Overview

The Washington State University Paul G. Allen School for Global Animal Health (Allen School) research is based on the fundamental understanding that human and animal health is inextricably linked. In some instances the connection is obvious, as is the case for zoonotic diseases where disease causing agents are transmitted directly from animals to humans. Examples include but are not limited to salmonella, brucellosis, rabies and Ebola. Other connections are less obvious; for example when household nutrition or income is negatively affected by livestock diseases that impact weight gain, milk or egg production. This linkage between animal and human health exists throughout the world, yet the impact is most significant in low resource populations.

At the Allen School we recognize that there are significant opportunities to dramatically lessen human health disparities through strategies and interventions that improve animal health. In East Africa, the Allen School has a unique partnerships with the University of Nairobi and Kenya Medical Research Institute in Kenya, the Nelson Mandela African Institution of Science and Technology in Tanzania, and partners with national and local governments of countries we work with that focus on educating students with the goal of increasing in-country researchers and programs, and finding solutions to solve local health challenges. Here we highlight examples of projects in East Africa by Allen School Faculty in line with the school’s mission of research aimed at improving human health and welfare.

Population-Based Animal Syndromic Surveillance Project

People who own livestock are better able feed to their families, send their children to school and provide for their medical needs. Livestock animals provide major financial and nutritional assets to farming families.

In 2012, WSU launched a program in Kenya to track the health and livelihood of families and the livestock they own. By focusing on the human-animal-environment interface, researchers are identifying how animal health directly relates to the health and welfare of people and the environment. The Population Based Animal Syndromic Surveillance project involves monthly community interviews of 1,800 homes to gather information about the health of both animals and humans.

After collecting data on handheld computers, the information is uploaded onto a secure server to enable a joint WSU and Kenyan team to analyze the information to identify interventions that will have the most impact. Community participants receive access to healthcare for both humans and animals.

The goal of this effort is to better understand how to improve the health and productivity of animals, and then measure the improvement via human development, health, economic stability, and education.

The next phase of the project will look at the impact of targeted interventions on animal health and corresponding economic implications. In rural Kenya, women make the decisions about revenue that comes from the sale of eggs or chickens. Men make decisions from sale of products from other livestock like cows, goats, and camels. Allen School researchers are looking at the household impact of vaccinating chickens against Newcastle Disease, a highly contagious disease that causes great loss in many small farms in Kenya. By vaccinating...
Zoonotic Disease

Zoonotic diseases are infections that pass from animals to people. Scientists estimate that approximately 60% of the known infectious agents in the world are zoonotic and up to 75% of the new or emerging diseases also fall into this category.

Diseases can spread around the world very quickly due to the ease and prevalence of human travel. When wild animal migration is added, disease transmission across boarders becomes even more challenging. Many of the diseases on which Allen School researchers focus are recognized by the World Health Organization as Neglected Tropical Diseases or are national priority diseases for this region.

Funders/Collaborators

- Bill and Melinda Gates Foundation
- Centers for Disease Control Prevention (CDC)
- Defense Threat Reduction Agency
- Food and Agricultural Organization of the United Nations (FAO)
- Medical Research Council-UK
- Merck Animal Health and MSD Animal Health
- National Institute of Health (NIH)
- National Science Foundation
- Paul G. Allen Philanthropies
- Sanofi Pasteur
- UNICEF
- UK-Biotechnology and Biological Sciences Research Council (BBSRC)
- U.S. Department of Agriculture
- Wellcome Trust
- World Health Organization (WHO)
- World Animal Protection

chickens, researchers are looking to discover how this translates to protein consumption and nutritional status of children and mothers, and how that translates into health and economic improvements for families.

This program is led by Dr. Thumbi Mwangi and is funded by the Paul G. Allen School for Global Animal Health. Elkanah Otiang is a PhD student currently involved with this project.

Brucellosis and MERS Coronavirus

More than 65% of the 19-21 million domestic dromedary camels live in the horn of Africa region including Kenya, Ethiopia, and Somalia. The camels are used to transport people and supplies across the desert, for milk, and as a source of meat.

Camels can transmit disease to people, particularly brucellosis and MERS coronavirus through mechanisms that are not well understood but perhaps involve physical contact and drinking camel milk. The Allen School researchers are testing camels to determine their infection frequency as well as reviewing the transmission pathways between people and camels for both diseases, brucellosis and MERS CoV. Camels are a regular source for infection transfer due to their longevity, living 15-20 years as compared to cows living approximately four years and goats two years. That longevity provides multiple reinfection opportunities. The Washington Animal Disease Diagnostic Laboratory is involved in determining the brucella strains circulating in camels.

The goal of the studies on brucellosis and MERS CoV in the camel populations is to find ways to break the transmission cycle in an effort to control both diseases and reduce death in animal and human populations.

The project is led by Dr. Kariuki Njenga and Dr. Isaac Ngere and is funded by CDC Kenya.

