Perceptions of water quality among rural Albertans and association with livestock.

David Hall, DVM, PhD (AgEcon) and Abraham Munene, BSc, MSc
dchall@ucalgary.ca

Alberta Innovates – Water Innovation Program Forum

May 24, 2018       Matrix Hotel, Edmonton
Funding – Thank you Alberta Innovates!

Formerly Alberta Innovates – Energy and Environment Solutions
A transdisciplinary team

**University of Calgary**
- David Hall – animal health, economics and policy
- Sylvia Checkley – public health and envl. Epidemiology
- Abraham Munene – PhD student

**University of Alberta**
- Norm Neumann – Environmental microbiology, Water quality

**Alberta Agriculture and Forestry**
- Jamie Wuite – On-farm water supply, Technology transfer, Water policy

**Alberta Health Services**
- ProvLab environmental microbiology

Rural households, Livestock producers, Water interest groups
Agriculture, water, and emerging infectious diseases (EIDs)

- c.70-80% of diseases infectious to humans are of animal origin

- Basic changes in farm management reduce risk of infection > 50%
  (UNDP, Hanoi, 2008; Hall & Le, 2015)

- Improved water health or hand washing reduce morbidity > 25%
  (Shuster-Wallace et al., UNU-INWEH, 2008)
Agriculture, water, and emerging infectious diseases (EIDs)

• No requirement for rural residents to test water quality

• c. 450,000 Albertans consume water of unknown quality from 215,000 wells
  • 89.3% rarely or never test their water (Summers, 2010)

• For rural Albertans, what is:
  • knowledge of water quality
  • perceptions of water quality on homestead
  • association with presence/ management of livestock

• Limited health knowledge leads to increased risk of EIDs
The problem to address

Agriculture, water, and emerging infectious diseases (EIDs)

• Livestock management
  • Manure management, other animal waste
  • Pathogens including *E. coli* → human illness
  • concern if entering surface or ground water

• Understanding perceptions/ management of those risks
  • Influence behaviour change of rural home owners wrt water testing
  • Improve livestock waste management
  • Reduce contamination of water from livestock waste

• Policy change? Standard Operating Procedures?
One Health

The interaction of animals, humans, and their environment

Cross-disciplinary health problems require cross-disciplinary health solutions

Photo: AVMA
Study design

- Cross sectional study of 1000 rural households

**Perceptions**
- water health attributes, livestock waste management, and mitigation strategies relative to water including water testing
- via questionnaire (demographics, agricultural & economic factors, attitudes and beliefs)

- Livestock raised on or very close to half these locations
- Requested participants submit a well *water sample* to AHS
  - Testing for total coliforms and *E. coli*
- Qualitative
  - based on *interviews* with selected participants
Analysis

- **Limited dependent (choice) regression techniques**
  - examine relations between perceptions and mitigation strategies
  - predictors of willingness to test & treat well

- **General hypothesis**
  - residents’ perceptions of livestock as a risk factor has some association with well water mitigation strategies
  - mitigation includes testing of well water
Questionnaires and samples

• Mail out: c. 2200+ questionnaires mailed/ emailed
  • AWWID database
  • Contacts via Working Well/ watershed management group(s)
  • Professional market research firms (limited success)
  • c.20% contacted by email

• Returns:
  • 369 useable returns: 125+ paper returns, 244+ electronic returns
  • 68 livestock owners

• Water test samples
  • 82 submissions (c.22% response based on questionnaires returned)
  • Barriers cited: time of day to submit, perception of “clean” water
  • Only 1 positive for E. coli
Stated satisfied with well water quality (n=86)
Perception: Sick from well water (n=142)

Members of my household have become ill from our well water

Likert scale (low to high)
Stated attitude that participants worry about well water contamination. (results are significantly different by livestock ownership grouping, p<0.01)
Farm ownership and reported testing of wells for bacteria (results are significantly different by livestock ownership grouping, p<0.10).
Reported treatment of wells by farm ownership (results are significantly different by livestock ownership grouping, p<0.05)
Livestock owners more likely to test for bacteria

- Livestock owners = 48
- Non-livestock owners = 43

(p < 0.05)
Livestock owners more likely to treat well water

Livestock owners = 57
Non-livestock owners = 52  (p < 0.05)
Are livestock a source of contamination?

Stated belief that livestock are a source of contamination, sorted by livestock ownership.

