

Incorporating multiple scales and perspectives to understand the epidemiology of *E. coli* O157:H7

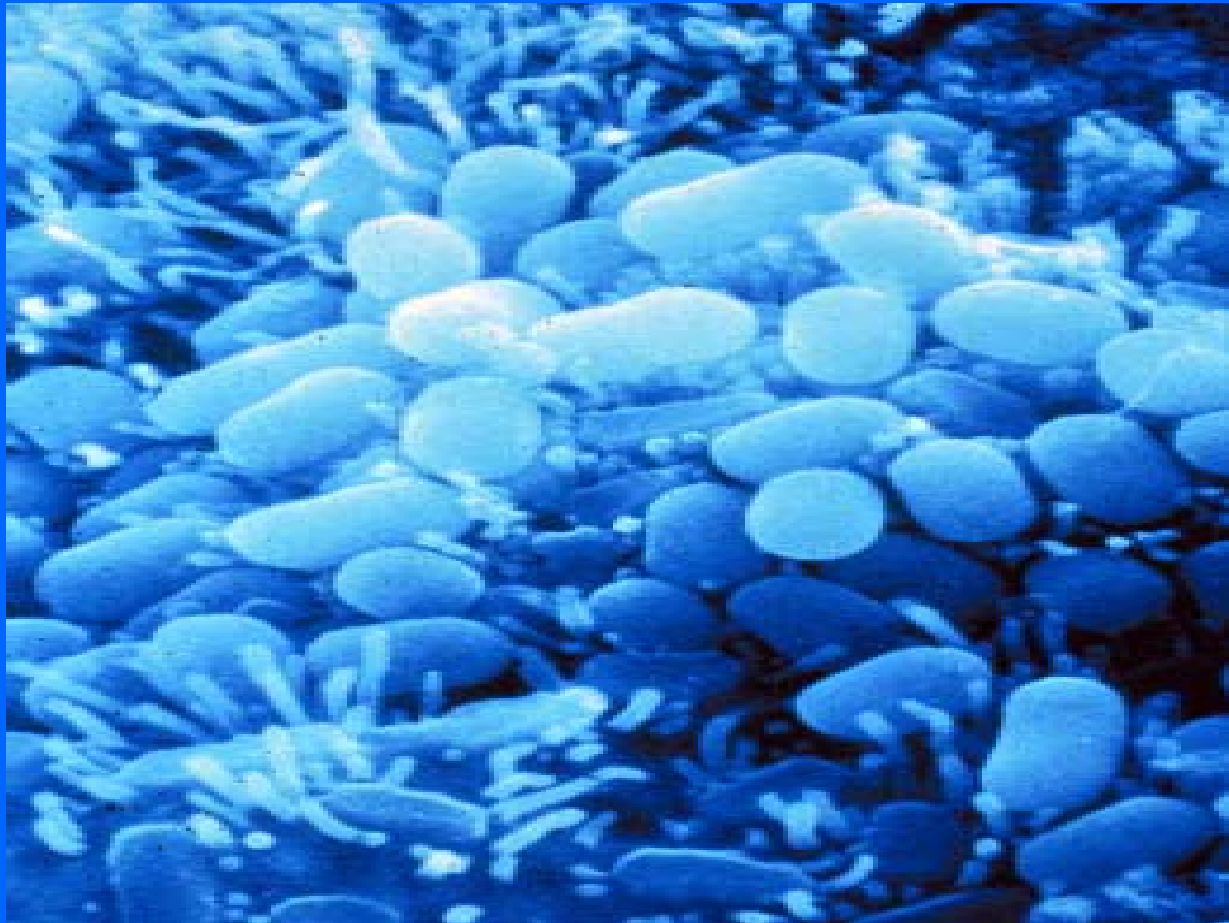


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Outline

1. Epidemiology of *E. coli* O157:H7
2. Scales and perspectives
3. Recent projects:
 - a. Longitudinal feedlot study
 - b. Dairy cattle and starlings study
 - c. Community level risk factors study
4. Challenges for CPHAZ