Rabies Free Africa Program

As one of its primary research and delivery programs, Allen School researchers are working to eliminate human deaths from canine rabies by 2030.

Human incidence of rabies has dramatically dropped in a region of East Africa thanks to continued vaccination of domestic dogs, in large part due to the success of the Rabies Free Africa program in Tanzania. This initial focus has expanded to work on rabies in Kenya.

Rabies Free Kenya

The program focuses on a two-tier approach: mass dog vaccinations and community-based surveillance and treatment. The initial work centered on getting rabies listed as one of the top infectious diseases in Kenya. This led to a national strategy for rabies elimination that is being used to create a model that other countries can utilize.

Concurrent with the mass dog vaccination campaigns, the education campaign for dog bite victims is ongoing. This is paired with a surveillance program that traces suspect human cases of rabies exposure and reports back to health facilities and villages to discover other people, and animals, that may have been exposed and not sought treatment.

This program is led by Dr. Thumbi Mwangi and is funded by the Wellcome Trust, World Health Organization, Sanofi Pasteur, Kenyan national and local governments, and collaborating with Kenya’s Zoonotic Disease Unit and organizations such as World Animal Protection, World Organization for Animal Health (OIE), Sharon Live-On Foundation among others.

Rabies Free Tanzania Program

The Tanzanian rabies research program based on the boundary of the Serengeti National Park was responsible for establishing domestic dogs, and not wildlife species, as the source of human rabies. To this day Rabies Free Tanzania continues to vaccinate over 45,000 dogs a year. Not only do these activities create a rabies free zone, they are also used by the Allen School for carrying out intervention research that focuses primarily on how rabies control programs can be carried out more cost-effectively. This research is vital if we are to meet the “Zero by 30” goal. For example, recent research from the program has discovered that the commonly used rabies
vaccine is thermotolerant and can thus be stored outside of cold-chain conditions for extended periods of time. Follow on studies are now looking at utilizing this thermotolerant property to develop novel vaccine delivery strategies that we expect will enable dogs to be vaccinated ongoing throughout the year at low cost even in the most remote settings where power for refrigeration units is limited.

This program, which collaborates with the Tanzanian One Health Desk and the University of Glasgow, is led by Dr. Felix Lankester and is funded by MSD Animal Health, and donations by the Ferrel Family.

Zika

Zika is a disease transmitted to people through bites from insects, most commonly from mosquitoes but it can also be spread from ticks and some flies. Adults that contract the disease usually show mild symptoms but infection during pregnancy can impede fetal brain development resulting in microcephaly.

Researchers from the Allen School are leading the largest Zika study in Sub-Saharan Africa located in Mombasa, Kenya. Researchers are following approximately 3,000 pregnant women recruited from three hospitals in Mombasa through the course of their pregnancy to identify evidence of Zika virus infection and its outcome. The study will provide data leading to evidence-based strategies to prevent Zika virus infection in pregnancy in Africa. It could also lead to vaccine introduction and improved counseling of patients about risks to their pregnancies and their children. The information will also contribute to effective preparedness for health facilities providing services to affected children and families.

This program is led by Dr. Eric Osoro and is funded by CDC Kenya.

Wildlife and Livestock Disease Surveillance

Allen School researchers are engaged in a study to identify ways to track infectious disease outbreaks in real time. Utilizing a mobile phone application created by Texas A&M University, wildlife officers in Kenya report disease while in the field. They then have access to real time feedback on disease in the area to identify trends. Prior to this project, no systematic information was known about Kenyan wildlife diseases.

The mobile phone application is also being used by field veterinarians to report livestock diseases. The livestock reporting app is being piloted in four regions where the field veterinarians using it receive real-time feedback on infectious disease trends in their area before visiting the next farm. This allows them to make recommendations based on prevalence of disease in the area. After expanding the program across the country, the next phase will include data transmission to regional human healthcare leaders to identify zoonotic disease outbreaks at the outset.

In line with the global health security agenda, the real-time reporting from livestock and wildlife disease provides opportunities to prevent spillover to humans. Working with the Ministry of Health and county health departments, researchers can use this disease surveillance apparatus to intervene in disease outbreaks. The long-term objective is to utilize this application and surveillance model tracking of infections zoonotic disease globally within wildlife and livestock populations.

This program is led by Dr. Kariuki Njenga and Dr. Naomi Kemunto and is funded by CDC Kenya and Food and Agricultural Organization of the United Nations (FAO).

Causes and Extent of Mortality of Domestic Ruminants in Tanzania

Ruminant livestock are critical to livelihoods and the food security of millions of livestock-keeping communities across Africa, but productivity is constrained by a high burden of infectious diseases. Many abortigenic agents are known to circulate widely in livestock in sub-Saharan Africa, causing reproductive losses. Many of these pathogens are also zoonoses that are known to be important causes of common human disease syndromes, including fever. However, surveillance systems to generate data on the incidence and causes of livestock reproductive losses and their impact on productivity in sub-Saharan Africa are inadequate. There is also still a poor understanding of the most effective and acceptable interventions that might be implemented in response to livestock abortion surveillance data.
The Allen School is collaborating with numerous partners including the University of Glasgow and the Nelson Mandela African Institution of Science and Technology to establish a mobile phone based livestock disease reporting surveillance system in northern Tanzania. Focusing primarily on reproductive loss, the surveillance system aims to identify the primary infectious causes of livestock abortion and thereby to identify intervention strategies that will reduce this burden.

