Reducing *Escherichia coli* O157 risk in rural communities

Microbial persistence, public awareness, immunity, risk assessment, cost of infection and acceptability of interventions

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Aims of the talk

• Present an overview of findings from the RELU *E. coli* O157 risk research project
• Discuss in more detail findings of particular interest to ACMSF
The problem as we saw it 2007

- *E. coli* O157:H7 resides in the gut of ruminants without effect.
- Excretion rates $1 - 10^5$ cfu g$^{-1}$ faeces
- About 200 cases/yr in Scotland and 1,000 in England & Wales
- Disease can be severe: bloody diarrhoea, Haemolytic Uraemic Syndrome, death
- Young children, the elderly and people living in rural areas are at greatest risk
Research approach

- Six discrete work packages
- Integration of social and natural sciences
- Comparison of north Wales and Grampian
- Engagement of stakeholders
- Intervention focus
Survival in soil

No differences between soil types (8 tested)

Survival

Decreased rapidly during first 7d
then relatively constant until end of experiment (120d)

Reactivates within 9 hours
more strongly at lower temperatures
Public awareness

- Survey by questionnaire: 2031 respondents
- 2 study areas: Grampian and north Wales
- 4 groups: farmers, residents, visitors, abattoir
- 53 interviews with stakeholders
<table>
<thead>
<tr>
<th>Source</th>
<th>% cases (95% CI)</th>
<th>% cases (95% CI)</th>
<th>% likely (95% CI)</th>
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</thead>
<tbody>
<tr>
<td><strong>GRAMPIAN</strong></td>
<td></td>
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<tr>
<td>environment</td>
<td>65.8 (49.6 – 82.0)</td>
<td>56.1 (52.2 – 60.1)</td>
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<tr>
<td>food</td>
<td>26.9 (11.0 – 42.8)</td>
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<tr>
<td>water</td>
<td>7.3 (0.0 – 16.0)</td>
<td>9.9 (0.0 – 11.1)</td>
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<tr>
<td>person to person</td>
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<tr>
<td><strong>NORTH WALES</strong></td>
<td></td>
<td></td>
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<tr>
<td>environment</td>
<td>21.9 (9.3 – 34.5)</td>
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<td></td>
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<tr>
<td>food</td>
<td>62.6 (48.0 – 77.2)</td>
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<tr>
<td>water</td>
<td>15.5 (9.7 – 21.3)</td>
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</table>
Public awareness

The graph shows the frequency of various symptoms reported by different groups of people. The symptoms include:

- Vomiting
- Stomach cramps
- Watery diarrhoea
- Bloody diarrhoea
- Sweating
- Fever
- Headache
- Tiredness
- Don't know
- Aching joints
- Loss of balance
- Severe back pain
- Sore throat
- Runny nose
- Red skin rash
- Itching eyes

The graph compares the frequency of these symptoms between all respondents, Farmers from Grampian, and Visitors. The symptoms are ranked from the least to the most frequently reported, with circles highlighting the top three symptoms in each category.
Being ill from *E. coli* O157

Are you concerned about *E. coli* O157?  
[ ] Yes  [ ] No  

If you are concerned about *E. coli* O157 please explain what concerns you:

What concerns me as a livestock producer most is the fact that we can’t detect by looking at a beast whether it has O157 or not. And yet we are expected by the F.S.A. and other to endanger our lives. Belly clipping etc. for purely cosmetic reasons in order to market the Ecoli bugs. Rule on the site after we have clipped and in fact we make it worse by clipping as the beast gets covered up and start shedding and cornering the beam with white. No one at F.S.A. or HSE gives a damn.

How seriously ill do you think you would be if you were infected with *E. coli* O157?  
[ ] not at all ill  [ ] mild illness  [ ] serious  [ ] very serious  [ ] don’t know

Which of the following do you think are symptoms of an *E. coli* O157 infection?  
[ ] severe back pain  [ ] headache  [ ] aching joints  [ ] loss of balance  
[ ] vomiting  [ ] sweating  [ ] red skin rash  [ ] runny nose  
[ ] sore throat  [ ] tiredness  [ ] itching eyes  [ ] fever  
[ ] stomach cramps  [ ] bloody diarrhoea  [ ] watery diarrhoea  [ ] don’t know

Describe your attitude to *E. coli* O157:

A very serious problem that is being attacked from the wrong place as usual, why are we so bloody back-ended in this country that we don’t insist on steam sterilization of carcass in our abattoirs? Why do the F.S.A. or called experts not check clean beast hide for Ecoli? Why was Prof. Perrington not challenged over his stupid and misguided belly-clipping report??
Communicating *E. coli* O157 rural risk

**VIRULENCE**
- Toxin genes - \( vt1, vt2 \)
- Attaching genes *eae*
- Non O157 VTEC

**MORPHOLOGY**
- Rod shaped bacterium
- One or more polar flagella
- Gram negative
- Facultative anaerobe

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**Child dies from *E. coli* infection**

A two-year-old child has died after contracting the *E. coli* O157 infection.

