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H.R. 3771: Advancing Emergency Preparedness Through One Health Act of 2019

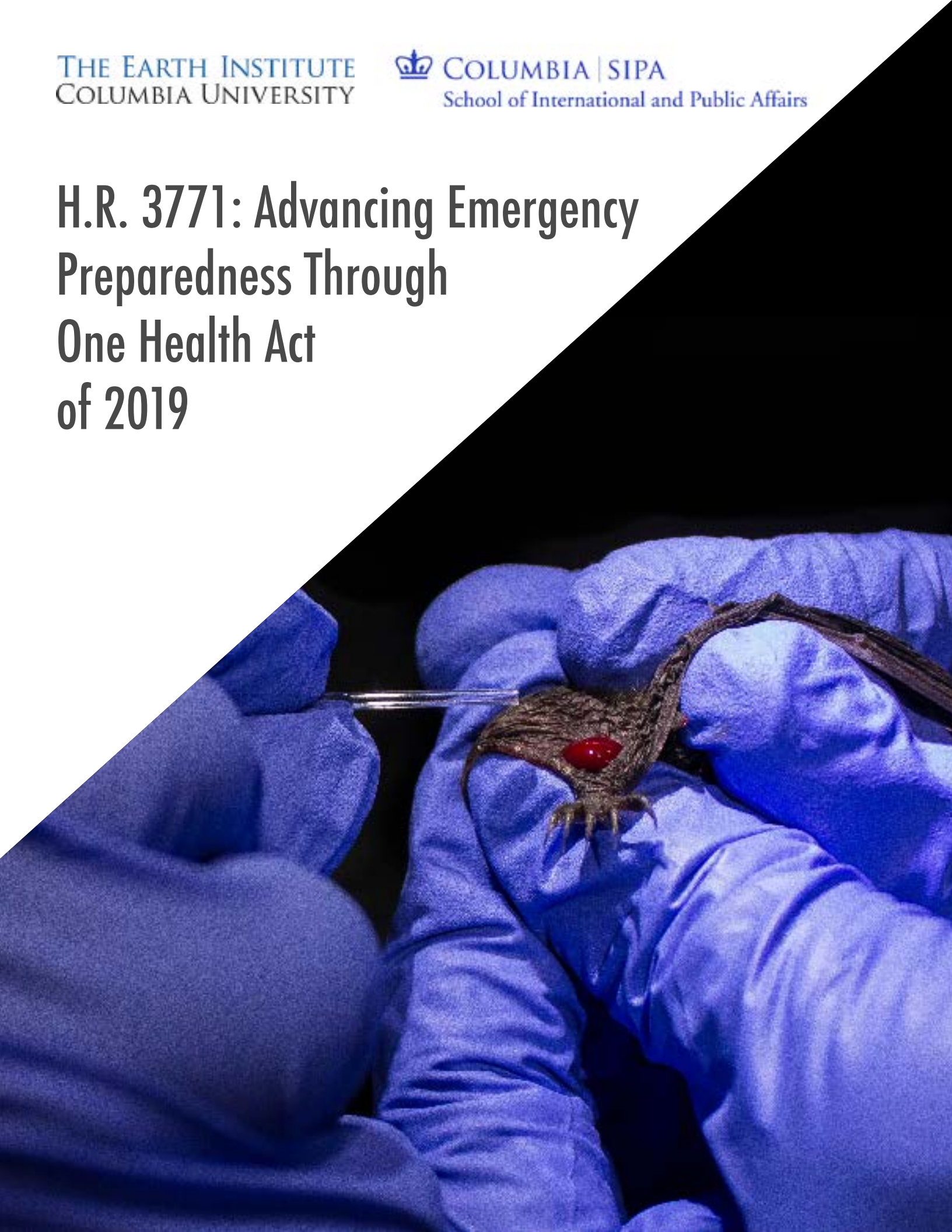

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Table of Contents

Executive Summary 4

Background and Context 5

The Increasing Threat of Zoonotic Diseases 6
- Climate Change
- Changing Landscapes
- Livestock and Animal Trade
- Human Susceptibility and Transmission

The State of One Health in the U.S. 9

How Will H.R. 3771 Address the Problem? 9
- Interagency Collaboration
- Research
- Early Identification

Measuring the Success of H. R. 3771 12
- Inputs, Processes, Outputs and Outcomes
- Success Indicators
- Challenges and Opportunities

Controversies Related to H.R. 3771 18
- Political Factors
- Social Factors
- Economic Factors

Conclusion 20

Glossary 21

References 26

Executive Summary

The global scientific community has been anticipating a pandemic of zoonotic origin for decades, yet few countries were as ill-prepared for the onset of the novel coronavirus, SARS-COV-2 (COVID-19), as the United States. Despite calls for creating interagency coordination and infrastructure to prepare for the inevitable emergence of a novel disease since at least 2009, the US has virtually no standing body to respond to zoonotic outbreaks domestically or abroad. By the end of July, 2020, the lack of preventative measures resulted in a devastating economic recession, more than 40 million Americans applying for unemployment, and more than 150,000 deaths in the US alone--approximately 23% of the world total. Like most health and environmental catastrophes, the lion's share of the burden is felt by the nation's most vulnerable populations: the elderly, the poor, and Black, Indigenous, and Latinx communities. In contrast, countries with previous epidemics like severe acute respiratory syndrome (SARS) and Middle-East respiratory syndrome (MERS) still fresh in their national memories reacted swiftly with measures to curb the impact of the virus, resulting in far lower mortality and economic losses.

While the current zeitgeist is focused on COVID-19, zoonoses--diseases that spread from animals to humans--are broad ranging in both scope and geography. They include well known illnesses like malaria, AIDS, and Lyme's disease, and lesser known diseases like schistosomiasis and Q fever; their sources range from exotic pangolins to house cats and New York City rats. The Centers for Disease Control and Prevention (CDC) estimates that zoonoses account for 75% of newly emerging infectious diseases and infect as many as 2.5 billion people every year. As humans change the way we interact with nature through land-use alterations, anthropogenic climate change, industrial agriculture, and the global animal trade, we increase our contact with animals, and change the ways animals come into contact with each other, leading to an explosion of new and deadly diseases over the past half century. The globalized nature of the world's economy provides virtually limitless opportunities for disease to spread between populations.

There is no single action or response that will protect humanity from the growing threat of zoonotic diseases, but by acknowledging the interconnectedness of human, animal and environmental systems, it is possible to create policies that will mitigate the effects of zoonoses. H.R. 3771 — Advancing Preparedness Through One Health Act of 2019 seeks to create a framework for the detection, prevention, and rapid response to zoonotic outbreaks. By strengthening interagency partnerships, the US will be able to address the multifaceted challenges posed by zoonotic diseases, including but not limited to health impacts, economic stresses, food supply chain disruptions, national security, and equity.
Following an in-depth discussion of the Bill and the One Health framework, this report analyzes the environmental factors impacting the emergence and spread of zoonoses, and assesses the solutions proposed in H.R. 3771, incorporating examples of both successful and unsuccessful implementation of One Health around the world.

An in-depth discussion of implementation strategies and funding resources is beyond the scope of this paper; however, the report will conclude with a broad overview of evaluation tools and highlight some of the potential controversies which need to be anticipated and planned for in advance.