The project is being led for the Allen School by Dr. Felix Lankester and is funded by the Supporting Evidence-Based Interventions (SEBI) project, and the University of Edinburgh.

**Anthrax**

Anthrax remains as a regional health problem in East Africa. Anthrax persists in ecosystems resulting in loss of human and animal life if there is no intervention and is a solid example of the challenges to be addressed by better understanding the human-animal-environment interfaces.

In Kenya, more than ten outbreaks of anthrax occur every year, leading to loss of livestock, wildlife, and sometimes humans. Cattle, sheep, goats, and camels die within a day of contracting the disease. Alternatively, humans show signs of illness with the vast majority recovering. Dogs that scavenge the carcasses of deceased animals, generally show no symptoms.

Allen School researchers are using historical data and current outbreaks to developing an anthrax risk map for the country, and to discover the factors leading to outbreaks in specific sites such as soil types, topography or vegetation. By utilizing this data, researchers will be able to identify opportunities for prevention and intervention to slow or stop the spread of Anthrax.

This project is led by Dr. John Gachohi and Leonard Nderitu (PhD student) and is funded by the United States Defense Threat Reduction Agency.

**Influenza**

The H5N8 Influenza virus is a highly pathogenic avian virus that has caused wild and domestic bird deaths in 35 countries in Asia, Europe, the Middle East, and Africa as of early 2017. The quickly spreading nature of this virus poses a major threat to poultry producers.

Researchers at the Allen School are conducting a study to understand the transmission of this strain of influenza between migratory wild birds and domestic poultry in order to find ways to break the transmission cycle. They are also looking to determine the extent to which H5N8 has already infected birds available in live bird markets in both urban and rural settings.

This project is led by Dr. Kariuki Njenga and Dr. Eric Osoro and is funded by CDC Kenya.

**Antimicrobial Resistance (AMR)**

The Allen School’s expertise in understanding how human-animal-environment interfaces contribute to emergence and spread of disease makes it a natural leader of efforts to tackle antimicrobial resistance (AMR). AMR is particularly challenging in low- and middle-income countries where the most affordable antibiotics are the ones for which resistance is most common.

In East Africa our team has focused on identifying what behaviors, environmental exposures and other factors contribute to the risk of carrying gut bacteria that are resistant to antibiotics for both people and animals. This work has included diverse communities from rural agricultural and pastoralist areas in northern Tanzania to a densely populated informal settlement (Kibera) in Nairobi, Kenya.

Our Tanzania work has highlighted the importance of environmental transmission and the cultural factors. For example, Massai households that consume raw milk are at particular risk for having antibiotic-resistant gut bacteria. Boiling milk is not culturally acceptable so we are introducing specially-designed thermometers that help people determine when milk has reached pasteurization temperatures. Early work shows that people are more likely to treat their milk when this option is available. We anticipate that this intervention will help improve milk safety, which will likely have important health benefits for children and pregnant women.

In Nairobi we have found that antibiotic use at the individual level is not linked to carriage of antibiotic-resistant gut bacteria, but the prevalence of these resistant bacteria is so high that the community may be completely saturated with these organisms. The most effective interventions in this case need to focus on ways to limit the transmission of these organisms within and between households. Transmission is also important between communities and hospitals, which is why we are preparing to conduct a colonization study to identify factors that influence how people are colonized with “high level resistance” (e.g., carbapenems) in Kibera and an associated hospital. We are also working to understand how antibiotics are used in the Kenyan healthcare system.

Leaders on these programs are Dr. Douglas Call, Dr. Sylvia Omulo and Dr. Mark Caudell, funded by the Centers for Disease Control and Prevention (CDC), and the National Science Foundation.

**Drinking Water Quality & Safety**

This Allen School project addresses the quality and safety of drinking water available to people in Kenya, especially in areas where people and livestock live in close proximity in order to understand two aspects of water quality in Kenya: what contaminants are in the water, and how contaminants move through the ecosystem.

A low technology test, microbial source tracking, is used to screen water sources and water available for drinking at households to distinguish contamination through livestock waste from that from human waste. These data are related to observed household morbidity to determine the contribution of water availability and safety, sources of contamination on incidence of diarrhea among children.

This project is led by Dr. Thumbi Mwangi and is funded by the Medical Research Council of the UK as a collaboration between University of Southampton, University of Brighton, Victoria Institute for Research on Environment and Development (VIRED) and the Kenya Medical Research Institute.