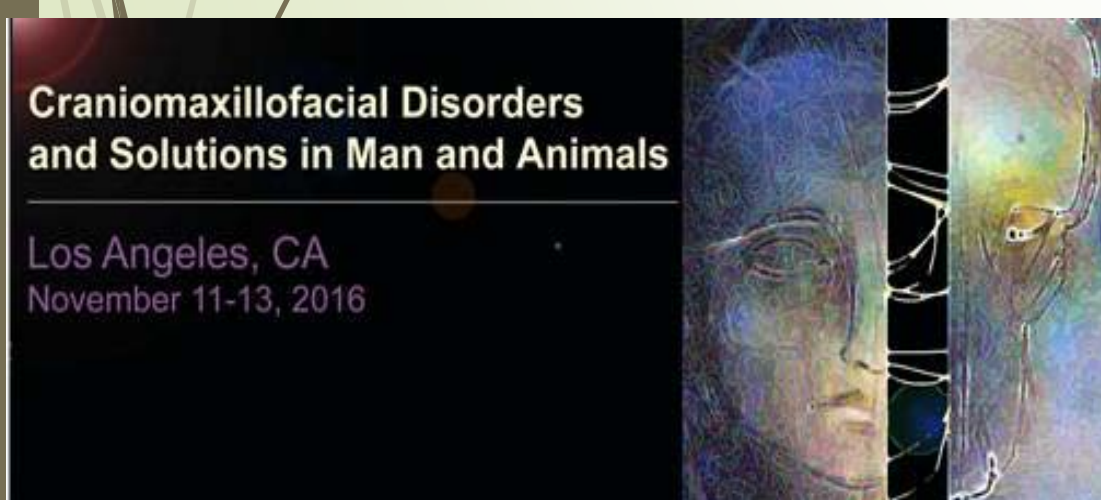
Craniofacial reconstruction through regenerative technology.

One Health benefits for animals and people.

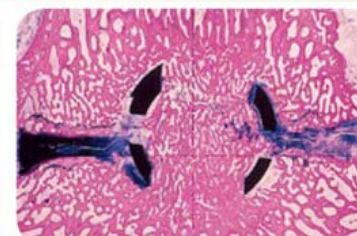
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Case example: Dogs with a malignant or benign tumor of the jaw (mandible) often undergo surgery to remove a section of the diseased jaw (mandibulectomies); or in the case of trauma (e.g. car accidents) reconstruction of the jaw is needed in order to restore function.

- In the past, bone grafts were used but the results were far from ideal.
- FDA has approved 2 spinal fusion products for use in people consisting of **recombinant human bone morphogenetic proteins (rh-BMPs)** which are growth factors that help induce formation of bone and cartilage.
- Using titanium locking plates as a scaffold, rh-BMPs are combined with a collagen and calcium compression resistant matrix to achieve predictable and timely bone regeneration/reconstruction of the jaw.



Collagen



Collagen + rh-BMP



(Frank J.M. Verstraete, Boaz Arzi, Daniel J. Huey, Derek D. Cissell and Kyriacos A. Athanasiou 2015. <http://onlinelibrary.wiley.com/doi/10.1111/j.1532-950X.2014.12123.x/epdf>)

Canine, Feline, and Human Obesity – A disease/epidemic

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Health risk problems include: Type 2 diabetes*, cardiorespiratory disease, musculoskeletal, and cancer.
*Global public health issue – Diabetes has quadrupled world wide since 1980... Today there are 422 million adults living with diabetes. (<http://who.int/mediacentre/news/releases/2016/world-health-day/en/#>) (<http://veterinaryrecord.bmj.com/content/175/24/610.full>)

World wide: diabetes cost \$673 billion in 2015; and increased to \$825 billion in 2016.



Optimal health for both humans and animals includes: Healthy Diets and Exercise.

