**ANDREW G. HUFF RESEARCH STATEMENT**

I am devoted to conducting high quality public health research that advances our understanding of the relationships between natural resources, human, animals, and infectious agents. By examining these complex systems, and quantifying the effectiveness of mitigation strategies and policy options, decision makers are able to make scientifically sound and socially responsible choices. My research appeals to a broad interdisciplinary audience because I use qualitative methods to determine why and how people make decisions, quantitative methods to eliminate and reduce bias and improve predictive accuracy, and models (e.g., agent, systems dynamics, differential equations, statistical) to evaluate and compare public health mitigation strategies and to forecast infectious disease.

**Past Research**

*Graduate*

The Department of Homeland Security’s (DHS) Office of Science and Technology funded my dissertation research ($1.2 million before indirect costs) over three years, and I managed the budget, other collaborating researchers, and contractors on this grant. My dissertation research focused on evaluating the decision-making process for the allocation of security threat mitigation resources and policies in food and agriculture systems to protect them from intentional and unintentional contamination events. Specifically, I focused on a decision making tool named the Food and Agriculture Systems Criticality Assessment Tool (FASCAT) which was used to evaluate 741 food and agriculture systems across the United States. The data and analysis performed by FASCAT was used by the DHS to allocate $17 billion in mitigation resources to protect potentially vulnerable and high consequence food systems from intentional contamination events. Before beginning my research I conducted an extensive literature review of the history of food protection, food outbreak investigations methods, and the available mitigation strategies to protect food systems. and built a network of subject matters experts (SMEs) in food systems, public health, and bioterrorism (Huff et al., 2013a).

I began my research by traveling to observe FASCAT training and data collection process to determine how the process worked, and to observe if there were any behaviors of the trainers or SMEs that potentially introduced bias into the collected data (Huff et al., 2013b). I found that DHS trainers and SMEs engaged in behaviors that were likely to introduce significant bias into FASCAT’s data, thus resulting in biased FASCAT scores and policy outcomes. To confirm my observations, a Likert scale survey was distributed all users of FASCAT (Huff et al., 2013b), and the results indicated that SMEs were prone to multiple biases, there were gaps in training and funding, and SMEs had inconsistent food protection values and beliefs.

Despite theses sources of bias, FASCAT was the only method supported by the government for the identification of at risk food and agriculture systems, and for the allocation of mitigation resources. DHS provided the data collected by FASCAT from 2008 to 2013 to perform quantitative analyses. I performed ANOVA, multiple linear regressions, and mixed and random effects models to evaluate if FASCAT was an accurate predictor of risk and criticality. Results indicated that FASCAT was performing as it was intended, and if biases were eliminated to the greatest extent possible during the data collection process, then FASCAT could accurately rank order food and agriculture systems criticality in a manner that enabled policy makers to accurately allocate scarce public health mitigation and intervention resources (Huff et al., 2014). Consequently, several opportunities for improvement were identified in FASCAT’s scoring algorithm.

Based on the results of the quantitative analysis, I developed a novel and bias free method for criticality and risk analysis of complex systems. The new tool was named Criticality Spatial Analysis (CRISTAL) and has been patented by the University of Minnesota (Huff et al., 2013c). CRISTAL collects food system structure data directly from private industry databases and then calculates risk and criticality as a function of spatial risk characteristics from a geodatabase. Now, the government has the capability to collect the necessary food and agriculture structural data without bias.

*Post Graduate*

At Sandia National Laboratories, I worked in several multidisciplinary research teams for a variety of government and industry clients (most in a classified setting where publication was internal to the laboratory) on the following topics:

* Validation and verification of social network models used in the evaluation of smoking interventions and policies by the FDA’s Center Tobacco Products.
* Assessment of the Patient Protection and Affordable Care Act and the effect on rural communities and vulnerable populations.
* International stochastic food and agriculture systems modeling to predict the source and flow of contaminants through a complex network.
* Hurricane swath analyses to predict the consequences of actual hurricane events in real time to allocate emergency resources rapidly.
* Agent-based complex network modeling of social contact networks in tobacco and e-cigarette using populations to determine what policy interventions are likely to reduce tobacco and e-cigarette prevalence in the United States.
* Agent-based infectious disease model to predict the spread of infectious agents in a clinical setting to determine what clinic-level policies and mitigation strategies can prevent the spread of various infectious diseases.
* Agent-based pandemic influenza modeling to determine if influenza mitigation strategies vary based on underlying local community structure characteristics.
* International zoonotic animal disease system dynamics modeling to predict disease transmission and select effective animal or human disease mitigation strategies with extremely limited resources.
* International public health training for Middle Eastern zoonotic diseases taught to high-level foreign government officials.

**Current Research**

Currently, I am the Vice President for Data & Technology at EcoHealth Alliance, and lead a team of masters and Ph.D. level data scientists, infectious disease experts, and software engineers. My team conducts scientific research to identify and measure infectious disease drivers and develops software for biosurveillance, One Health big data, and disease forecasting. My team's research focuses on the fusion of biosurveillance and environmental health data streams, emerging infectious diseases, and infectious disease forecasting. As the P.I. on this project, my current annual research budget is $2.4 million, funded by the Defense Threat Reduction Agency, and the project is currently in year 3 of 4. In this year’s funding cycle we have submitted 6 manuscripts for publication and 6 more are in preparation. Additionally, we have filed trademarks, copyrights, and patents on these technologies built from our own research and development (apps.eha.io). For example, we have created a technology named GRITS that uses Natural Language Processing to identify and diagnose infectious diseases spatially from textual data sources in 30 languages. Next, my team and I created a software platform called MANTLE to clean, join, translate, and share datasets related to infectious disease ecology. Another technology that we created, FLIRT identifies where infected travels are likely to travel to, or conversely identify where they traveled from using a network statistical inference. Last, we created a Technology named TATER that is used by users on Mechanical Turk to rapidly annotate and clean large data sets from ethnographic interviews. Additionally, I am a country liaison for the PREDICT 2 Emerging Pandemic Threats program. In this program, I establish, train, and build zoonotic biosurveillance systems capacity in developing countries.

