**Principles of Geocomputing Project Proposal Template**

**Project Title:** Spatial and ecological epidemiology of human and animal brucellosis disease in Iran

**Group:** Brucellosis Waynerosis

**Members:**

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**One sentence summary:**

A spatio-temporal analysis of the relationship between human and animal Brucellosis cases; focusing on the association between animal vaccination practices and disease transmission by county in Iran.

**Project Description**:

*Description:*

*Brucellosis* disease is a highly contagious zoonotic disease. The infection is almost invariably transmitted by direct or indirect contact with infected livestock or their products (Zhang, 2014). The bacteria species *B. melitensis* (which infects sheep and goats), *B. suis* (swine), and *B. abortus* (cattle) cause significant economic losses to animal owners and induce severe human disease (Gwida, Al Dahouk, & Melzer, 2010). Although the animal vaccination program in Iran was initiated in 1949, brucellosis is still present as an endemic acute infection in this country (Kafil, baha Hosseini, & Sohrabi, 2014).

*Background:*

*Brucellosis* species cause considerable economic threats to animal producers as well as a significant public health threat to humans. In animals, *Brucellosis* causes spontaneous abortion and is passed to humans through unpasteurized milk products. In human cases, it requires a long course of antibiotics to treat and causes half a million cases per year globally (WHO). There are a few vaccines for animal cases, most notably the RB51 vaccine strain. This strain has caused human cases in the US as it can cross from the animal to dairy products. There is no human vaccine available. This project will research the relationships between animal and human cases to identify covariates contributing to risk of human cases.

*Methods:*

We will investigate the relationship between animal vaccination status and disease incidence in humans at the sub-county or county level. Disease incidence in humans and animal vaccination status is provided in the data at the county level. Using spatial and spatiotemporal scan statistics/hotspot analysis to locate spatial, temporal and spatiotemporal disease clusters for human and animal cases. Environmental variables will be aggregated at the county level using the Earth Engine module. If scope allows, we will investigate whether these environmental variables (e.g. length of growing season) moderate the effect of animal vaccination rates on human incidence.

*Why it matters:*

Brucellosis is a significant threat to both animal and human health. It has widespread economic ramifications in animal cases, and can be lethal in human cases. A spatial analysis of brucellosis incidence and animal vaccination rates may reveal patterns that help inform targeted vaccination efforts in Iran going forward. A greater understanding of disease transmission patterns can therefore help improve public understanding of the disease.

**Data sources:**

* Animal brucellosis cases from 2008-18 (point data)
  + Excel sheet of all animal cases, lat, long, date, barn testing data, results
  + We will use this data to investigate factors contributing to animal cases.
* Human brucellosis cases 2009-12 (sub county polygon level)
  + Human cases recorded by address (contains PHI)
  + We will use this data to assess factors contributing to human infection rates.
* Provincial SES data
  + <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5971181/>
  + Quintile data of SES based on prior research

**Timeline:**

* Status report (March 26)
  + We plan to have code that reads in data and merges animal cases, human incidence, and SES data
  + Will have done more research on availability of SES data
    - Currently have it at the province level, will look for it at the county level
  + We plan to have computed and aggregated environmental variable values using earth engine module
  + Will have identified clustering methodology to be used
  + Will have looked at the distributions of various environmental variables to determine whether any should be explored further
  + Since the study is fairly exploratory, we will identify whether any of the various approaches we have used to this point seem particularly promising.
* Prototype (April 16)
  + Will have used jupyter widgets to create slider bars for hyperparameters (e.g. vaccine efficacy)
  + Will have written functions to run the selected clustering methodology
  + Will have investigated interaction between environmental variables and prevalence