

SPATIAL SCAN STATISTICS AND PFGE: NEW TOOLS FOR THE SURVEILLANCE OF E. COLI O157

***D.L. Pearl¹, M. Louie², L. Chui³, K. Dore⁴, K.M. Grimsrud⁵, D.
Leedell³, S.W. Martin¹, P. Michel⁴, L.W. Svenson⁵, and S.A.
McEwen¹***

¹Dept of Population Medicine, University of Guelph

²Sunnybrook and Women's College Health Sciences Centre, Toronto, Ontario, Canada

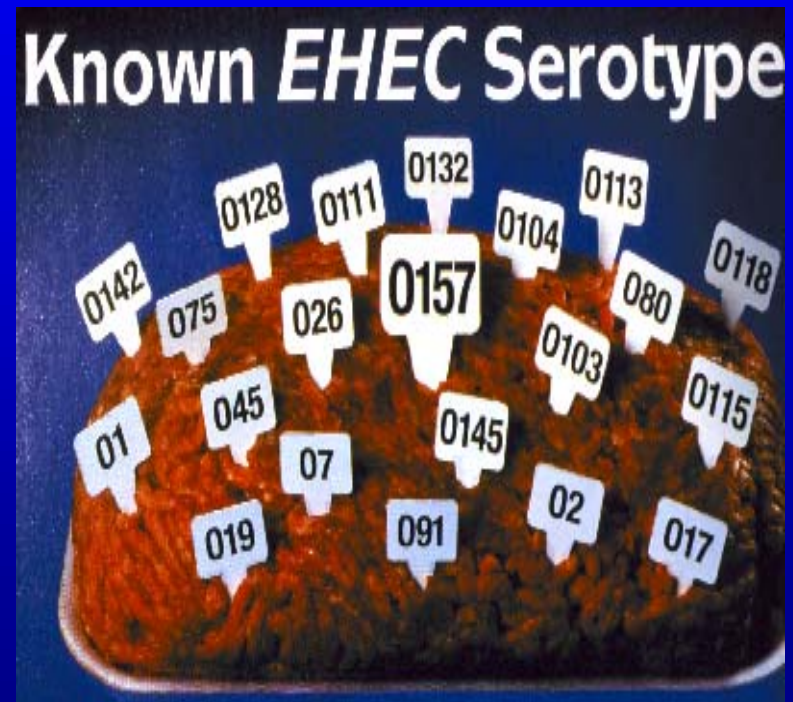
³Provincial Laboratory for Public Health (Microbiology), Edmonton, Alberta, Canada

⁴Health Canada, Guelph, Ontario & St. Hyacinthe, Quebec, Canada

⁵Alberta Health and Wellness, Edmonton, Alberta, Canada

Pathogenesis and Epidemiology

- Cattle reservoir – asymptomatic shedders
- Gastroenteritis, hemorrhagic colitis, hemolytic uremic syndrome
- Rates highest in children less than four
- Food, water, environment, and contact with shedders





Yukon

North-
west

Territories

Nunavut

British
Columbia

Alberta

Saskat-
chewan

Manitoba

Ontario

Québec

Newfoundland

PEI

New
Brunswick

Nova
Scotia

E. coli O157 & Alberta

- Crude rate higher than national average
- > 9 cases/100 000 from 2000-2002
- Six outbreaks reported to Laboratory Centre for Disease Control & over 50 household outbreaks from 2000 – 2002

Research Questions

- 1) Is the rate of disease statistically higher in southern communities (i.e. spatial clusters)?
- 2) When are disease rates highest (temporal clusters)?
- 3) Are “occult outbreaks” present in Alberta (spatio-temporal &/or temporal clusters)?
- 4) Can PFGE help us validate statistical approaches for identifying “occult outbreaks”?