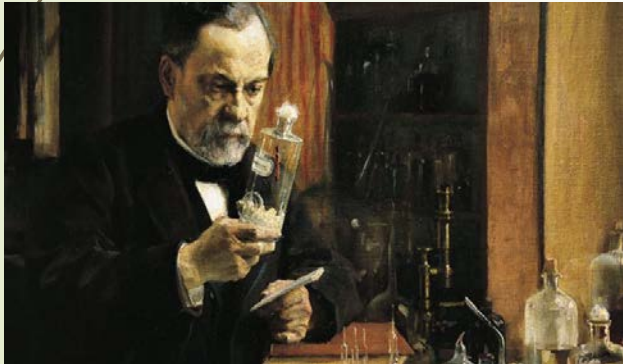


Sir Alexander Fleming (1881 - 1955)

- 1928 discovered penicillin
- 1944 knighted
- 1945 awarded the Nobel Prize in Medicine

Dr. Fleming cautioned that: **“Resistance is a natural counterpart to antibiotics.”**

Antimicrobial resistance (AMR) is the ability of a microorganism (e.g. bacteria, viruses, fungi, and parasites) to stop an antimicrobial (such as antibiotics, antivirals, antifungals, antimalarials, and anthelmintics) from working against it (e.g. Bacteria often become resistant through the acquisition of transmissible genetic elements, such as plasmids, that carry several resistance genes.). As a result, standard treatments become ineffective, infections persist and may spread to others.



Louis Pasteur (1822 - 1985)

- Developed germ theory
- Created pasteurization
- Created vaccines for anthrax & rabies
- Developed fermentation

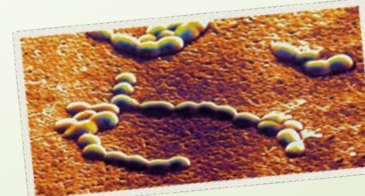
“Gentlemen, it is the microbes who will have the last word.”

“Messieurs, c’est les microbes qui auront le dernier mot.” Louis Pasteur



Concerns Rise over Antimicrobial Resistance

- Antimicrobial resistance (AMR) is a major international concern.
- The evolution of AMR is now occurring at an alarming rate and is outpacing the development of new countermeasures capable of thwarting infections.
- AMR threatens patient care (human and animal), economic growth, public health, agriculture, economic security, and national security.
- International travel increases opportunities for microbes to share genetic material and to spread globally.
- AMR is biologically complex and an improved understanding of the processes is needed. Science continues to evolve – and we continue to identify steps to mitigate risk.
- We all need to be stewards of judicious use of our antimicrobials!



National Strategy on Combating Antibiotic Resistant Bacteria

The National Strategy outlines **5 Goals** and Objectives:

1. Slow the emergence of resistant bacteria and prevent the spread of resistant infections.
2. Strengthen National **One-Health** surveillance efforts to combat resistance.
3. Advance development and use of rapid diagnostic tests for identification and characterization of resistant bacteria.
4. Accelerate basic and applied research and development for new antibiotics, other therapeutics and vaccines.
5. Improve international collaboration and capacities for antibiotic resistance prevention, surveillance, control, and antibiotic research and development.



WHO-OIE-FAO 2015 Global Action Plan on AMR

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- **Objective 1:** **Improve** awareness and understanding of antimicrobial resistance through effective communication, education and training.
- **Objective 2:** **Strengthen** the knowledge and evidence base through surveillance and research.
- **Objective 3:** **Reduce** the incidence of infection through effective sanitation, hygiene and infection prevention measures.
- **Objective 4:** **Optimize** the use of antimicrobial medicines in human and animal health.
- **Objective 5:** **Develop** the economic case for sustainable investment that takes account of the needs of all countries, and increase investment in new medicines, diagnostic tools, vaccines and other interventions.

[May 2015 - World Health Assembly adopted this Global Action Plan on AMR]

<http://www.who.int/antimicrobial-resistance/en/>



**WORLD ORGANISATION
FOR ANIMAL HEALTH**



United Nations – High level meeting on AMR

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GLOBAL ACTION PLAN
ON ANTIMICROBIAL
RESISTANCE



- United Nations held a high-level meeting on antimicrobial resistance on 9-21-2016.
- The members countries embraced the 2015 Global Action plan on AMR.
- ... “Support a multi-sectoral and **One Health approach** to address antimicrobial resistance, including through public health-driven capacity-building activities and innovative public-private partnerships and incentives and funding initiatives, together with relevant stakeholders in civil society, industry, small- and medium sized enterprises, research institutes and academia, to promote access to quality, safe, efficacious, and affordable new medicines and vaccines, especially antibiotics, and; alternative therapies and medicines to treatment with antimicrobials, and other combined therapies, vaccines and diagnostic tests; ...”