Background & Context

On July 16th, 2019, four months before the first known case of COVID-19, Representative Kurt Shrader and 13 co-sponsors introduced H.R. 3771: The Advancing Preparedness Through One Health Act of 2019,[1] hertofore referred to as the Bill. This Bill aims to establish an interagency One Health Framework that can better prevent, prepare for, and respond to zoonotic outbreaks by expanding existing federal initiatives and partnerships, thereby lessening the public burden zoonotic disease poses for health, economic, and national security in the United States. The One Health framework is a holistic approach that recognizes human, animal, and environmental health as interconnected, and seeks to create integrated solutions across disciplines, agencies, and geographic boundaries.[2] By assimilating knowledge and data from multiple disciplines there is increased capacity for anticipating, prioritizing, and addressing relevant threats effectively. Already utilized in dozens of countries, a One Health approach has been instrumental in mitigating and understanding potential zoonotic disasters such as Crimean-Congo hemorrhagic fever (CCHF) in the Zhambyl region of Kazakhstan, Rift Valley Fever in East Africa, and even rabies in the US.[3] The integrative and collaborative nature of One Health helps to proactively avoid or reduce disease burdens, financial costs, and societal disruptions by facilitating prevention and earlier detection of emerging pathogens at the human-animal-environment interface.[4]

Replacing the US' current decentralized system with a coordinated and collaborative response across human, animal, and environmental health communities is crucial for maintaining national health and well-being in an ever-globalizing society. This legislation specifically aims to improve public health preparedness against zoonotic outbreaks over a 10-year period by:[5]

- Promoting interagency coordination and identifying and expanding partnerships, both within and outside the federal nexus;
- Promoting scientific understanding of the interconnectivity between human, animal, and environmental health;
- Identifying, studying, and surveilling priority zoonotic diseases and their transmission between animals and humans; and
- Advancing protocols and workforce development to improve zoonotic disease prevention, response, and recovery.

Within one year of the Bill's enactment the Secretary of Health and Human Services and the Secretary of Agriculture, referred as the Secretaries - in coordination with the Agency for International Development (USAID), the Environmental Protection Agency (EPA), the Department of Homeland Security (DHS), the Department of the Interior (DOI), the Department of Defense (DOD), and the Department of Commerce (DOC) - must develop, publish and submit to Congress a national One Health Framework that describes the activities and timeline necessary to achieve One Health Program goals.[5] This Framework will also identify and assess existing federal zoonotic disease management "best practices" and make recommendations to complement and expand efforts of coordinating departments and agencies, as well as appropriate partners such as the CDC, the Food and Drug Administration (FDA), and Office of the Assistant Secretary for Preparedness and Response.[5]

In the one year since H.R. 3771 was introduced, the global community has become intimately knowledgeable about zoonoses, and these diseases are becoming more prevalent due to a number of environmental and social factors. As the global population expands, the demands we place on the natural environment become increasingly onerous, and delicate ecosystems are thrown out of balance. Globalization brings disparate populations closer together through international trade, business and tourism. While an interconnected economy provides opportunities to build wealth and promote the exchange of ideas, goods and services, it has also created the potential for an isolated incident of disease to become the global pandemic we are experiencing today, underscoring the urgent need for ingrained emergency preparedness legislation.

The Increasing Emergency of Zoonoses

In total, there are estimated to be 1,400 known human pathogens, including viruses, bacterium, fungi, and protozoa.[6] Zoonoses account for approximately 60% of these pathogens and it is estimated that 75% of all emerging infectious diseases (EIDs) will be of a zoonotic nature, indicating that the human-animal interface represents a major risk for emergence. The risk of EIDs is on the rise, due in large part to anthropogenic activities that have blurred the lines between the natural and the built environment, and disrupted the trophic balance in fragile ecosystems. The following sections will discuss some of the primary ways in which human activities are facilitating the emergence of zoonotic diseases, and inadvertently creating environments that enable transmission from animals to humans.

Climate Change: The Impact of a Warming Planet on Animal & Vector Geographies

The epidemiology of infectious diseases fluctuates rapidly in response to changes in the environment. The warming of the climate has significant impacts on the geographic range of many infectious diseases. Within the subsect of zoonoses, vector-borne diseases are the most heavily influenced by changes in the climate. Variations in climatic patterns such as precipitation and temperature create new ecological niches for vector-borne pathogens, thus altering their spatial distribution. Mosquitoes and ticks are exothermic and have life cycles that are reliant on temperature. Warmer average temperatures will result in increased reproduction, increased feeding frequency, and faster digestion of blood.[7] Warming temperatures will also allow mosquitoes to survive in higher elevations and in regions that were previously too cold to sustain them, expanding their range from tropical areas into more temperate climates. Range shifts poleward and in altitude have already been observed for a variety of arthropod vectors.[8] The effects of changes in precipitation on vectors are not as clearly understood as changes in temperature, but still warrant observation and consideration. Increased precipitation can create more breeding sites, as many species of mosquitoes prefer to breed in wetter climates (Figure 1).

Figure 1. A shallow pool acting as a perfect breeding site for mosquitoes.[9]

Changing Landscapes: How Deforestation Destroyed the Barriers Between Human and Animal Ecosystems

Similar to climatic variation, deforestation can create new ecological niches that allow for the proliferation of vectors. Water puddles in deforested areas have a lower concentration of salinity than puddles in heavily forested areas. These puddles act as better breeding sites for malaria-carrying mosquitoes.[10] Deforestation is a primary contributor to the increasing contact between humans and pathogen-carrying animals, however the mechanisms of disease emergence due to deforestation are complex. Selective logging, known as the partial removal of forests, while leaving the remainder of the forest intact, is likely to increase zoonotic disease emergence.[11] Selective logging sustains the majority of the natural biodiversity of forests; therefore, it is more likely to sustain the diversity of potential zoonotic pathogens.[11] One of the primary purposes of selective logging is to build roads, creating fragmented forests. In tropical regions, outbreaks of yellow fever and dengue have been linked to forest clearing. In Central and Western

Africa, the majority of Ebola outbreaks occurred in areas with high amounts of forest fragmentation.[12] The creation of roads can also heighten transportation in and out of a certain region, increasing the possibility of diseases spreading between areas. Ultimately, deforestation increases the risk of zoonotic diseases through the alteration of wildlife distribution, change in habitats, and facilitated interaction between humans and animals.

Figure 2. Deforestation and habitat destruction breaking down the natural barriers between humans and animals[42]

Livestock and Animal Trade: How Industrialized Agriculture and the Wildlife Trade Create Unnatural Contact Between and Across Species

Zoonotic pathogens are often found in animals intended for the wildlife trade and in livestock animals used to feed the growing human population. It is estimated that the global population will reach 7.8 billion in 2021[31], increasing the demand for meat products; large-scale livestock production will be required to meet these growing demands. Intensive production of livestock at such a large scale congregates thousands of genetically identical and similar animals into confined spaces. These consolidated spaces create environments where pathogens can spread easily, as animals frequently come into contact with each other's saliva, urine, and feces. Additionally, the environment of large-scale agriculture creates stressors for animals, causing them to shed viruses at higher rates and be more susceptible to diseases.[16] Similar to intensive livestock production, the wildlife trade involves the transport of large numbers of animals. The difference between the two is that the wildlife trade usually intermingles animals of varying species, potentially exposing them to pathogens to which they have no prior resistance, a process called pathogen pollution.[13] The amount of zoonotic diseases resulting from the global wildlife trade is difficult to quantify, as much of the trade operates illegally or with minimal surveillance and regulation. In both cases, farmers and handlers are frequently coming into contact with these animals, increasing the potential for pathogens to cross the interspecies barrier, discussed in the next section.

Human Susceptibility and Transmission in the Age of Globalization

Understanding how zoonotic pathogens spread is critical in preventing the spread of infectious diseases. Most pathogens require a living host, known as a reservoir, in order to survive and multiply. However, some pathogens are able to persist outside of a living host, in substances such as soil and water. Many diseases that have reached epidemic and/or pandemic status have come from animal reservoirs, with humans acting as accidental hosts.[14] Regardless of the reservoir, transmission of a pathogen must occur in order to spread. An infectious pathogen can be transmitted from its natural reservoir to a susceptible host via differing transmission routes (Table 1). Afterwards, the infected host must be able to transmit the pathogen to other susceptible individuals.

TRANSMISSION ROUTE	DESCRIPTION	EXAMPLES
DIRECT CONTACT	Spread through physical contact with infected individuals. • Bites and scratches • Bodily fluids such as blood, urine, saliva, or feces	Rabies Influenza Mononucleosis
FOMITE	Indirect transmission with contaminated inanimate objects. • Hard surfaces such as doorknobs, handrails, and tabletops • Soft surfaces such as clothing and bedding	Methicillin-resistant Staphylococcus aureus (MRSA) Vancomycin-resistant Enterococcus (VRE)
ORAL	Transmitted through the ingestion of contaminated food and water.	Cholera Salmonella E. coli
AEROSOL	Inhalation of contaminated pathogens. • Contaminated droplets from coughing, sneezing, or talking can remain suspended in the air for long periods of time	Measles Tuberculosis
VECTOR-BORNE	Transmitted by an arthropod vector. • Mosquitoes • Ticks	Malaria West Nile Virus

Table 1. Modes of transmission of infectious diseases.