(results are significantly different by livestock ownership grouping, p<0.01)
Summary statistics: Manure as a risk factor (n=75)

Rank source of risk wrt manure

- Feedlot ↹ most likely
- Swine farm
- Dairy cattle ranch
- Cow-Calf ranch
- Broiler farm
- Egg layer farm
- Steers on pasture
- Horse ranch
- Wildlife ↹ least likely
Summary statistics: Predictors of mitigation

Choice variable analysis (e.g., logistic regression)

Logistic regression

Log likelihood = -31.692173

| Predictor  | Odds Ratio | Std. Err. | z   | P>|z|   | [95% Conf. Interval] |
|------------|------------|-----------|-----|-------|----------------------|
| Welldrk    | 6.324774   | 5.702466  | 2.05| 0.041 | 1.080426 37.025      |
| Awaregrp   | 7.455302   | 6.195449  | 2.42| 0.016 | 1.462535 38.00357    |
| Chlorwtr   | 3.923368   | 2.698102  | 1.99| 0.047 | 1.019266 15.10187    |
| Lvsntbacgrp| 1.752184   | 1.613481  | -1.89| 0.059 | 0.288243 1.065124    |
| Wellfregrp | 5.664574   | 4.493185  | 2.19| 0.029 | 1.196706 26.8131     |
| Ownfarm    | 0.844169   | 0.7051384 | -0.20| 0.839 | 0.1642165 4.339524   |
| Worrygrp   | 0.373737   | 0.2779752 | -1.32| 0.186 | 0.0869893 1.605707   |
| Genderpart | 0.4690418  | 0.394311  | -0.90| 0.368 | 0.0902878 2.436655   |
| Prevmmngrp | 8.427093   | 8.015468  | 2.24| 0.025 | 1.306332 54.36283    |
| _cons      | 0.0420969  | 0.0625814 | -2.13| 0.033 | 0.0022848 0.7756194  |

Number of obs = 86
LR chi2(9) = 38.45
Prob > chi2 = 0.0000
Pseudo R2 = 0.3776

Dependent variable = stated do test their water
Summary statistics: Predictors of mitigation

Best predictors of likelihood to mitigate well contamination (incl. water testing)

- Owning a farm
- Awareness of hazards
- Believe livestock pose a risk
- Stated contentment with drinking water quality
- History of testing

Weak or non-predictors:

- Children in household (weak)
- Income, education, age
- Method of manure management
Phone calls

• **Qualitative semi-structured interviews**
  - Selected from water management group participants expressing interest in participating
  - Attitudes/ perceptions of water quality, presence & impact of livestock
  - c. 15-20 minute conversation; will have completed up to 20

• **Concerns so far:**
  - “Yes, I’m concerned with my water quality”
  - “I’m not a livestock keeper. I’m kinda concerned that livestock might be a risk factor wrt water contamination.” (and v.v.)
  - “Would be nice if I could go online and track my water test results over time.”
  - “Not enough people know water testing is free (but I do).”
Munene and Hall – Distance from water wells to AHS test centres

- 34% of wells w/i 15 mins drive
- 68% of wells w/i 30 mins drive
- Distance is a barrier to compliance
- Other factors:
  - Convenience
  - Ability to leave farm work
  - Time sensitive
- A GIS technique
Less than half of rural residents test drinking well water

Most rural residents:
• are content with the quality of their drinking well water
• feel there is low risk of microbial contamination
• risk increases with livestock, but can be mitigated

Livestock owners:
• are more likely to test and treat their drinking water
Conclusions

Other:

- **participation in water mgmt. groups** likely increases willingness to test
- **maintaining awareness** of well water testing and maintenance (messaging/ community activities/ prov govt) is important to sustaining preventive measures

- Incorporating testing in **structured livestock manure management programs** may increase participation rates
- affirmation to non-livestock owners of the important role agriculturalists play in mitigating risk of contamination from livestock
University of Calgary
David Hall – animal health, economics and policy
Sylvia Checkley – public health and envl. Epidemiology
Abraham Munene – PhD student

University of Alberta
Norm Neumann – Environmental microbiology, Water quality

Alberta Agriculture and Forestry
Jamie Wuite – On-farm water supply, Technology transfer,
Water policy

Alberta Health Services
ProvLab environmental microbiology

Rural households, Livestock producers, Water interest groups

Funding gratefully acknowledged