The girl, from Ballantrae, in South Ayrshire, died at the weekend after being taken to the Royal Hospital for Sick Children in Glasgow.

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**South Wales *E. coli* Outbreak**

**Guilty plea 'long overdue'**
Mother of victim welcomes butcher 'guilty pleas'

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**Godstone Farm**

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**Wishaw 1996**
**New Deer 2000**
Immunity

Serum antibody levels to *E. coli* O157

- Farm workers and their families from Norwich, Hereford, Preston (2000): 3%
- RELU study (2010) four groups (farmers, abattoir workers, rural and urban residents) 541 tested of which 27 were positive.
1. The human incidence of *E. coli* O157 infection is 4.3 fold higher in Grampian than North Wales.

2. The ratio of rural to urban cases is the same in Grampian (2.0) as it is in North Wales (2.3).

3. The relative proportion of cases associated with Food or Environment is higher than for Water.
The predicted mean number of cases attributed annually by transmission pathway in Grampian*.

<table>
<thead>
<tr>
<th>Risk Factors</th>
<th>Percent cases attributed (95% CI)</th>
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<tbody>
<tr>
<td>Regression</td>
<td>26.9 (11.0 – 42.8)</td>
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<td>Model</td>
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<tr>
<td>Risk</td>
<td>7.3 (0 -16.0)</td>
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<td>Assessments</td>
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*Important caveats
- model assumptions
- over-prediction by risk assessment
The efficacy of risk mitigation strategies suggest that:

**Food (burgers)**
- Proper cooking is required
- Removal of high shedding animals from the food chain

**Environment**
- Banning camping on fields recently grazed by cattle.
- Mitigations involving hand washing, reducing prevalence/concentration shed, keeping animals off pasture prior to visit

**Water**
- increasing proportion of PWSs treated
- Banning PWSs in areas with high cattle & sheep densities
Combining lay and technical views of risk.

1. Higher level of lay knowledge of *E. coli* O157 was claimed in high incidence disease areas.

2. Personal likelihood of infection was the same in high and low disease incidence areas.

3. Food and environment ranked as higher risk than water in agreement with technical risk assessment.
So far, we have collected data from 42 cases. The costs estimated from those who participated in the questionnaire survey were (cost per case): 

- **NHS costs**: £4,413  
- **Personal costs (direct out-of-pocket)**: £38  
- **Lost employment costs (opportunity costs)**: £1,543  
- **Total cost for Acute Phase**: £5,994

- **Total estimated cost for England and Wales**: £7.2 million

There was one HUS case amongst recruited cases – not necessarily representative of HUS cases; costs of this were added to total; 

We have estimated the number of severe cases from the literature and estimated the cost of £17,661 (discounted value) over 30 years per cohort case by up dating costs of cases in Roberts and Upton, 2000 to present day prices 

Costs of E.coli O157 to public and environmental establishments is being investigated and will be reported later
Is E coli a significant concern?

Consultation process with farmers and public
Practicality & Effectiveness of Measures to Reduce E coli O157 risk

many potential measures
+ absence of hard evidence on measures
+ a (perceived) need to act

= a problem
Practicality & Effectiveness of Measures to Reduce E coli O157 risk

Identify best candidate measures:

highly effective

+ highly practical
Consultation & Elicitation Process

Round 1
Identified 100 measures
Contacted 53 experts
Shortlist of 30 measures

Round 2
Contacted 70 experts
Survey on 30 measures’ Practicality & Effectiveness

Round 3
Farmers complete surveys:
Practicality: 112 Farmers
Effectiveness: 90 Farmers
Effectiveness of Measures to Reduce O157 Risk

cattle vaccination

septic tank maintenance
Practicality of Measures to Reduce O157 Risk

- Pre-slaughter removal of high shedders
- 4 weeks spreading interval before recreation
Consultation & Elicitation Process

Combine

Experts’ Effectiveness scores

with

Farmers’ Practicality scores
animals away from PWS
dry bedding
clean water troughs daily
cohorts
dbl/fence
ban untreated abattoir waste
septic tank maintenance
monitor PWS
hand washing
cattle vaccination
The situation as we see it  2010

- Environment and food are more significant sources than private water supplies
- Public awareness of bloody diarrhoea as a symptom is low
- No single ideal intervention identified by expert elicitation
- Working on costs of infection versus costs of mitigation
- Young children could be focus for risk governance
The RELU team

Acknowledgements:

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