The emergence of zoonotic diseases is dependent on the interaction between three entities: a pathogen and two hosts, with humans and animals acting as the reservoir.[15] Because zoonotic pathogens rely on an animal reservoir for transmission, the interactions between humans and animals determines the spread of zoonotic pathogens. The extent of these interactions is dependent upon the prevalence of zoonotic pathogens, or the zoonotic pool, and the population dynamics of humans that have influenced the ecological patterns that drive pathogen abundance.[10] The invasiveness of human activity into almost all geographic areas around the world and the globalization of economic activities have reshaped the relationship between humans, the natural world, and pathogens.[17] The ability for a pathogen to successfully integrate into the human population and be transmitted between humans requires the pathogen to cross a series of biological barriers.

1. The interspecies barrier — contact between humans and an animal reservoir.
2. The intrahuman barrier — ability of a pathogen to infect a human host and survive the human's immune response.
3. The interhuman barrier — the ability of a pathogen to efficiently transmit among humans, causing epidemics and pandemics.

Successful pathogen integration into the human population also depends on the susceptibility of the host. Host susceptibility is a complex topic that depends on a variety of factors including microbial adaptation, immunity of the host, genetics, climate, and specific external immunity, as in the availability of a vaccine.

While there are many factors that contribute to the emergence of zoonotic diseases and the susceptibility of humans to these diseases, it is clear that alterations of the natural environment as a result of human impact are a key contributor. Anthropogenic activities such as deforestation, industrialized agriculture, and the wildlife trade have fundamentally altered the way humans interact with the natural environment. Land-clearing activities have removed natural barriers previously separating humans from animals; livestock and the wildlife trade have unnaturally introduced species to one another, facilitating pathogen pollution; and changes in climate have expanded the range of pathogen-carrying vectors.

The State of One Health in the USA

The modern foundation of One Health was formally established in the 1980s by Calvin Schwabe, an epidemiologist that helped unify animal and human health efforts to tackle zoonotic diseases.[18] However, it was not until the next century that this interdisciplinary approach would reach the federal level. In 2007, in an effort to bring together animal and human health agencies in the US, the American Veterinary Medical Association and the American Medical Association created a One Health Initiative taskforce, comprised of human and animal health experts in response to the threat of disease.[19] In 2009, the CDC established a One Health office and by 2012, the U.S. Department of Agriculture (USDA) had established a One Health Coordination Center under their Animal and Plant Health Inspection Service.[19] Despite previous involvement of the Homeland Security Council in zoonotic response efforts in 2005 with the publishing of the "National Strategy for Pandemic Influenza,"[20] the agency has no formal involvement in the One Health initiatives established since.

Currently, the US One Health initiative is under the oversight of the Department of Health and Human Services (DHHS) and the USDA. The CDC serves as a main collaborator among other research institutions such as the FDA and the National Institutes of Health (NIH), relying on a stepwise approach to zoonotic outbreaks.[21] The recognition of the One Health framework by international agencies in 2008 also led to the creation of the PREDICT program under the USAID in 2009.[22, 23] The PREDICT program was tasked with monitoring EIDs, increasing workforce capacity and improve research laboratories for zoonotic infections.[24] In its 10-year history, it detected over 1,000 new viruses, including a new strain of Ebola, and established best practices in One Health surveillance and biosecurity. However, funding for the program was cut in 2019, although temporarily extended on April 1st, 2020 for 6-months to aid in COVID-19 response efforts.[24]

How Will H.R. 3771 Address the Problem

H.R. 3771 addresses the need for prevention, preparation, and treatment of novel zoonotic disease emergence through interagency coordination, disease research, early identification, and capacity building. These provisions function under the One Health framework by addressing the three underlying causes of zoonotic disease outbreak: large-scale livestock production and unregulated wildlife trade, mass deforestation, and anthropogenic climate change. By implementing a multifaceted framework internationally, the root causes and repercussions of zoonotic outbreaks can be identified and contained, preventing unnecessary deaths and ensuring equitable development during these events.

Interagency Collaboration

Interagency coordination under the One Health framework would provide the necessary support for comprehensively addressing the drivers of zoonotic disease outbreaks and the tools needed to respond to outbreaks efficiently. Multiple federal and state agencies, as well as health centers will work together to foster extensive research and surveillance of outbreaks and host frequent data exchanges in order to construct a clear scope of novel diseases (Table 2). This wide-scale teamwork also ensures necessary and equitable budgeting for future zoonotic disease outbreak contingency plans, including infrastructure to avoid economic downturns, facilitate equitable adherence to stay-at-home orders to prevent spread, and wide-scale access to personal protective equipment (PPE) for medical workers.

AGENCY	ROLE
CENTER FOR DISEASE CONTROL AND PREVENTION	Identify, trace, and give guidance on zoonotic disease outbreaks
DEPARTMENT OF AGRICULTURE	Ensuring safety in agriculture, food production, and managing health of food-producing animals[19], including food imports, and assisting in updating vaccine production methods
ENVIRONMENTAL PROTECTION AGENCY	Evaluate biothreat risk such as wildlife and ecosystem and develop effective, environmentally responsible approach to treatment and prevention protocols, and to evaluate wildlife and ecosystem health and resilience and its effect on human health
FOOD AND DRUG ADMINISTRATION	Approves all food and drug products while ensuring safety of all food products; two-way approach to comparative medicine between animals and humans, such as surveilling disease development in household pets and their owners, or observing treatment effectiveness between animals and people and comparing for vaccine development[43]
DEPARTMENT OF THE INTERIOR	Emphasize the importance of ecosystem health in federal lands in order to prevent outbreaks through conservation management and environmental stewardship
DEPARTMENT OF DEFENSE	Guard against bioterrorism threats and reduce biological threats through research and contact tracing
LOCAL GOVERNMENTS AND MEDICAL CENTERS	Data exchange concerning contractions, symptoms, treatment development, and health recommendations

Table 2. US agencies and roles within One Health framework.

The agencies described above, in conjunction with other entities such as Tribal Nations and international governments, will collaborate to improve the way humans interact with the environment, resulting in greater buffers between developing zoonoses and humans. Finally, interagency coordination will also strengthen the availability of accurate public information to combat misinformation around zoonoses and develop strong infrastructure for defense against biothreats.

Research

The One Health approach includes research to promote the scientific understanding of the interconnectivity between human, animal, and environmental health.[1] The emergence of zoonotic diseases is not due to an isolated incident, but rather a combination of environmental issues — mass deforestation and land-use changes, animal trade and agriculture, and anthropogenic climate change — therefore, research must account for these factors in order to understand the root of the problem. Understanding the nature and behavior of zoonoses allows for more effective preventative measures as well as timely large-scale adjustments in agriculture, trade, and development. Effective implementation of H.R. 3771 would take advantage of the robust interagency collaboration by frequently sharing information in order to expedite important outcomes and discoveries. These vital findings can include virus origin and vector pathways and transmission patterns, ultimately leading to an improved response to novel disease outbreaks. Collaborative research also entails engaging in joint fieldwork, laboratories, discussions, and studies amongst experts in various fields--such as veterinarians, medical researchers, epidemiologists, and environmental and wildlife experts.[29] The purpose of research is to build greater understanding of how zoonotic diseases spread

and mutate, to provide guidance for response protocols, and to encourage preventative systemic changes such that the disease can be promptly contained, inhibiting wide-scale transmission.[30] It is critical to communicate scientific research and safety measures to help the public effectively prepare for public health emergencies and better understand proposed preventative measures.

