


Quantitative Microbial Risk Assessment for Estimating Setback Distance from Aerial Irrigation of Dairy Manure

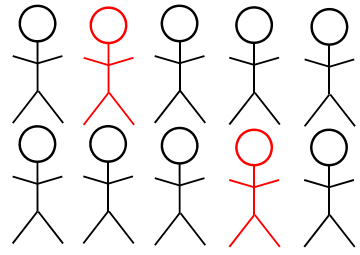


Tucker Burch, Mark Borchardt, Susan Spencer
USDA – Agricultural Research Service
Joel Stokdyk and Aaron Firnstahl
US Geological Survey Wisconsin Water Science Center
Becky Larson, Dept Biological Systems Engineering UW-Madison
Burney Kieke, Marshfield Clinic Research Foundation
Ana Rule, Bloomberg School of Public Health, Johns Hopkins University

Definitions

Risk: cases of illness/people exposed
– Can also be interpreted as probability

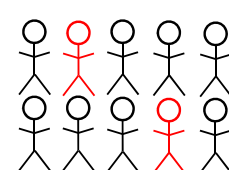
Example:
10 people exposed
2 cases of illness (red)
Risk = 2/10
Probability = 0.2
(or 20%)

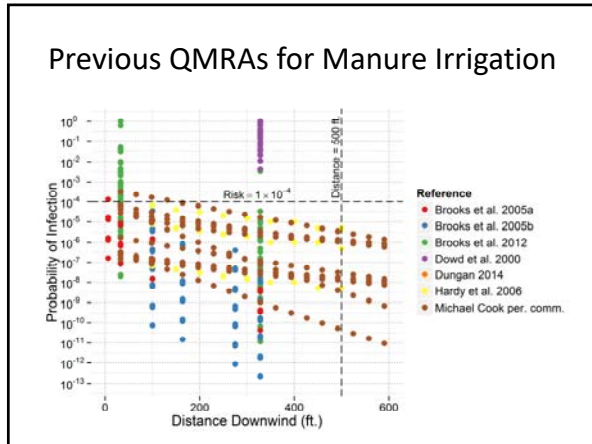


Definitions

QMRA: quantitative microbial risk assessment
– Predicts risk using mathematical models
– Prediction is based on average pathogen dose

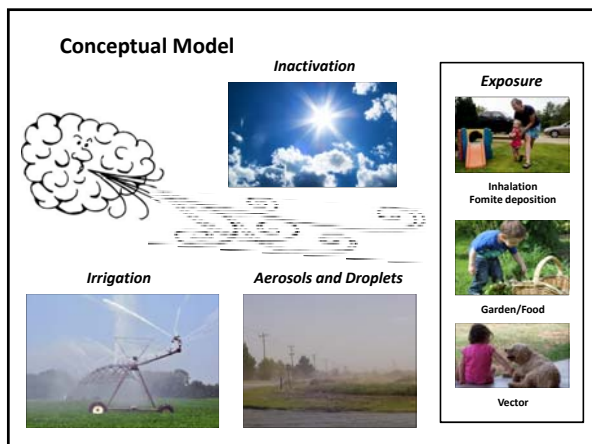
Alternative is epidemiology
– Measures risk directly
– Expensive \$\$

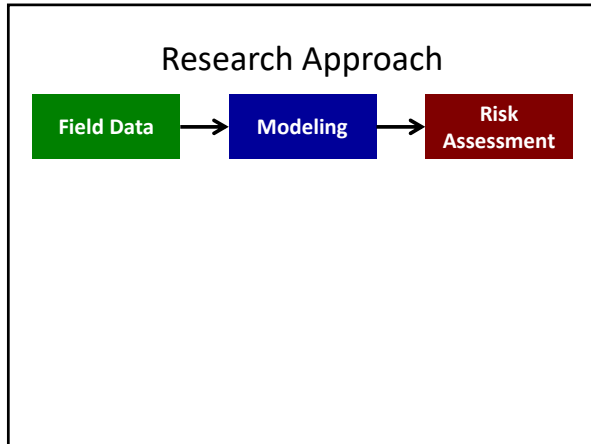


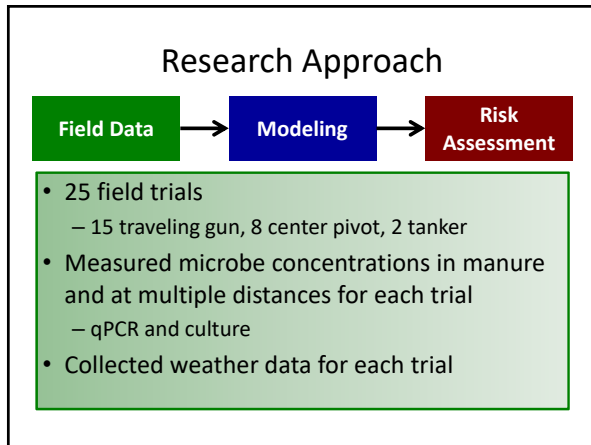


- ### Project Objectives
1. Identify the risk of illness from airborne pathogens during manure irrigation.
 - Acute gastrointestinal illness (AGI)
 - Relate to distance

 2. Identify other variables (e.g., weather conditions) most important for airborne pathogen transport during manure irrigation