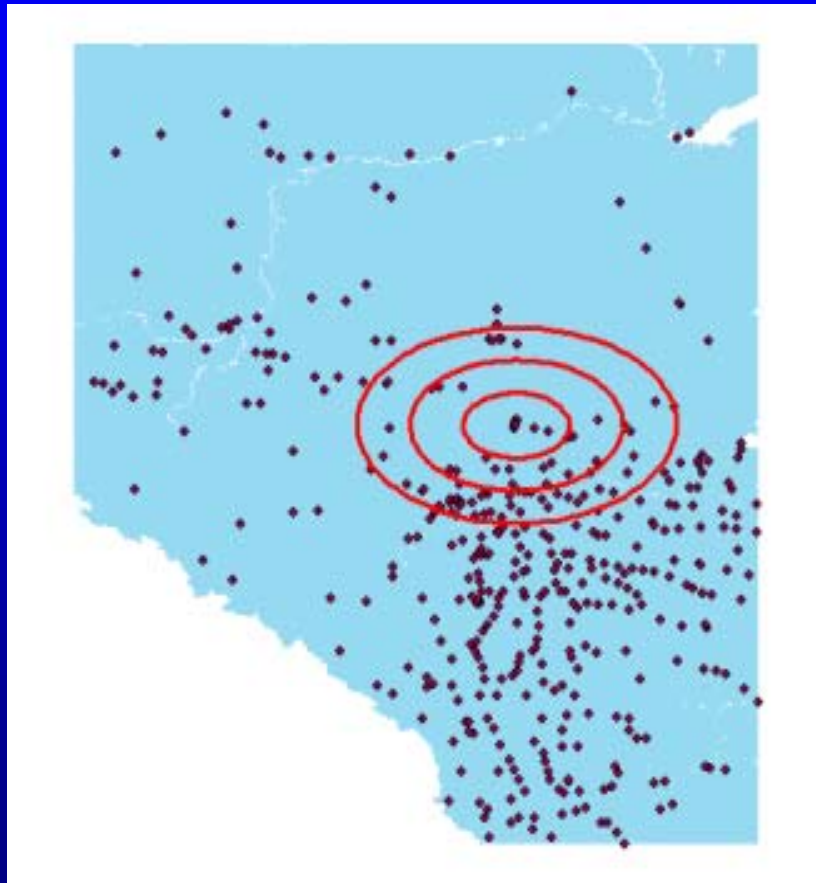
Data from Alberta 2000-2002

- 876 cases recorded by passive surveillance
- 651 human cases examined using PFGE
- 2001 Canada Census for background population and location of CSD centroids
- Postal code conversion file with manual corrections

Issues in Quantifying Clusters

- Need to correct for background population size and demographics
- MAUP & MTUP problem lead to pre-selection bias
- Multiple testing problem