Early Identification

The proactive component of H.R. 3771 is to identify, study, and surveil priority zoonotic diseases and their transmission between animals and humans, particularly in priority areas, before they spread further after being identified. Surveillance in this context is the collection, analysis, and interpretation of data to confirm disease presence and identify trends to guide necessary actions for disease control.[32] This includes establishing a global standard for managing wildlife-trade activities and agriculture based on the known disease risks, and allowing for more effective targeting and animal monitoring in order to detect health anomalies before zoonotic disease transmission to humans occurs.[33] Environmental monitoring is also essential to track land-use changes and deforestation — both of which contribute to the transmission of zoonotic diseases by increasing proximity to a disease reservoir. Once a zoonotic disease can be transmitted from animals to humans, it is important for contact-tracing and wide-scale testing to be implemented to monitor the disease's movement and ensure its containment.

H.R. 3771 uses the One Health approach in a safe and organized manner through interagency coordination, capacity building, research and communication, and early identification. One of the most important components of H.R. 3771 is implementation of environmental and wildlife surveillance and monitoring to track and contain potential zoonotic disease before it has the opportunity to be transmitted from animal to humans. This approach establishes a proactive response, as zoonotic diseases are targeted and controlled before the situation escalates and becomes a public health emergency. The solutions in H.R. 3771 would utilize modern and updated scientific research and coordination between agencies to contain emergent zoonoses and prepare a measurable and sound contingency plan in the event of an outbreak.

CASE STUDY: BOLIVIA

In 2012, six howler monkeys were reported dead outside an animal sanctuary in Santa Cruz, Bolivia. Due to frequent monitoring and early warning systems in place through the PREDICT program, the case was immediately reported to the University of San Andres Institute of Molecular Biology. The Institute was able to identify the cause of the mysterious howler monkey deaths as Yellow Fever, most likely transferred from mosquitos in the area.

Following the One Health framework, the Ministry of Health was contacted, and preventative measures were taken, including broad vaccinations, public awareness campaigns, and mosquito control programs. As a result of these proactive measures, no human cases were reported, and the disease outbreak was swiftly contained.[40]

Figure 3. Howler Monkey[39]

Measuring the Success of H.R. 3771

The spillover of zoonotic diseases to humans and animals have enormous health and economic costs. The World Bank estimates that the outbreak of six zoonotic diseases between 1997 and 2009, incurred global costs exceeding $80 billion, while the CDC estimates 2.5 billion annual cases of zoonotic infections globally, resulting in 2,700,000 deaths.[1] H.R. 3771 seeks to evaluate three scientific problems in the framework of One Health, which include: (1) domestic and wildlife animal trade, (2) deteriorating environmental health and climate change, and (3) public health burden increasing with rising zoonotic disease outbreaks. This section highlights the inputs, outputs, and outcomes of the legislation and the One Health framework, as well as a monitoring framework to measure their success.

Inputs, Processes, Output and Outcomes

To achieve H.R. 3771's overarching goal, the Bill identifies One Health framework as the output, for coordinated federal activities under the One Health program. Measuring the success of the One Health program requires evaluation of inputs, processes, and outputs to realize the program's outcomes, as specified in Table 3.

The program relies on several federal agencies and resources to achieve the Bill's goals under the supervision of the Secretaries. Within a year of enactment of H.R. 3771, the Secretaries, in coordination with expanded interagency partners, and other appropriate departments and agencies, are responsible to prepare, publish and submit to Congress the framework. Other inputs of the program include human and fiscal resources of various state and local agencies working on animal, human and environmental health; federal funding for implementation of the program; physical, social, and digital infrastructure to help monitor pathogen hotspots and transmission, livestock and wildlife trade, the health of animals, humans, and environment; private contractors building and/or maintaining these infrastructures; and domain experts working in research and development of zoonotic disease surveillance and response. These inputs will be used for the processes of assessment, planning, prioritization, implementation, communication, learning, and systemic organization, to achieve the primary goal of H.R. 3771 and expand interagency coordination between existing federal government One Health initiatives.

Indicators of Success

The success of H.R. 3771 can be measured in two ways: first, tracking implementation of H.R. 3771 via general indicators; and second, measuring the success of the One Health program via scientific indicators (Table 3). The success of One Health can be measured by monitoring the performance of the three elements of the output — animal health, environmental health, and human health. It is critical to measure the success of H.R. 3771 for purposes of performance management, experiential learning, prioritization, improvisation, and accountability over time and various scales — federal, state, local- of implementation.

IMPLEMENTATION OF H.R. 3771	
OBJECTIVES	Advanced emergency preparedness through One Health Program
INPUTS	1. **Federal resources** – human and fiscal 2. **State** and **local** agencies' **resources** – human and fiscal 3. **Infrastructure** – physical, social, digital for disease surveillance and response 4. Private **contractors** 5. Experts in **R&D** of disease surveillance and response
OUTPUT	Interagency **One Health Framework**
OUTCOMES	1. Formulation + Publication + Submission of the **Framework** to Congress 2. Increased **interagency planning, preparation and response** to One Health 3. Scientific understanding of interconnectedness between animal, human and environmental health 4. Identification of **priority zoonotic diseases** and areas of study 5. **Protocol and workforce** development 6. **Plan of action** identifying timeline for delivery of goals
KEY INDICATORS OF SUCCESS	1. Increased **expenditure** on One Health program 2. Increased **expenditure for priority areas of study**, and action 3. Reduced **socio-economic losses** from zoonotic diseases
MONITORING STRATEGIES	1. **Time-based reporting** of H.R. 3771 progress 2. Addendum and GAO report 3. **Audits** of federal budgets

Success Indicator #1: Increased Federal Expenditure on One Health

A well-functioning health program is a prerequisite of a productive economy. The United States' public expenditure toward health amounted to $1.7 trillion (~7% of GDP) in 2018[41], but expenditure alone does not produce a healthier society. The Congressional Budget Office notes that the limited interagency coordination during COVID-19 cost the nation a $3.4 trillion COVID-19 rescue bill, and 5.3% of lost GDP over 2020-2030.[2]

Strategic federal expenditure on One Health will thus help existing agencies to bolster and expand existing partnerships with other agencies and departments to reduce multifaceted losses emerging from zoonotic outbreaks. While the relationship between federal expenditure toward the health sector and health status of societies varies with context, monitoring agencies can use federal expenditures on the One Health as a proxy indicator of its progress and implementation.

Monitoring techniques:

1. Time-based reporting of One Health implementation;
2. Government Accountability Office (GAO) report and Addendum; and
3. Audit of Federal budgets.

Table 3. Monitoring the Success of the Implementation of H.R. 3771

ONE HEALTH FRAMEWORK: ANIMAL HEALTH	
OBJECTIVES	Prevent, prepare and respond to inter-species pathogen spillover to animals
INPUTS	1. **Stakeholder** engagement- agriculture, livestock, animal trade, etc. 2. **Financing — local, State, Federal** 3. Technical **expertise** — veterinarians, climate scientists, etc. 4. Training and **Capacity building** — census, etc. 5. **Standards** and methods — production, distribution, waste management 6. Situation & **Context analysis** — culture and geographies influence actions
OUTPUT	Reduced **contact** and pathogen **spillover** among species, including humans, at the interface of wildlife trade and environmental degradation
OUTCOMES	1. Reduced **incidences** of zoonotic diseases in animals 2. Lowered **risks of loss** of wildlife, livestock and domestic animals
KEY INDICATORS OF SUCCESS	1. Low animal **mortality** from zoonotic diseases 2. Low **culling** of animals due to zoonotic diseases 3. Less loss of animal **productivity** from zoonotic diseases 4. Low risks to **vaccine** manufactured from poultry eggs 5. Sustainable **livestock farming**
MONITORING STRATEGIES	1. Domestic and International animal trade **surveillance** 2. Monitoring pathogen reserves & vector population change- pathogen **biosurveillance** 3. Pathogen **screening** — target and broad-based 4. Surveillance of **priority zoonotic diseases** and their transmission between animals and humans

Success Indicator #2
Reduced Animal Mortality from Zoonotic Diseases

Wildlife species under severe environmental pressure are threatened by extinction from the spread of novel pathogens while international trade provides a facilitated route for the global dissemination of these pathogens. Additionally, livestock production and market access to animal products have been increasingly threatened by the emergence of disease. In 2014-2015, highly pathogenic avian influenza (HPAI) outbreak in the United States led to the culling of nearly 50 million birds, and a monetary loss of over $3.3 billion for poultry and egg farmers, animal feed producers, baked good production, and other related industries.[1] Zoonotic outbreaks also affect the supply chain of a wide range of vaccines, including those for influenza, yellow fever, rabies, and measles-mumps-rubella (MMR), which are primarily cultivated in poultry eggs. Egg shortages resulting from zoonotic disease outbreaks can potentially disrupt vaccine manufacturing efforts. One way to quantify the reduction of animal mortality from zoonotic diseases is to determine a baseline mortality rate and monitor the change over time.