Epidemiology of *E. coli* O157:H7



Cattle as a Major Source of O157:H7

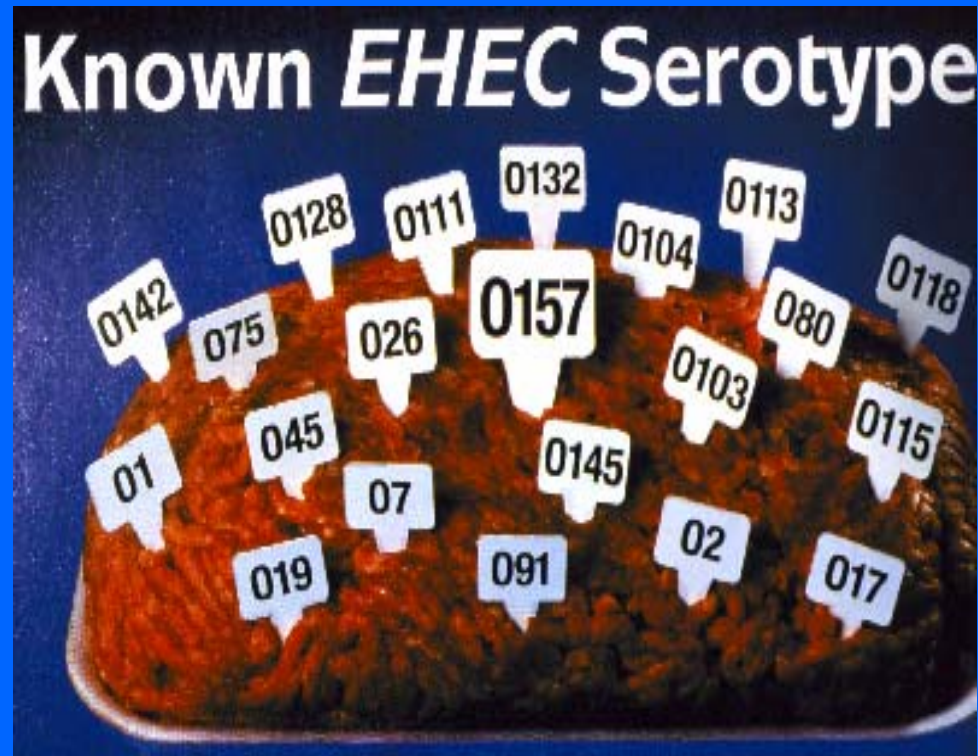
- Cattle recognized as major source (not exclusive).
- Also isolated from flies, dogs, pigs, sheep, deer, wild birds etc.
- Cattle are asymptomatic intermittent shedders.
- Highest shedding in summer (feedlot and dairy) and fall at weaning (cow-calf).

Morbidity in humans

- CDC estimated 73 480 cases/year in the US.
- 1 reported case for 10 symptomatic cases.
- 3-5 cases per 100 000 population.
- Mild diarrhea to hemorrhagic diarrhea to HUS.

More than a “Hamburger Disease”

- Meat (e.g. ground beef)
- Waterborne
- Cross-contamination in food preparation
- Contamination of produce with ruminant feces
- Person-to-person
- Animal-to-person
- Other foods of animal origin
- Environmental contamination