[<http://www.un.org/pga/71/wp-content/uploads/sites/40/2016/09/Draft-AMR-Declaration.pdf>]

[<http://www.un.org/pga/71/2016/09/21/press-release-hl-meeting-on-antimicrobial-resistance/>]

Minnesota Department of Health develops a One Health Antibiotic Stewardship Collaborative Five-Year Strategic Plan



Home Page: <http://www.health.state.mn.us/onehealthabx/>

Current State Plan Progress and Data: <http://www.health.state.mn.us/onehealthabx/plan.html>

- An antibiogram is a compilation of antimicrobial susceptibilities of selected pathogens. In Minnesota, they have a human antibiogram of isolates from the Minnesota Department of Health Public Health Laboratory and an animal antibiogram of isolates from the University of Minnesota Veterinary Medical Center.

Antibiograms can serve as valuable tools in guiding therapy choices.

- Human Antibiogram:
[Antimicrobial Susceptibilities of Selected Pathogens](#)
- Companion animal antibiogram:
[VMC Antibiogram \(PDF\)](#)
- Banfield Pet Hospital - Antimicrobial Usage Patterns Among Companion Animal Veterinarians - 2017
https://www.banfield.com/getmedia/e6c50f42-9ded-4323-aa03-4fd92a2aa012/VET-Report_Final_web.pdf

CDC Tool: Latest Map of Investments to Combat Antimicrobial Resistance (Jan. 2018)

CDC has developed an **Investment Map** showcasing CDC's activities to slow antibiotic resistance and meet national goals. These are the first comprehensive reports on state progress made following the first year of Congress' unprecedented investment in CDC's Antibiotic Resistance Solutions Initiative. [\$160M FY16 and \$163 M FY17].

The **AR Investment Map** features: more than 170 state-reported successes, like rapidly identifying and containing rare and concerning resistant germs to protect communities, and printable state- and city-specific fact sheets that describe how CDC invests in activities in that area.

- <https://www.cdc.gov/ARinvestments>
- <https://www.cdc.gov/drugresistance/solutions-initiative/index.html>



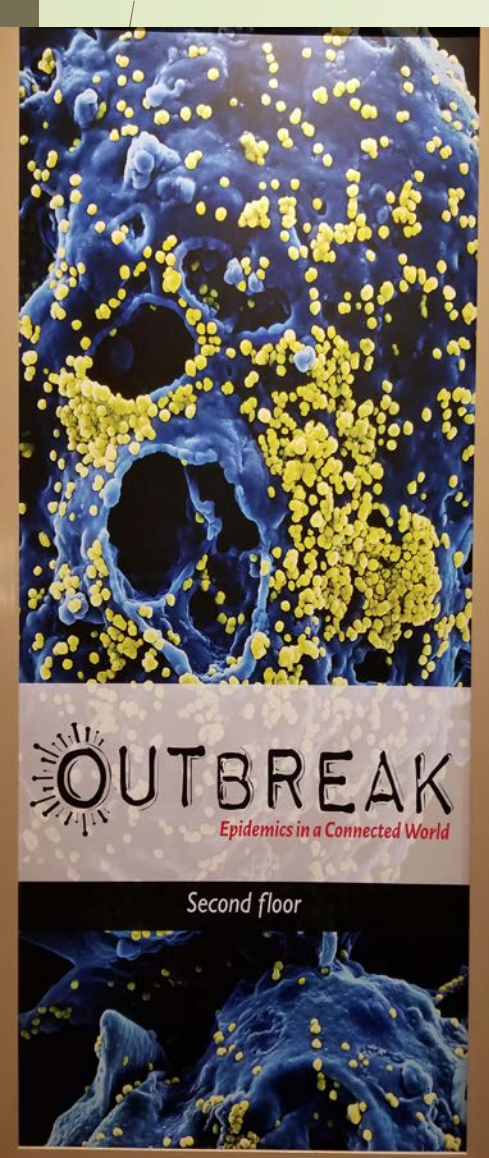
New Smithsonian Exhibition Explores Pandemics and Emerging Infectious Diseases – May 17, 2018