Monitoring techniques:

1. Domestic and international animal and wildlife trade surveillance
2. Change in pathogen reserves and vector population over space and time
3. Pathogen screening- target and broad based
4. Surveillance of priority zoonotic diseases and their transmission to animals

Table 4. Monitoring the Success of One Health: Animal Health

ONE HEALTH FRAMEWORK: ENVIRONMENTAL HEALTH	
OBJECTIVES	Prevent, prepare and respond to pathogen hotspots changing in size and location with environmental degradation and climate change
INPUTS	1. **Stakeholder engagement** – forest rangers, Federal agencies, industry, citizens, etc 2. **Financing** – State, Federal 3. Technical **expertise** – conservation scientists, environmental scientists, etc 4. Training and **Capacity building** – pathogen biosurveillance, etc 5. **Standards and methods** – hotspots, man-animal conflicts, hotspots, habitat fragmentation 6. Situation & Context analysis – importance of environment in cultures, regions.
OUTPUT	Protection and preservation of **natural boundaries** between animal-human-environmental ecosystems
OUTCOMES	1. Reduced **habitat fragmentation** 2. Reduced **pollution** 3. Improved **ecosystem vitality**
KEY INDICATORS OF SUCCESS	1. Stabilization of **pathogen hotspots** 2. Improved **sanitation and drinking water coverage** 3. Increase in **forest cover** 4. Increase in **protected areas**
MONITORING STRATEGIES	1. Monitoring **changing land use**/land cover 2. **Satellite-monitoring** of displacement of wildlife habitats and ecosystem fragmentation 3. Monitoring **fluctuations** in vector population and pathogen **hotspots** 4. Disease **surveillance**

Success Indicator #3
Stabilization of Pathogen Hotspots

Pathogens flourish in tropical and subtropical areas, but with increasing interactions between human settlements and wildlife habitats facilitated by international trade and travel, the interface between the three elements of One Health is rising. A zoonotic disease that is not new to the world, may become new in particular geographies. Additionally, the changing climate is altering the size and extent of global, regional, and local hotspots of pathogens and vectors. While monitoring the change of hotspots with climate change is difficult for short time scales, scientists use testing and screening of known pathogen hosts or carriers to reduce the multifaceted costs of pathogen spillover to humans and animals.

Monitoring techniques:

1. Monitoring changing land use and land cover;
2. Monitoring displacement of wildlife habitats and ecosystem fragmentation;
3. Fluctuations in vector population and pathogen hotspots
4. Disease surveillance

Table 5. Monitoring the Success of One Health: Environmental Health

ONE HEALTH FRAMEWORK: HUMAN HEALTH	
OBJECTIVES	Prevent, prepare and respond to priority zoonotic outbreaks, transmitted between animals and humans
INPUTS	1. **Stakeholder** engagement – medical practitioners, nursing staff, legislators, CDC, USAID, etc 2. **Financing** – Federal, State, local, private 3. **Technical expertise** – virologists, general medicine, etc. 4. Training and **Capacity building** – clinical staff, waste handlers, etc 5. **Standards** and methods – of pathogen screening, medication, etc. 6. Situation & **Context analysis** – risks and vulnerability differ across regions
OUTPUT	Reduced interface and risk of diseases emerging from inter-species pathogen spillover, affecting humans, domestic animals, wildlife and ecosystems
OUTCOMES	1. **Reduced incidences** of zoonotic diseases in humans 2. **Reduced burden of diseases** on economy, public health and environment
KEY INDICATORS OF SUCCESS	1. Low human **mortality** from zoonotic diseases 2. Less loss of human **productivity** from zoonotic diseases 3. Less **economic loss** from zoonotic diseases 4. Less insurance **claims**
MONITORING STRATEGIES	1. **Testing** and screening 2. Disease **surveillance** 2. Monitoring **travel and trade** 3. Change in **vector population** 4. Changing **insurance plans** and health expenditures

Success Indicator #4
Reduced Human Mortality From Zoonotic Diseases

In the past two decades, zoonotic diseases such as Ebola, avian influenza, SARS, COVID-19, have disrupted public health and global commerce, with severe yet variable repercussions felt across economies, demographics, and geographies. Some of these diseases have existed for decades, whereas others are emerging or reemerging, gaining the ability to jump between species and overloading traditional methods of disease surveillance, prevention, and response.

Increased inter-species spillover of zoonotic diseases and global movement of goods and people not only provide safe and expansive transportation of pathogens, but also exacerbate climate change and thus a change in the distribution of vectors, pathogens, and disease hotspots.

Monitoring techniques:

1. Testing and screening
2. Disease Surveillance
3. Monitoring travel and trade
4. Change in vector population
5. Changing insurance plans and health expenditures

Table 6. Monitoring the Success of One Health: Human Health

Challenges and Opportunities

H.R. 3771 seeks to implement a One Health framework with a robust surveillance infrastructure, collecting and disseminating real-time data to various federal agencies and other agencies working towards the One Health program. However, the Bill remains unclear on certain aspects of monitoring and evaluation of the program. Some of the challenges and issues include:

1. Uncertainty of predicting risk: Often, perceived risk is different than the actual risk of zoonotic diseases. A pathogen spillover may happen in new geographies or a pathogen may skip species that are under surveillance, leading to zoonotic outbreaks in unanticipated species or locations.
2. Distribution of functions, functionaries and funds: H.R. 3771 identifies federal agencies and departments as formulators of the Framework, and the need to identify and expand partnerships among these agencies as well as states, Tribal Nations, academic institutions, non-governmental organizations, and private entities. It, however, does not specify how or who will define the distribution of functions, functionaries, and funds in this collaborative framework, while avoiding duplication.
3. Information exchange: Collection and real-time communication of requisite data for each indicator require a robust digital infrastructure. The latter will be updated and monitored regularly for quality compliance. However, H.R. 3771 does not specify who will manage this infrastructure, how it will be managed, and who will be able to access real-time data.
4. Feedback loops: Within 3 years of the creation of the framework, the Secretaries in coordination with agencies of the program will submit an addendum to the Congress highlighting the progress achieved in advancing activities of the framework. In 2 years, post-submission of the Addendum, the Comptroller General of the United States shall submit a GAO report to Congress, detailing existing collaborations between departments and agencies that prevent and respond to zoonotic disease outbreaks in animals and humans; and evaluating the progress of the framework. However, how these evaluation results will be incorporated into the program for continued learning and improvization remains unclear.
5. Time: How the framework will respond to the One Health program after 10 years of enactment of H.R. 3771 is ambiguous.

H.R. 3771 paves the way for the US to bolster and expand existing partnerships towards transboundary zoonotic diseases with the One Health program. Devising standard operating procedures for disease identification, surveillance, risk assessment and evaluation methods for measuring success is the first step to examine a spatial-temporal change in this ecosystem of interactions. Implementation of the framework might happen gradually, but the multifaceted costs associated with zoonotic disease outbreaks are increasing faster than anticipated. The United States must enact H.R. 3771 to better prepare, prevent and respond to these immediate and forthcoming threats.

Controversies Related to H.R. 3771

Despite recognition of zoonotic impact across various governmental sectors, existing strategies lack a comprehensive, synchronous collaboration and streamlined plan to respond to outbreaks. For example, despite bioterrorism potential of various zoonoses, possible threats identified by USAID were taken over by the DOD without subsequent communication or sharing of information.[31] Even with the potential benefits of the proposed legislation, there are some factors that may pose an issue to implementing H.R. 3771. This section will identify and analyze potential areas of concern and controversy under political, social, and economic sectors in the proposed legislation.