Measurements during Irrigation Trials

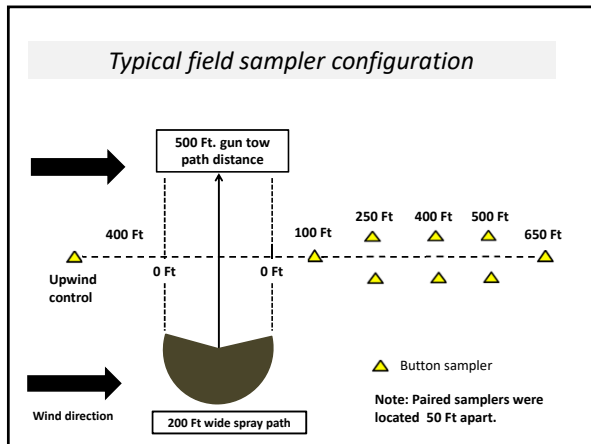
Microbes and Pathogens

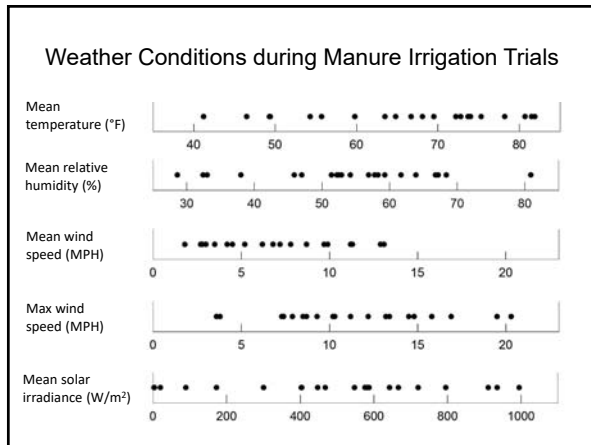
- qPCR
- conventional culture

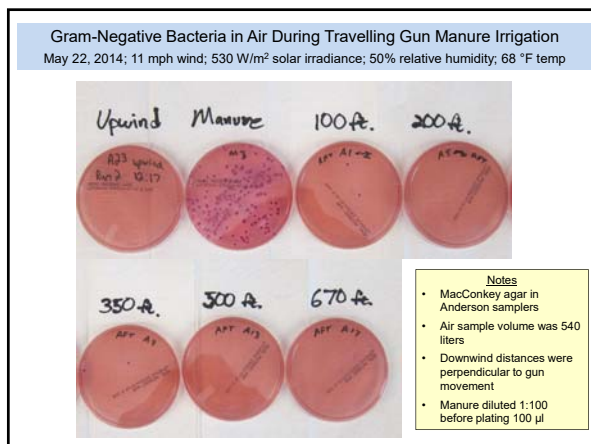
Portable Weather Station

- wind direction and speed
- air temperature
- solar radiation
- relative humidity
- precipitation (always = 0)









Research Approach

```
graph LR; A[Field Data] --> B[Modeling]; B --> C[Risk Assessment]
```

- Statistical modeling (i.e., regression)
- 2 objectives:
 - Predict air concentrations for risk assessment
 - Relate air concentrations to weather conditions and microbe concentrations in manure

Research Approach

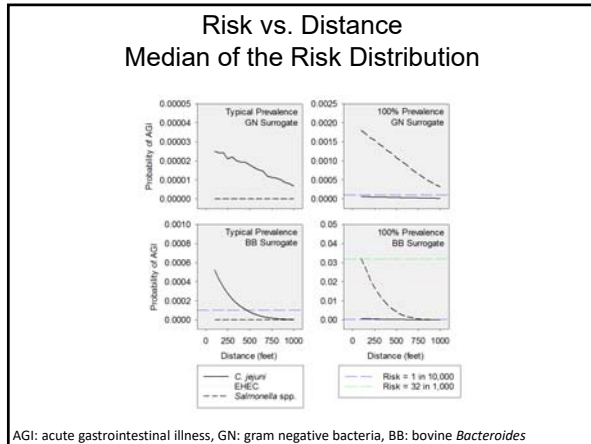
```
graph LR; A[Field Data] --> B[Modeling]; B --> C[Risk Assessment]
```

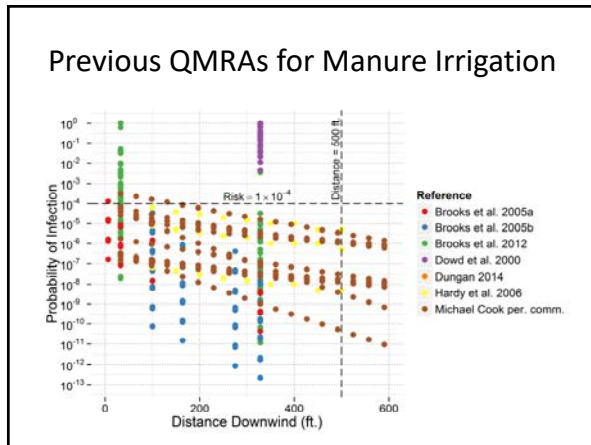
- Statistically most important variables:
 - Distance from irrigated manure
 - Wind speed
 - Pathogen concentrations in manure

Research Approach

```
graph LR; A[Field Data] --> B[Modeling]; B --> C[Risk Assessment]
```

- Quantitative microbial risk assessment
- Average dose calculated from: pathogen prevalence, distance, age, inhalation rate, time spent outdoors
- 2 pathogen surrogates: bovine *Bacteroides* and gram negative bacteria





- ### Summary
- At 500 feet downwind from dairy manure irrigation illness risk is on the order of 1/100,000 to 1/100 per irrigation event
 - Risk depends on pathogen type, pathogen prevalence, and downwind distance
 - Pathogen air concentrations downwind from manure irrigation depend on wind speed, pathogen concentrations in manure, and distance
 - This study is unique for using field data

Acknowledgements

- We thank ...
- Jan Altmann, Jordan Gonnering, Hana Millen and Zach Zopp for field and laboratory work
- John Panuska for contributions to the study design
- Scott Fischer and owners and staff of participating dairy farms
- Philip Schmidt, Peter Teunis, and Norval Strachan for dose-response parameter distributions
- This study was funded in part by the Wisconsin Department of Natural Resources