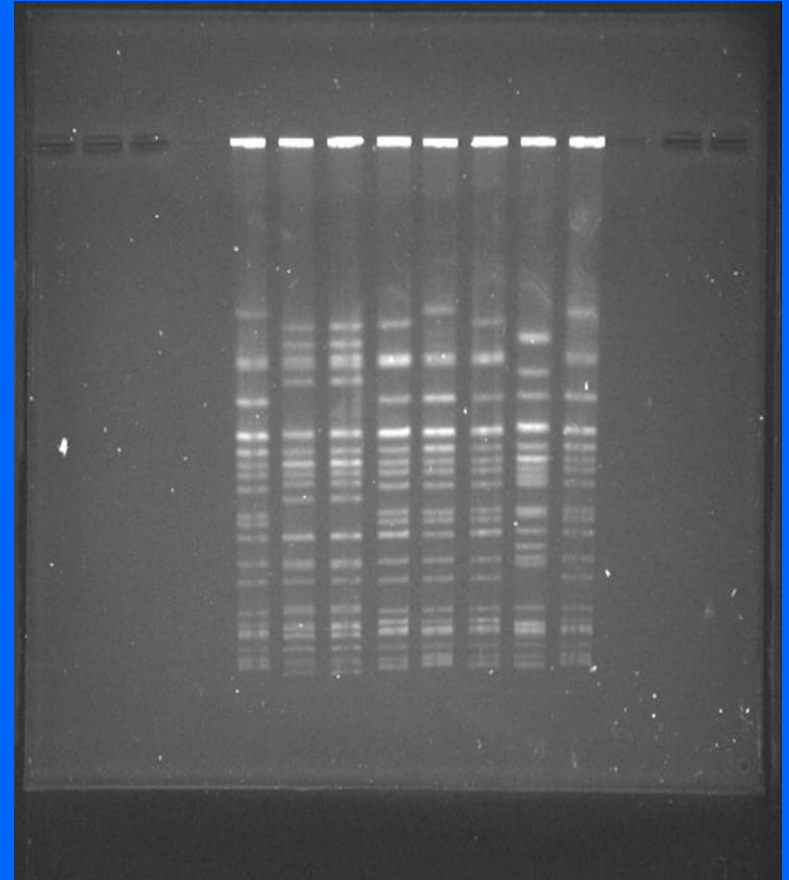


Scales and perspectives



Scales

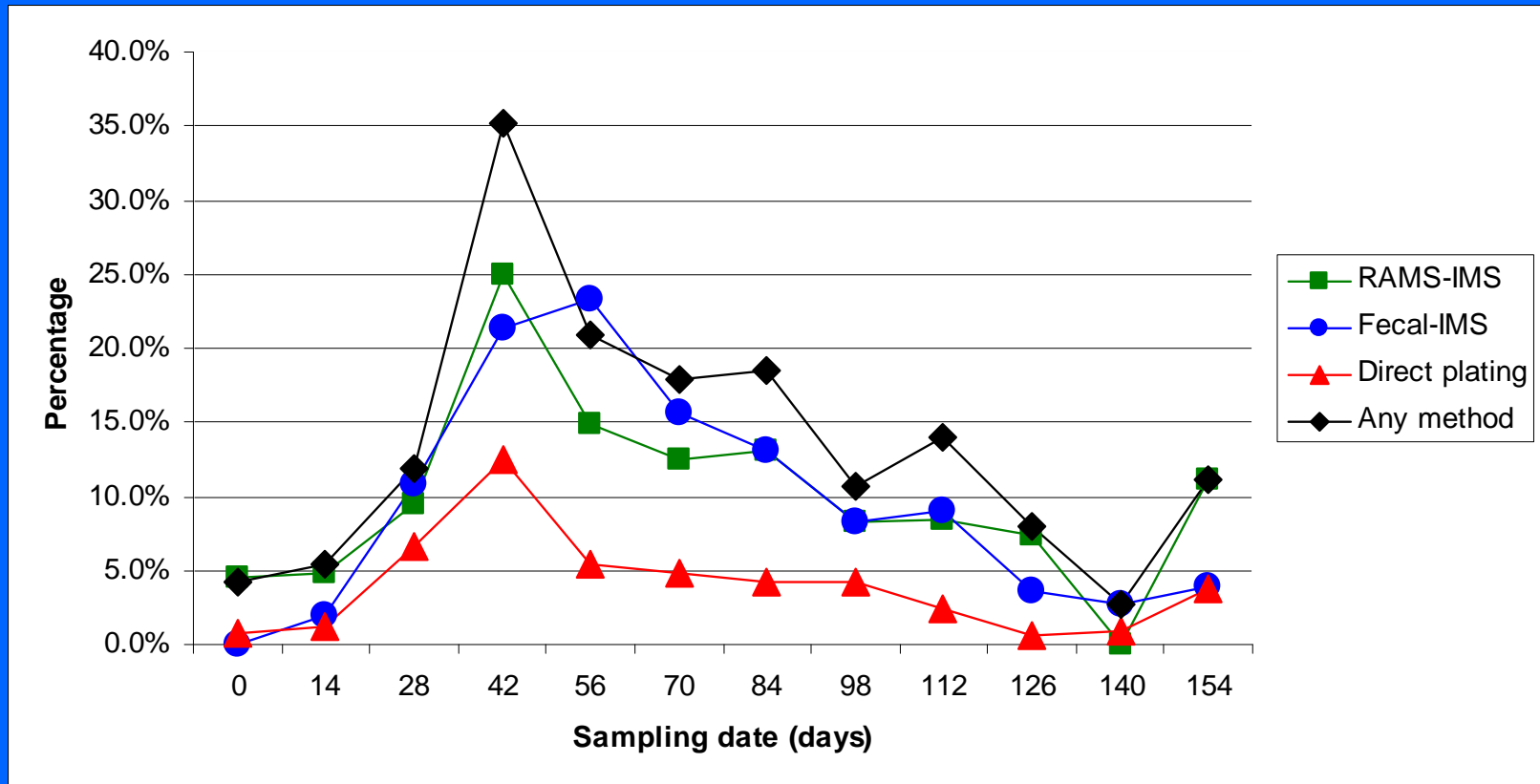
- Molecular –
subtyping (e.g.,
PFGE)
- Animal
- Farm
- Community
- Regional



Perspectives

- Production flow (farm to fork)
- Species affected
- Point in time vs. longitudinal
- Spatial
- Networks
- Wildlife and environmental factors
- Sociological and economic

Longitudinal feedlot study



Study description

- Beef feedlot at OARDC of the Ohio State University.
- 168 angus-cross steers.
- Nov 2005-April 2006.
- 24 pens with various feeds and supplements.
- RAMS-IMS, Fecal-IMS, and direct plating every 2 weeks.
- Mixed logistic regression models that included random slopes to account for repeated measures.