Political Factors

In order to effectively prepare for zoonotic outbreaks, early identification processes require expansion and a combination of centralized and decentralized data sharing to accommodate all collaborating agencies and partners. Under Section 3, Part B of the bill, there are recommendations for coordination of data-sharing and information, joint fieldwork engagement and surveillance.[1] However, there is potential for misinformation in open-source data due to the lack of common vocabulary in One Health surveillance.[32] Although use of CDC's Systematized Nomenclature of Medicine Clinical Terminology (SNOMED) is widely used in the US by both human and animal health experts, it is yet to be acknowledged by the World Organization for Animal Health (OIE), the agency responsible for coordinating global research of zoonoses along with the World Health Organization (WHO) and the Food and Agriculture Organization of the United Nations (FAO), hindering international collaboration.[37] Controlling rapid disease transmission also requires use of health surveillance data, especially from nations with active outbreaks, as experienced during COVID-19. However, this is only as effective as health professionals, public and private laboratories, and other local, state, territorial, and federal departments are willing to coordinate and share health surveillance information, on top of the differing institutional responsibilities of each agency. There is also no identified party responsible for protecting, storing and sharing surveillance data, and existing state or federal regulations such as the US Health Insurance Portability and Accountability Act (HIPAA), can impede data-sharing on a national level. On an international scale, data surveillance is not reported at equal rates across the world despite zoonoses disregard for geographical boundaries, generating challenges to international collaboration. The proposed plan also has no mention of public engagement across the developed and developing world, despite the high risk of zoonotic outbreak placed on developing nations — especially in Southeast Asia, Africa, South and Central America — and a defined framework to adapt existing response and workforce capacities of different nations is lacking. Of the 125 reference laboratories across the world, 62% percent are located in developed nations across Europe and North America.[32]

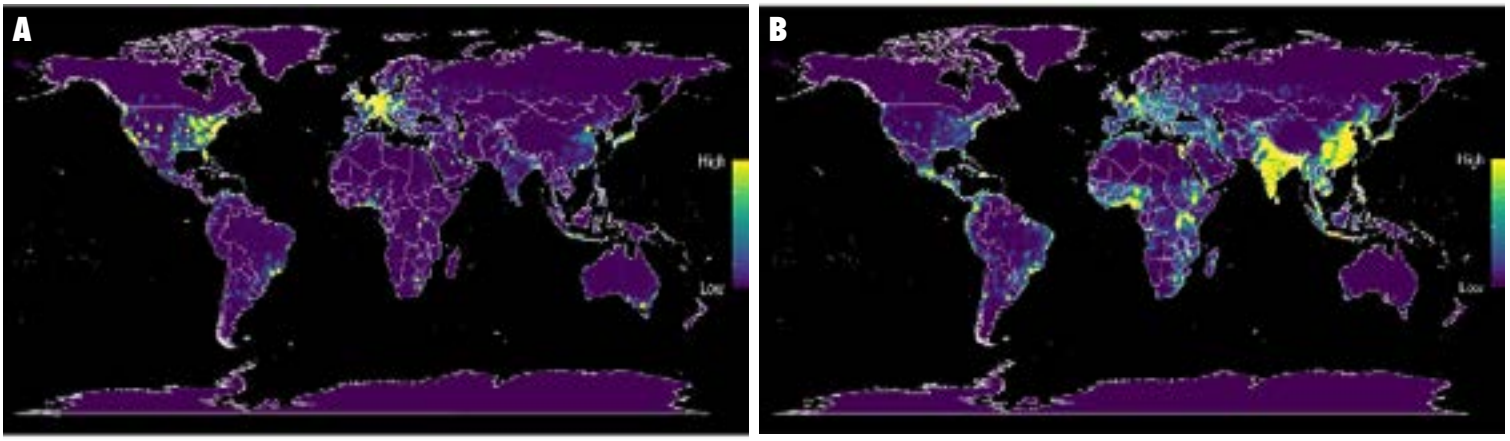


Figure 4. Heat maps of the geographic distribution of zoonotic emerging infectious disease showing a) predicted distribution based on reported events and the b) estimated risk after factoring out reporting bias[33]

Social Factors

The current legislation requires understanding the relationship between zoonoses and human health to address direct costs of diseases, but omits explicit acknowledgement of societal behaviors and barriers. An incomplete understanding of the cultural and economic dependence on animal trade practices and other high-risk activities, and an absence of appropriate alternatives will lead to unsustainable and inefficient One Health protocols. For example, a study was conducted in Laos to understand the significance of bushmeat consumption in certain societies despite acknowledgement of increased risk for disease transmission. The study identified three important factors.[34] First, half of wildlife consumers perceived bushmeat as a healthier alternative to livestock meat, thus consumption was identified as a preference rather than a necessity. Second, government officials were identified among the wildlife consumers despite the illegality of wildlife trade, indicating a significant cultural connection between animal trade practices, wet markets in urban centers, and wild meat consumption. Additionally, among rural communities, wildlife trade and consumption were linked to both livelihood and protein intake among the people. Eradication of high-risk activities without prior understanding of their significance to society can prove to be detrimental to identified linkages.. Proper acknowledgement of social and ethical affiliations will drive implementation of holistic responses to zoonotic threats, minimizing dependence on the precautionary principle. Precautionary principle responses can result in either excessive outcomes, such as the culling of 40 million birds in Vietnam in 2004 to eradicate HPAI, or lack of response due to reliance on the principle's ambiguity, leading to public mistrust and reduced adherence to public health protocols.[35] The bill also proposes advancement of understanding the impact of zoonoses on humans, animals, and the environment in which they live in. However, specific research of environmental health is not traditionally given the same priority as human and animal health sectors. Anthropogenic climate change and dynamic land use practices driven by human food and product consumption are increasing human contact with the natural world at disproportionate rates across the globe. Overlooking environmental health impacts can overwhelm efforts to effectively respond to zoonotic outbreaks, either abroad or domestically, and be susceptible to pressure from outside interest groups.

Economic Factors

Improved joint response and the workforce development proposed can be limited by scientific evidence available. To improve new data availability and monitor zoonoses as described in H.R. 3771, requires initial investments, however, there is no identified process in the legislation for the distribution of funds among all the collaborating parties. The World Bank estimates a $3.4 billion annual investment is needed to implement prevention protocols, but that estimate can run up to $30 billion savings in avoided damages in a once in a lifetime pandemic.[36] Compared to the $850 million spent by the U.S. in response to HPAI during 2014-2015, plus an additional $100 million allocated for further preparedness activities and $3.3 billion in indirect costs previously described, the initial investment can be supported with pre-determined source and distribution of funding.[37] Removal of wildlife trade and consumption is associated with large indirect economic losses. Models based on recorded animal trade transactions and biomass calculations in the Ivory Coast estimate the bushmeat trade is approximately worth $150 million USD for their local economy.[38] Higher economic development also increases exposure to wild animals and hunting practices of exotic species driven by the demand of luxury markets from consumers in developed nations where the resale of bushmeat can be higher compared to the domestic meat market. For example, in Paris, bushmeat resale ranged from $31-46 USD per kg according to data from June 2008, as opposed to the average price of domestic meat at $23 USD per kg, creating a higher demand for bushmeat and a greater reward for those participating in wildlife trade.[38] Due to the legality of the wildlife trade sector, the exact worth can be hard to quantify yet, estimates suggest it be a multibillion-dollar endeavor and a practice that increases zoonotic disease transmission. Implementation of One Health practice will require a cost-benefit analysis of wildlife trade markets, education on the risk of disease transmission and other public health interventions as they relate, access to food resources, and equitable job opportunities for those whose livelihood depends on the trade.

Conclusion

The potential of zoonotic diseases to disrupt lives on a global scale is one of the greatest existential threats facing society today. This is evident not only in the current pandemic, but also in the persistence of diseases like malaria, Lyme's disease, and tuberculosis, which infect millions of people every year. Due to the pertinacious forces of global climate change and population growth, and deeply ingrained systems surrounding agriculture and wildlife trade, the continuing emergence of infectious diseases of zoonotic origin is inevitable, but their impact on human life can be mitigated through intentional policy practices by using the One Health framework.

