One Health and the Importance of WGS Data-sharing from All Food Sectors

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We all know how useful WGS data is within the context of foodborne outbreaks.
But how can we MAXIMIZE the benefits of WGS?

• Specifically, in the context of a One Health Approach

• What is “One Health”?  

• A One Health framework holds that a connection exists between the environment and animal and human health.

• Therefore, it is encouraged to have collaborative approaches across environmental, animal, and human sectors to reach an optimal level of health across local, national, and global settings.
How can we MAXIMIZE the benefits of WGS within a One Health Approach?

• OPEN DATA SHARING
Understanding the impact of the human genome

- 3.2 billion base pairs per haploid genome
- 22 autosomes and 2 sex chromosomes
- HGP began in 1990 (DOE and NIH) with $3 billion budget and 15 year time frame
- Massive world-wide commitment and sequencing centers
- **Data was made publicly available every step of the way**
Understand human genetic variation and create reference populations
My DNA compared to reference populations
However, HGP led to more than just Ancestry!

Human Sequencing

- Drug treatment
- Targeted drug development
- Gene therapy
- Improved human health
- Revealed genetic predictors of disease
- Human genetic variation
- Improved disease diagnosis
Why can’t we do the same for microbes?
Imagine sampling and sharing microbial DNA from all over the world
Building reference populations for Salmonella
Building reference populations for Listeria

https://commons.wikimedia.org/wiki/File:BlankMap-World_1935.png
Building reference populations for different foods
Building reference populations for animal health
Building reference populations for ANYTHING

https://commons.wikimedia.org/wiki/File:BlankMap-World_1935.png
And making the data available to everyone!
Using WGS to inform better agricultural practices
Fresh Tomato Industry

- Fourth most popular fresh market vegetable
- Approx 100,000 acres planted
- $1.1 billion annually
- Produced in every state
- California and Florida top 2 producing states
- Virginia and North Carolina in top 10
- Round, Roma and Cherry/Grape
**Salmonella enterica subsp. enterica sv. Newport**

- Emergent from livestock (i.e., cattle, swine, chickens)
- Many strains resistant to multiple drugs including third-generation (Cephalosporins)
- Third most common serotype of *Salmonella* associated with foodborne illness
- Diverse range of niches and reservoirs: livestock, variety of produce commodities, and a diverse array of environmental niches
- Hearty environmental bacterium with ecological and geographic signal (i.e., JJPX01.0014 – oysters; JJPX01.0061, -0.030 – Eastern Shore)

[Link to Bioquell website for resources and support on microbiology of salmonella enterica](http://www.bioquell.com/en-uk/resources-and-support/microbiology/salmonella-enterica)
Figure 14 - Age-standardized rate per 100,000 population, by county, 2006 to 2011
Key Conclusions from VA surveys

• Sampled Areas:
  – Virginia Tech Agricultural Research and Extension Center (AREC): 2009-2011
  – Roadside stand tomatoes: 2010-2011

• *Salmonella* Pattern 61 and other clinically relevant isolates found consistently in waters and sediments at AREC and the 6 other locations

• Environmental waters and sediments are potential reservoirs for *Salmonella*

• Agricultural practices related to the use of contaminated surface waters may introduce *Salmonella* onto crop plants
Using WGS to identify issues on the farm to fork continuum

Contamination occurs at farm

Represents 1 SNP

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Why WGS data needs to be shared with the world

- Better agricultural practices
- Safer food
- Improve microbial disease diagnosis
- Targeted drug development
- Improved human health
- Risk assessment
- Microbial genetic variation
One Health...

...Connecting us all