**At Michigan State University**

The world is facing difficult public health challenges over the next 30 years. Specifically, the complex interaction of climate change, increasing human population, urbanization, energy and water demand, and decreasing food production yields is causing many difficult public health problems that will be extremely challenging globally.

I believe that I can contribute to solving problems by building a research program at Michigan State University that investigates, quantifies, and models the interaction of the factors listed above to forecast disease emergence and identify public health solutions that are viable to stakeholders. I will recruit graduate students to tackle research projects: (1) in food and agriculture systems (climate, energy, population, water, agriculture sustainability) to determine where future investments can mitigate consequences; (2) in biosurveillance and disease emergence risk to quantify human, domestic animals, and wildlife interactions to identify and measure the effect of policy mitigation solutions that reduce zoonotic disease emergence risk; (3) modeling public health systems to determine where low cost investments can have the most impact in reducing disease burden; and, (4) in measuring the association between behavioral health and green space in urban ecosystems.

For example, to model public health systems, I would incorporate quantitative data of necessary system components (i.e., power reliability, clean water availability, transportation systems, biosurveillance sensitivity and specificity, medical/veterinary performance, laboratory diagnostic performance, prevention strategies, and communication systems) with surveys and interviews with subject matter experts (SMEs) to understand system functioning when empirical data are not available, and then model these systems to measure the effectiveness of public health interventions. Allocating resources to mitigate influenza and developing effective policies that reduce the burden of disease is a global challenge. Often times, the amount of pre- and post-exposure antiviral prophylaxis and vaccines (when effective) and policies that reduce the contact rate in the population are the only realistic intervention strategies to reduce the rate of influenza transmission. Determining which mix of these strategies is economically feasible and clinically effective is imperative, especially when resources are scarce. The integration of quantitative data and input from SMEs will be used to parameterize and feed a system dynamics model that tests the outcomes of different policy strategy mixes. Output from the model will be analyzed using rigorous statistical methods (sensitivity, uncertainty, and robustness analyses) to quantify and determine how policy interventions can most effectively reduce disease prevalence, and prevent adverse influenza consequences. Models can be validated, verified, and evaluated by comparing model results to actual outbreaks when they occur.

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**Professional Network, Research Collaborators, & Research Funders**

*Academic*

* Brandeis University – Sustainable Working Landscapes
* Columbia University – E3B and Mailman School of Public Health
* Technical University of Denmark
* University of California - Davis
* University of Minnesota – CIDRAP, NCFPD, SPH, CSE, VMED
* University of Oxford
* Stanford University

*Government*

* Centers for Disease Control
* Department of Homeland Security: Sector Coordinating Council/Government Coordinating Council Member – Food and Agriculture
* Defense Threats Reduction Agency
* Department of Defense
* Food and Drug Administration – Center for Food Safety and Nutrition, Office for Regulatory Affairs, Office of Tobacco Products
* Jordan Ministry of Health
* Jordan Ministry of Agriculture
* Jordan University of Science and Technology
* Health and Human Services
* Health and Human Services: Sector Coordinating Council/Government Coordinating Member – Public Health and Healthcare
* Los Alamos National Laboratory
* National Institutes of Health - National Institute of Environmental Health Sciences, National Institute of General Medical Sciences
* Sandia National Laboratories
* Sudan Ministry of Health
* United Stated Department of Agriculture – Economic Research
* Service, Foreign Agriculture Service
* University of Khartoum
* USAID – Emerging Pandemic Threats

*Private & Non-Governmental Organizations*

* Distributed Information Technologies, Inc.
* Food and Agriculture Organization of the United Nations
* Grocers Manufacturers Association
* PepsiCo, Inc.
* ProMED Mail
* United Health Group, Inc.
* World Health Organization
* International Society for Disease Surveillance
* International Society for Infectious Diseases

**Selected Publications**

Huff, A. G., Kircher, A., Hoffman, J., & Kennedy, S. P. (2013A). The development and use of the Food and Agriculture Systems Criticality Assessment Tool (FASCAT), *Food Protection Trends, 33, 218-223.*

Huff, A. G., Hodges, J. Kircher, A., & Kennedy, S. (2013B). State officials’ perceptions of Food and Agriculture Sector Criticality Assessment Tool (FASCAT), food-system risk, and food defense funding*. Journal of Homeland Security and Emergency Management, 0,* 1-16.

Huff, A. G., Kircher, A., Hoffman, J., & Kennedy, S. P. (2014). Criticality Spatial Analysis (CRISTAL). Filed by the University of Minnesota. Patent number 61784675.

Huff, A. G., Hodges, J., Kennedy, S. P., & Kircher, A. (2015). Analysis of the Food and Agriculture Systems Criticality Assessment Tool (FASCAT) and collected data. *Risk Analysis*, *35,* 1448-1467*.*