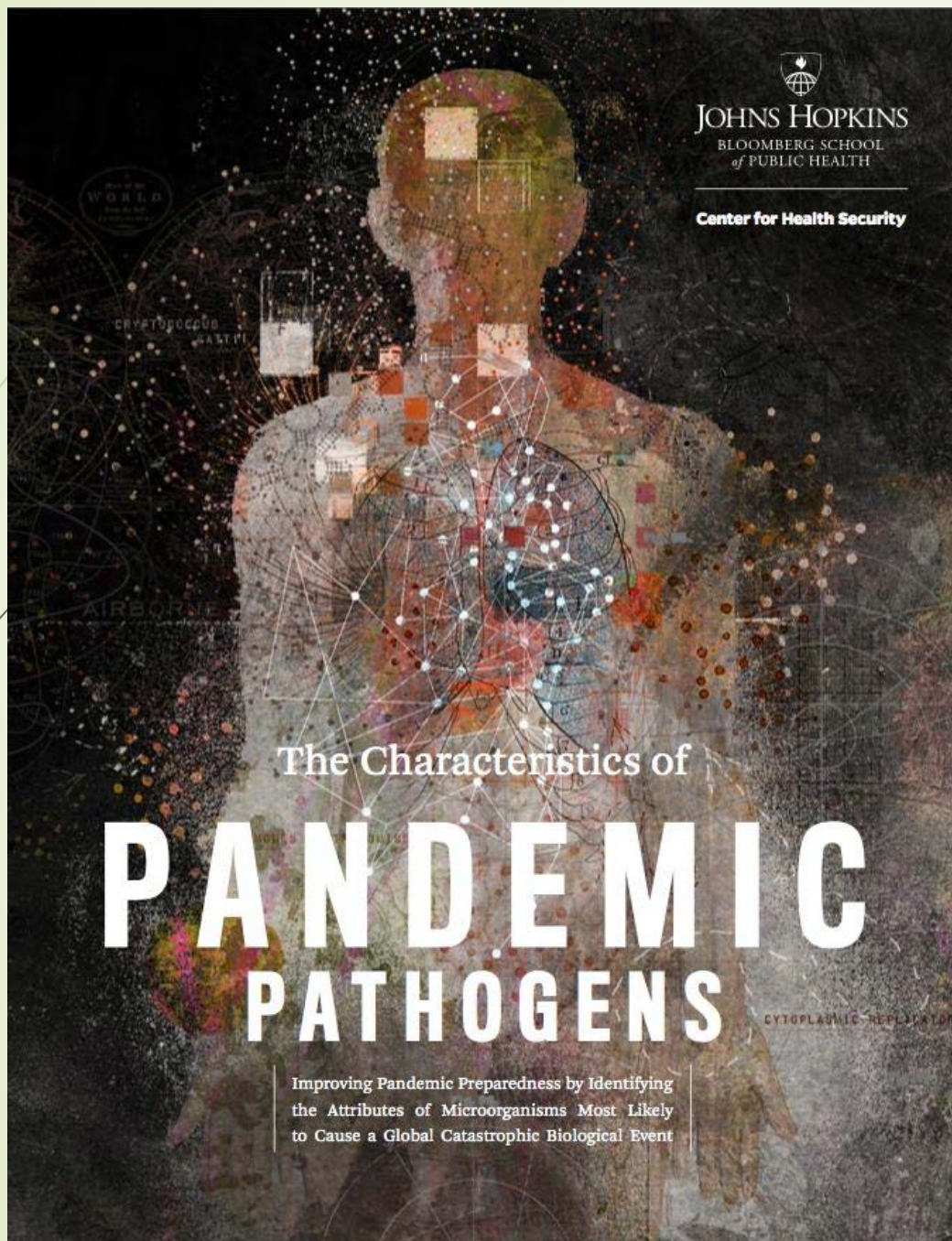
The Smithsonian's National Museum of Natural History will mark the 100th Anniversary of the Great Influenza Pandemic of 1918 with a new exhibition, **Outbreak: Epidemics in a Connected World**, which has a One Health focus and will remain on view for the public for three years!