Kulldorff's SaTScan Solution

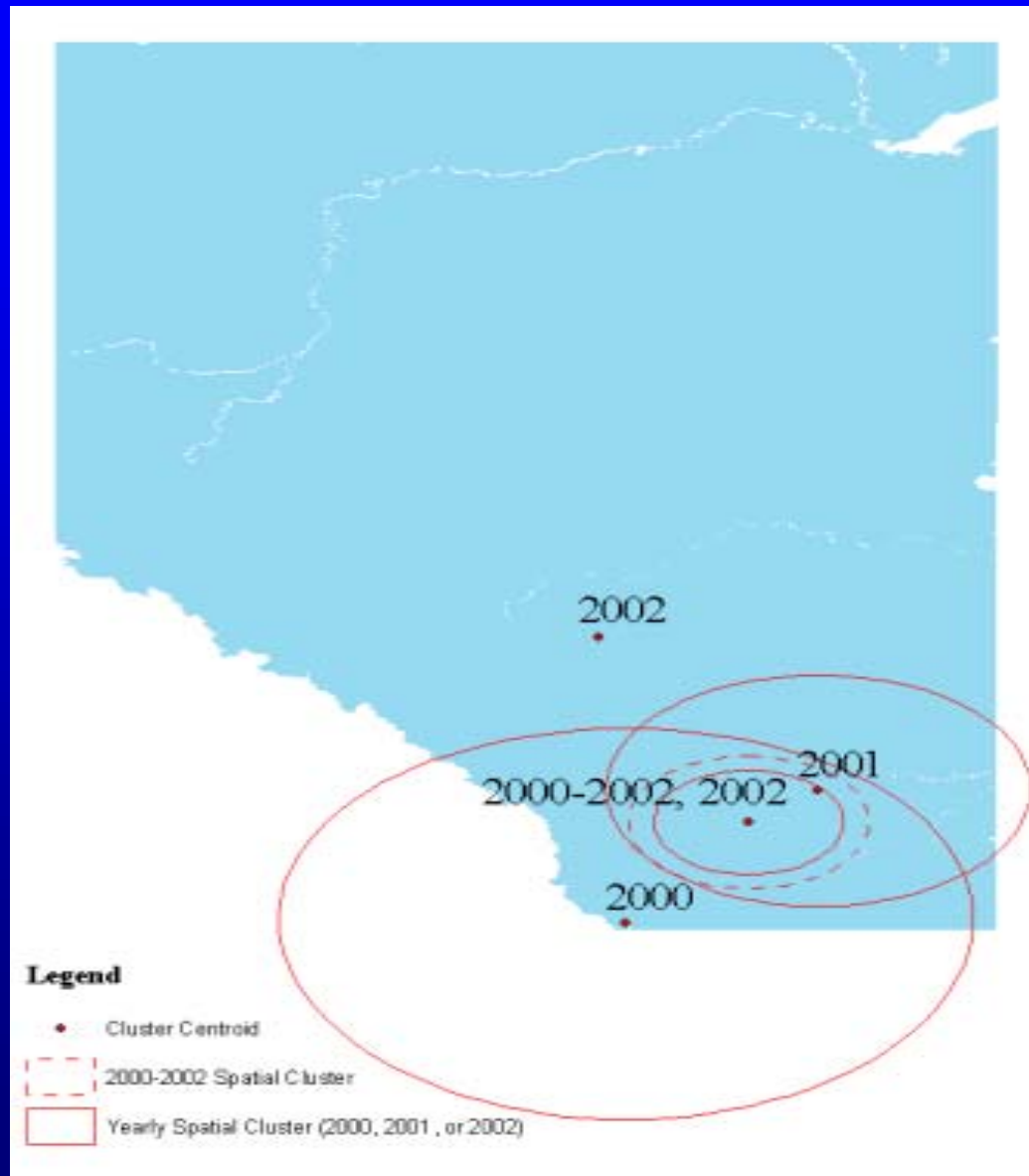


- 1) Scan: space, time, or space-time
- 2) Relative risk*
- 3) Likelihood ratio test based on appropriate model
- 4) Monte Carlo simulation to calculate p-value
- 5) 1 or 2 tailed

SaTScan 3.1.2 Models

- 1) Bernoulli (case & non-case data)
- 2) Poisson (case and population counts)*
- 3) Space-time permutation (case only)*