Drawing on techniques and practices that are already in place around the world, H.R. 3771 calls for incorporating One Health methodology into our national institutions to better prevent, prepare for and respond to emerging zoonotic diseases. Improving interagency collaboration on the federal, state and local levels, funding research, and wide scale monitoring of potential zoonotic hot spots will allow the US to respond immediately and effectively in the face of national emergency. Since its introduction before the onset of the current pandemic, H.R. 3771 has gained additional bipartisan support, and as of July 20, 2020 it has a total of 15 co-sponsors.[1]

The enormous loss of life, the hardship resulting from the economic recession, and the broad inequities laid bare by the COVID-19 pandemic are evidence of the urgent need for emergency preparedness in the United States. This Bill provides thoughtful solutions to the complicated and interconnected problems that lead to the emergence of zoonoses and provides a framework for protecting Americans in the likely event of future zoonotic outbreaks.

Figure 5. Wild life biologists collecting blood samples for evidence of disease in bats, 2017[45]

Glossary

Glossary of Acronyms

AIDS	Acquired Immune Deficiency Syndrome
AMA	American Medical Association
AVMA	American Veterinary Medical Association
CCHF	Crimean-Congo hemorrhagic fever
CDC	Centers for Disease Control and Prevention
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
COVID-19	Coronavirus Disease 2019
DHHS	Department of Health and Human Services
DHS	Department of Homeland Security
DoI	Department of Interior
DoC	Department of Commerce
DoD	Department of Defense
EIDs	Emerging Infectious Diseases
EPA	Environmental Protection Agency
FDA	Food and Drug Administration
FAO	Food and Agriculture Organization of the United Nations
GAO	Government Accountability Office
GDP	Gross Domestic Product
HHS	Department of Health and Human Services
HIPAA	U.S. Health Insurance Portability and Accountability Act
HIV/AIDS	human immunodeficiency virus/acquired immune deficiency syndrome
HPAI	highly pathogenic avian influenza
ILRI	International Livestock Research Institute
MERS	Middle East respiratory syndrome
NIH	National Institutes of Health
OIE	World Organization for Animal Health
PPE	Personal Protective Equipment
SARS	Severe Acute Respiratory Syndrome
SNOMED	Systematized Nomenclature of Medicine Clinical Terminology
US	United States of America
USAID	U.S. Agency for International Development
USDA	U.S. Department of Agriculture
USFDA	U.S. Food and Drug Administration
WHO	World Health Organization

Glossary of Terms

Aerosol transmission: One of two airborne means of infectious disease spreading. In aerosol form, viral particles are suspended in the air by physical and chemical forces for hours or more. In droplet form, in contrast, viral particles remain airborne for a few seconds after someone sneezes or coughs and are able to travel only a short distance before gravitational forces pull them down.

Agricultural intensification: An increase in agricultural production per unit of inputs (e.g. labour, land, time, fertilizer, seed, feed, cash). This intensification has been a prerequisite to human civilization. Increased production is critical for expanding food supply; intensification that
making efficient use of inputs is critical for maintaining the health of agricultural environments.

Anthropogenic: Caused by humans or their activities.

Asymptomatic carriers, also known as 'passive' or 'healthy' disease carriers: Individuals that, while infected with a pathogen, neither report nor appear to have any symptoms or signs of illness.

Avian influenza: A severe, often fatal, type of influenza that affects birds, especially poultry, and that can also be transmitted to humans. Known informally as avian flu or bird flu, the type with the greatest risk is highly pathogenic avian influenza (HPAI). Of three types of influenza viruses (A, B and C), influenza A virus is a zoonotic infection with a natural reservoir almost entirely in birds. Avian influenza, for most purposes, refers to the influenza A virus. Though influenza A is adapted to birds, it can also stably adapt and sustain person-to-person transmission

Biodiversity: The variability among living organisms from all sources, including terrestrial, marine and other aquatic ecosystems, as well as the ecological complexes of which they are part. Biodiversity includes diversity within species, between species and of ecosystems.

Biosecurity: A series of measures aimed at preventing the introduction and/or spread of harmful organisms in order to manage the risk to people, animals, plants and the environment. Biosecurity covers issues such as the introduction of plant pests, animal pests and diseases, and zoonoses, the introduction and release of genetically modified organisms and their products, and the introduction and management of invasive alien species and genotypes. The COVID-19 pandemic is a recent example of a threat that requires biosecurity policies and
regulatory measures in all relevant sectors.

Comorbidities: More than one disease/condition present in an individual at the same time. Other names to describe co-morbid conditions are 'co-existing' or 'co-occurring' conditions and 'multimorbidity' or 'multiple chronic conditions.

Coronavirus disease 2019: Illness caused by a novel coronavirus, 'severe acute respiratory syndrome coronavirus 2' (SARS-CoV-2), which was first identified amid an outbreak of respiratory illness cases in East Asia. The outbreak was first reported to WHO on 31 December
2019. On 30 January 2020, WHO declared the COVID-19 outbreak a global health emergency and the following March a global pandemic, WHO's first such designation since declaring H1N1 influenza a pandemic in 2009.

Crimean Congo haemorrhagic fever (CCHF): A viral haemorrhagic fever usually transmitted by ticks. It can also be contracted through contact with animal tissue where the virus has entered the bloodstream during and immediately post-slaughter of animals. Outbreaks of the disease can lead to epidemics, have a high case fatality ratio (10–40 per cent) and are difficult to prevent and treat. First described in the Crimea in 1944, the disease is endemic in all of Africa, the Balkans, the Middle East and in Asia.

Droplet transmission: Respiratory infections can be transmitted through droplets of different sizes when a person is in close contact with someone who is coughing or sneezing and is therefore at risk of having his/her mouth and nose or eyes exposed to potentially infective respiratory droplets.

Early warning systems: Complex tools and processes aiming to reduce the impact of natural hazards by providing timely and relevant information in a systematic way.

Ebola virus disease (EVD): A rare and deadly disease in people and nonhuman primates. The viruses that cause Ebola are located mainly in sub-Saharan Africa. People can get Ebola through direct contact with an infected animal (bat or nonhuman primate) or a sick or dead person infected with Ebola Virus.

EcoHealth: An emerging field that examines the complex relationships among humans, animals and the environment, and how these relationships affect the health of each of these domains. One Health deals with biomedical questions, with an emphasis on zoonoses, and is historically more health science-driven. In contrast, the EcoHealth concept is defined as an ecosystem approach to health, tending to focus on environmental and socio-economic issues and initially designed by disease ecologists working in the field of biodiversity Conservation.

Ecosystem degradation: A long-term reduction in an ecosystem's structure, functionality, or capacity to provide benefits to people.

Emerging infectious disease: Infections that have recently appeared within a population or those whose incidence or geographic range is rapidly increasing or threatens to increase in the near future.

Endemic zoonoses: Zoonotic diseases commonly found within a certain region or population. Unlike newly emerging zoonoses that attract the attention of the developed world, these endemic zoonoses are by comparison neglected. This is, in part, a consequence of under-reporting, resulting in underestimation of their global burden, which in turn artificially downgrades their importance in the eyes of administrators and funding agencies.

Environment health vs environmental health: 'Environment health' refers to the health of the environment and is used in this report to distinguish it from the term 'environmental health', which is the branch of public health concerned with all aspects of the natural and built environment affecting human health.

Epidemic: The occurrence in a community or region of cases of an illness, specific health-related behaviour, or other health-related events clearly in excess of normal expectancy. The community or region and the period in which the cases occur are specified precisely.

FAO, OIE, WHO Tripartite Alliance: A collaboration between the Food and Agriculture Organization (FAO), the World Organisation for Animal Health (OIE) and the World Health Organization (WHO) to address risks from zoonoses and other public health threats existing and emerging at the human-animal-ecosystems interface and provide guidance on how to reduce these risks. These three organisations have worked together for many years to prevent, detect, control and eliminate health threats to humans, originating—directly or indirectly—from animals. Putting the 'One Health' vision into practice has been facilitated by a formal alliance the three organisations established in 2010, acknowledging their respective responsibilities in combating diseases which have a severe impact on health and the economy, particularly zoonoses.