- **The origins of zoonotic diseases** - Since the rise of domestication, human interactions with other animals have increased and changed. Today, three-quarters of all new infectious diseases affecting humans originate in animals, and “Outbreak” will focus on how they spill over, spread and how they can be contained.
- **Humans' role in spreading animal-borne viruses** - “Outbreak” will look at the effects of habitat fragmentation and diversity loss, urbanization and global travel on increasing the risks of zoonotic-disease emergence and highlight the role of scientific research and behavior change in lowering risks of disease transmission.
- **How outbreaks are handled** - Future outbreaks are certain to occur. The exhibition introduces people who play many different roles in the global fight against epidemics, from identifying their animal origins to developing vaccines and interventions to help prevent the next one.

Understanding how we can prevent zoonotic viruses like Ebola, Zika and influenza from emerging and quickly spreading around the world—recognizing that human, animal and environmental health are connected as ‘One Health’—is a critical science lesson for the 21st century ... Sabrina Sholts, lead curator of the exhibition.

<https://newsdesk.si.edu/releases/new-smithsonian-exhibition-explores-pandemics-and-emerging-infectious-diseases>





Johns Hopkins Center for Health Security recently (May 2018) developed a framework to help identify microorganisms that are most likely to cause a global pandemic to inform future preparedness and response efforts.

http://www.centerforhealthsecurity.org/our-work/pubs_archive/pubs-pdfs/2018/180510-pandemic-pathogens-report.pdf

Benefits of Human – Animal Interactions

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All professions are needed to make One Health the default way of doing business at all levels of research, clinical practice, governments and policy.

- Agriculturalists
- Animal Health Practitioners
- Anthropologists
- Climatologists
- Ecologists
- Economists
- Engineers
- Entomologists
- Forestry Specialists
- Geologists
- Human Health Practitioners
- Horticulturists
- Marine Biologists
- Plant Pathologists
- Political Scientists
- Social Scientists
- Wildlife Specialists
- ... and more!



Cheryl Stroud, Bruce Kaplan, Jenae Logan & Gregory Gray: One Health training, research, and outreach in North America. *Infection Ecology & Epidemiology* 2016, 6: 33680.

- * Food Security
- * Food Safety
- * Nutrition



Emergency
Response



Bio/Agro-
Terrorism

- * Emerging Infectious Diseases
- * Antibiotic Resistance

One Health Opportunities



Biomedical
Research

- * Climate change
- * Planetary Health
- * Environmental Health



- * Obesity
- * Physical Activity



Disability



Occupational
Health



Injuries

Mental Health

Engaging in a Multidisciplinary One Health Approach

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- **You** can be the agent of change.... first, seek to understand, then reach out to other disciplines to “bring the needed expertise to the table” in a collaborative effort to address the needs more efficiently, and often with an innovative approach not previously considered.
- Engage policy/law makers from your local community, state, and federal levels to embrace a One Health collaborative, multidisciplinary approach to issues of mutual concern. Tell the “story” and provide the examples.
- Work with granting agencies to develop cross disciplinary funding proposals that encourages collaboration and embraces innovative technologies.

Engaging in a Multidisciplinary One Health Approach

- The challenges and commitments identified at major conferences and summits are interrelated and call for integrated solutions, such as a multidisciplinary One Health approach.
- Tell a story that your neighbors can relate to when explaining what One Health is all about. Small steps really do make a difference!! Make it personal and not overwhelming.
- Help facilitate introductions electronically, or by phone, or by in-person meetings... build relationships... engage in direct conversations... that lead to action items embracing a **Multidisciplinary One Health approach!!!**



Promoting efforts around the world to bring together all human, animal, plant and environmental health disciplines.



**165 One Health Day Events
took place for the
Inaugural One Health Day
November 3rd 2016**

One Health Day Student Event Competition

Sponsored by the
**One Health Commission
One Health Initiative
One Health Platform**





Thank you!