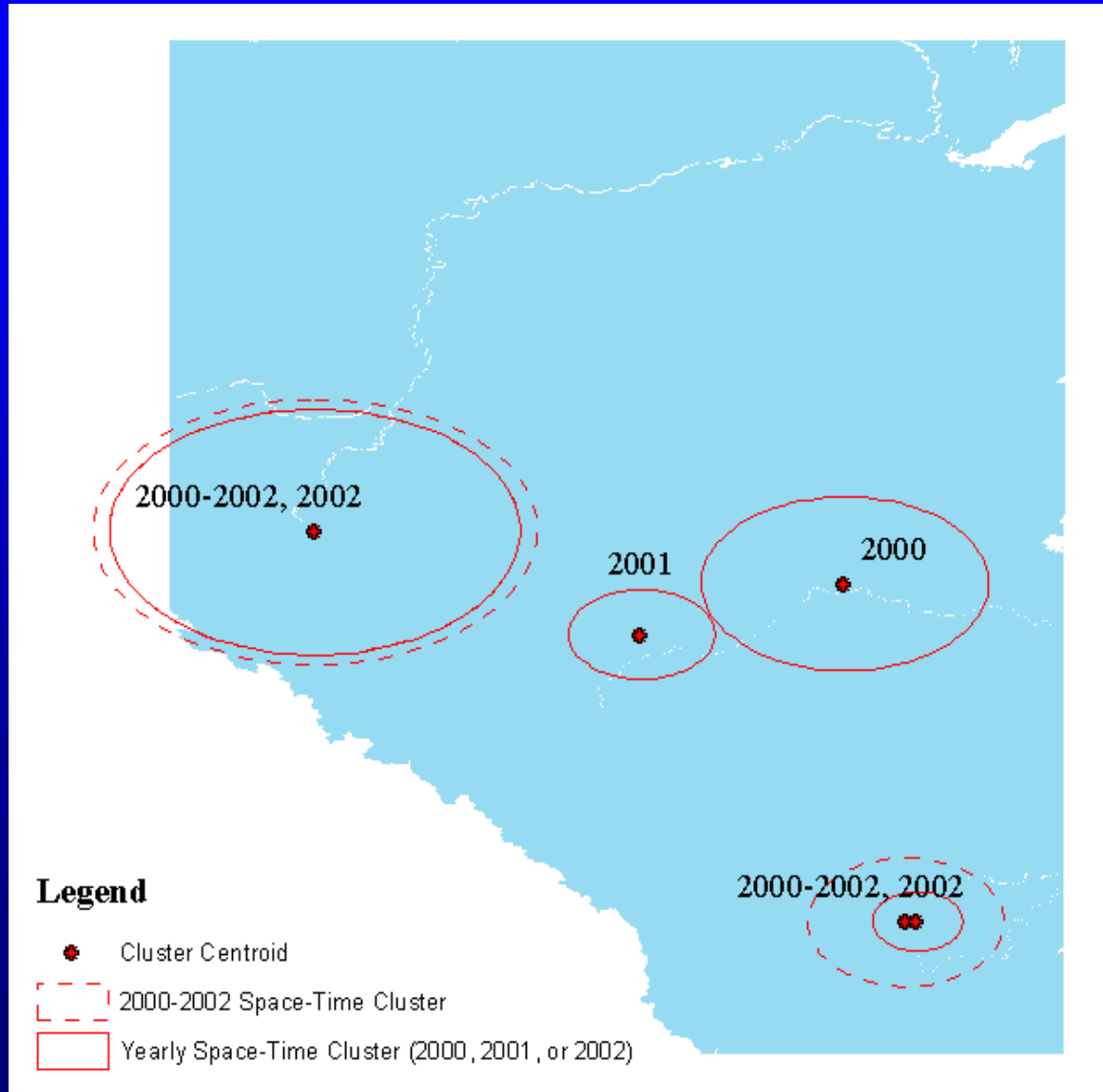
Spatial Clusters



Temporal Clusters

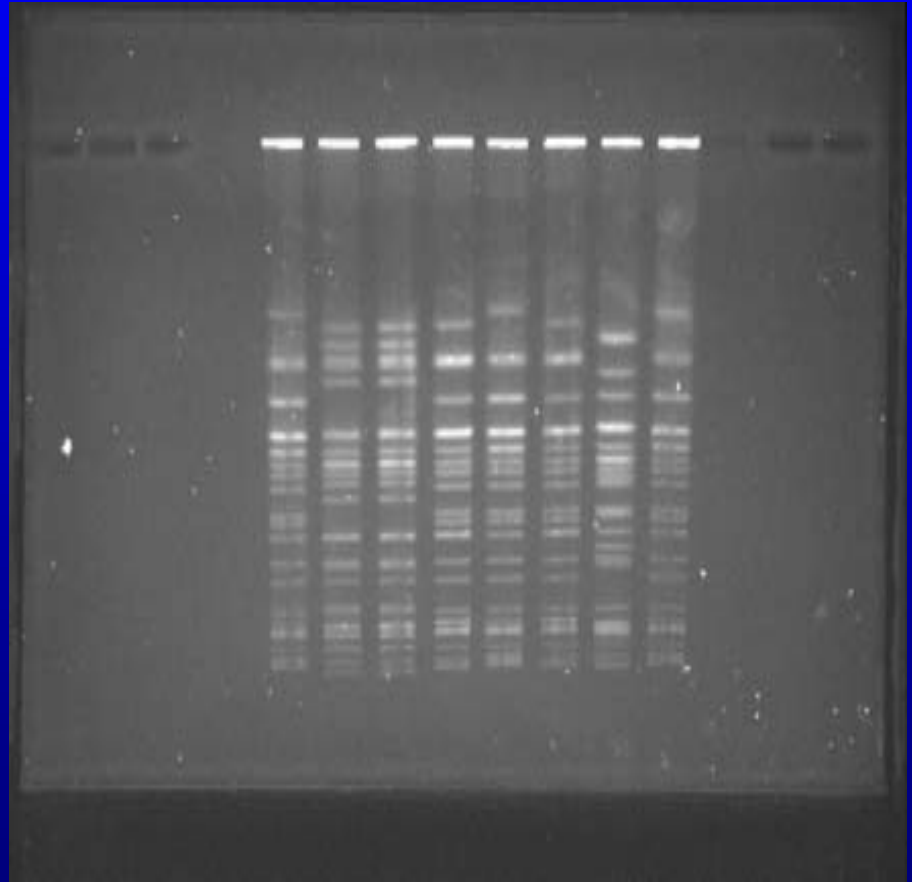
<i>Period Scanned</i>	<i>Cluster Period</i>	<i>Relative Risk*</i>	<i>P-value</i>
2000 - 2002	May 27/00 – Sep 27/00	2.43	0.0001
2000	May 27/00 – Oct 15/00	2.03	0.0001
2001	Jun 1/01 – Sep 3/01	2.37	0.0001
2002	May 6/02 – Aug 16/02	2.22	0.0001

Spatio-Temporal Clusters



Molecular Similarities if Multiple Patterns

- Method: PFGE
(fragment based analysis)
- PulseNet protocol
- Bionumerics 2.5
- Mean Dice Scores
(89.94%, SD = 2.48%)



Similarity Matrices

#	<i>2</i>	<i>109</i>	<i>340</i>	<i>341</i>	<i>341</i>	<i>341</i>	<i>341</i>
<i>2</i>	100						
<i>109</i>	89	100					
<i>340</i>	78	76	100				
<i>341</i>	90	88	85	100			
<i>341</i>	90	88	85	100	100		
<i>341</i>	90	88	85	100	100	100	
<i>341</i>	90	88	85	100	100	100	100

Statistics of Dice Scores

- Randomization / Monte Carlo tests
- Which period for comparison?

Summary

- 1) Disease rate is statistically higher in the south, but exact location may vary among years
- 2) Highest rates of disease in the summer
- 3) Scan statistics may be useful for finding “occult outbreaks” and auditing surveillance programs
- 4) PFGE as a validation tool

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