Fomite transmission: the transmission of infectious diseases by objects. It occurs when an inanimate object contaminated with or exposed to infectious agents (such as pathogenic bacteria, viruses or fungi) serve as a mechanism for transfer to a new host

Habitat fragmentation: A general term describing the set of processes by which habitat loss results in the division of continuous habitats into a greater number of smaller patches of lesser total and isolated from each other by a matrix of dissimilar habitats. Habitat fragmentation may occur through natural processes (e.g., forest and grassland fires, flooding) and through human activities (forestry, agriculture, urbanization).

Highly pathogenic avian influenza (HPAI): A highly contagious disease caused by viruses that occur mainly in birds and that can be deadly, especially in domestic poultry. Since 2003, an Asian HPAI H5N1 virus has resulted in high mortality in poultry and wild birds in Asia, the Middle East, Europe and Africa and has become endemic in some countries.

Host: An organism infected with or fed upon by a parasitic or pathogenic organism (for example, a virus, nematode, fungus). An animal or plant that nourishes and supports a parasite; the host does not benefit and is often harmed by the association.

Middle East respiratory syndrome (MERS): A viral respiratory disease caused by a novel coronavirus (Middle East respiratory syndrome coronavirus, or MERS-CoV) that was first identified in Saudi Arabia in 2012. Typical MERS symptoms include fever, cough and shortness of breath.

One Health: A collaborative, multisectoral, and transdisciplinary approach—working at local, regional, national and global levels—to achieve optimal health and well-being outcomes recognizing the interconnections between people, animals, plants and their shared environments.

Pandemic: The worldwide spread of a new disease. An influenza pandemic occurs when a new influenza virus emerges and spreads around the world and most people do not have immunity.

Pathogen: Any microorganism able to cause disease in a host organism.

Reservoir host: A primary host that harbours a pathogen but shows no ill effects and serves as a source of infection. Once discovered, natural reservoirs elucidate the complete life cycle of infectious diseases, providing effective prevention and control.

Rift Valley fever (RVF): A mosquito-borne viral zoonotic disease that affects sheep, goats, cattle and camels, causing devastating losses, especially among pastoral communities that rely on livestock for their livelihoods. The disease occurs in explosive outbreaks following periods of above-normal and persistent rainfall. People can become infected with Rift Valley fever after being bitten by an infected mosquito or through close contact with acutely infected animals or their tissues.

Secretaries: The Bill H.R. 3771 refers to the Secretary of Health and Human Services and the Secretary of Agriculture, as the Secretaries.

Severe acute respiratory syndrome (SARS): A viral respiratory illness caused by a coronavirus, SARSassociated coronavirus (SARS-CoV). First reported in Asia in 2003, the illness spread to more than two dozen countries in North America, South America, Europe and Asia before the SARS global outbreak of 2003 was contained. Since 2004, no known cases of SARS have reported anywhere in the world

Social distancing, also called 'physical distancing', means keeping six feet (two meters) of space between yourself and other people outside of your home, not gathering in groups, staying out of crowded places and avoiding mass gatherings.

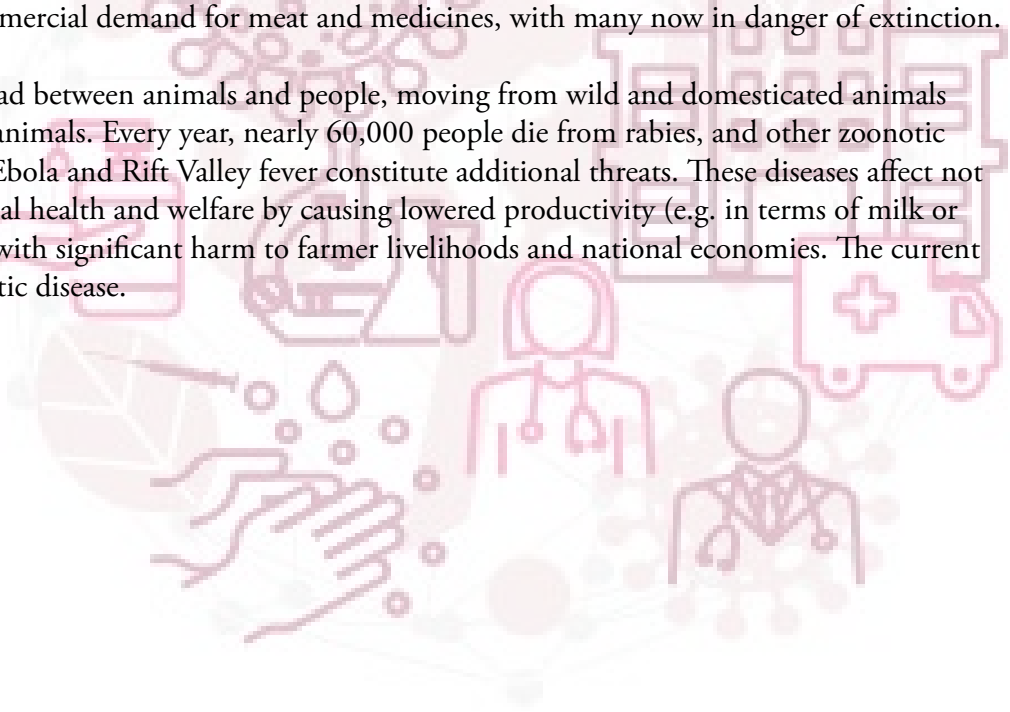
Vector: An organism or vehicle that transmits the causative agent or disease-causing organism from the reservoir to the host. Often thought of as a biting insect or tick but can be an animal or inanimate object. Many living vectors are bloodsucking insects and ticks, which ingest disease-producing microorganisms during a blood meal from an infected host (human or animal) and later transmit it into a new host, after the pathogen has replicated. Often, once a vector becomes infectious, they are capable of transmitting the pathogen for the rest of their life during each subsequent bite/blood meal.

Vector-borne diseases: Human illnesses caused by parasites, viruses and bacteria that are transmitted by vectors. Vector-borne diseases account for more than 17 percent of all infectious diseases, causing more than 700,000 deaths annually

Wet market, also called public, informal and traditional market. The term 'wet market' is considered a pejorative by some, so this report uses the term 'informal market'. All these terms refer to a marketplace selling fresh meat, fish, produce and other perishable goods as distinguished from 'dry markets' that sell durable goods such as fabric and electronics. Not all wet markets sell live animals, but the term is sometimes used to signify a live animal market in which vendors slaughter animals upon customer purchase. Wet markets are common in many parts of the world and include a wide variety of markets, such as farmers' markets, fish markets and wildlife markets. They often play critical roles in urban food security due to factors of pricing, freshness of food, social interaction, and local cultures. Most wet markets do not trade in wild or exotic animals, but have been linked to outbreaks of zoonotic disease. One such market was believed to have played a role in the COVID-19 pandemic, although investigations into whether the virus originated from non-market sources are ongoing as of April 2020

Wild meat, more commonly called **'bushmeat'** makes an essential contribution to food security for many people worldwide. Estimated bushmeat consumption in the Congo Basin alone is over 4 million tonnes per year. For many, wild meat may be the main type of meat available, an important component of food diversity or a food that contributes to cultural identity. Wild meatis a natural healthy food, although (as with domestic stock) its use may carry health risks related to zoonoses— diseases transmitted to humans through the handling or consumption of animals. Declines in wildlife due to over-hunting or other causes, whether direct (e.g. habitat degradation) or indirect (e.g. weak governance or climate change) could significantly affect many people´s food security and nutritional health. Furthermore, an increasing number of vertebrate species are being hunted to dangerously low levels as a result of increased commercial demand for meat and medicines, with many now in danger of extinction.

Zoonoses: Diseases that can spread between animals and people, moving from wild and domesticated animals to humans and from humans to animals. Every year, nearly 60,000 people die from rabies, and other zoonotic diseases such as avian influenza, Ebola and Rift Valley fever constitute additional threats. These diseases affect not only human health but also animal health and welfare by causing lowered productivity (e.g. in terms of milk or egg quality and safety) or death, with significant harm to farmer livelihoods and national economies. The current COVID-19 pandemic is a zoonotic disease.



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