Preliminary results

- 61.9 % of animals were positive on at least one test during the study period.
- 22.6 % were “super-shedders” based on one direct plate with 10^4 CFU/g.
- Several models indicated that a “super-shedding” event increased the odds of shedding among pen mates (Cernicchiaro et al., 2009).
- Molecular data needed to understand change in diversity over time and role of “super-shedders” in affecting other pen mates.

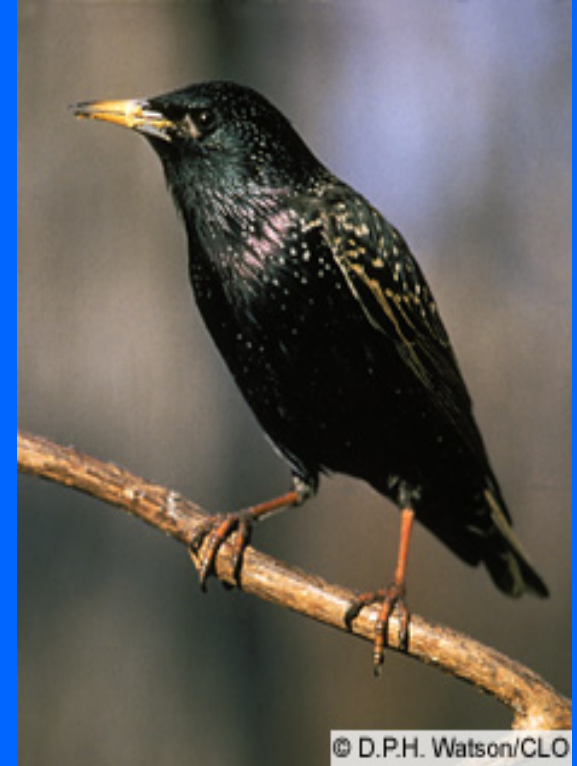
Dairy cattle and starlings study



Study description

Four year study investigating the role of European Starlings in the epidemiology of *E. coli* O157 of dairy cattle :

- a. Experimental studies to look at inter-species transmission.
- b. Radio-tracking studies to understand movement of birds during late-summer.
- c. Feed contamination studies.
- d. Risk factor analysis and molecular diversity studies (MLVA) for dairy cattle and starlings on 120 farms from Wayne and Holmes Counties in Ohio.



Preliminary results

- Proof of principle established for inter-species transmission using genetically tagged strains of *E. coli* O157:H7.
- Radio-tracked birds (n=49) show strong day-to-day fidelity to dairy sites of capture (LeJeune et al., 2008).
- Transit times from roost were rapid, 20 km covered in 20-25 minutes.
- Return transit could take > 1.5 hours with staging areas spaced along their route.
- Night roosts included thousands to millions of birds with some including multiple species.

Community level risk factors study



Study description

- Human reported cases of *E. coli* O157:H7 in Alberta (2000-2002).
- Multi-level Poisson models to determine risk factors for community level rates of disease.
- Examining socio-economic variables at the community-level and cattle density at the county-level.
- Comparing models based on sporadic cases vs. all cases (i.e., sporadic and outbreak).

Results of multilevel model

(Pearl et al., 2009)

Variables	IRR (95% CI)
Cattle/km ² (Q4 v. Q1)*	2.40 (1.16 – 4.98)
MIZ – Strong_Mod	1.45 (0.82 – 2.55)
MIZ – Weak	1.38 (0.77 – 2.50)
MIZ – Non-influenced	4.59 (2.10 – 10.03)
Percent movers	1.26 (1.12 – 1.43)
Percent movers squared	0.996 (0.993-0.999)
High aboriginal pop	0.34 (0.18 – 0.66)

* Statistically non-significant in model using sporadic data.

Challenges for CPHAZ

Addressing multiple perspectives

- Encouraging participation and collaboration from researchers not traditionally involved in health research.
- Integrating studies from across perspectives to promote effective public health policy.
- Identifying gaps in our knowledge and promoting needed research.
- Encouraging the development/application of methods suited for complex relationships.
- Developing strategies for funding interdisciplinary projects.

Collaborating organizations

- University of Guelph
- Public Health Agency of Canada
- The Ohio State University
- United States Department of Agriculture
- Alberta Health and Wellness
- Alberta Provincial Laboratory for Public Health

Questions?