REDUCING *ESCHERICHIA COLI* O157 RISK IN RURAL COMMUNITIES:

INTEGRATING EVIDENCE FOR POLICY

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Aims of the talk

- To present a brief overview of the project
- To describe the integration of project findings
- To describe the who, what and how of research evidence for policy
- To initiate discussion on the common challenges of integration of evidence for policy
The scale of the problem

- *E. coli* O157:H7 can reside in the gut of cattle and sheep without any observable effect.
- Faecal excretion rates typically range from $1 - 10^5$ cfu g$^{-1}$ faeces.
- In Scotland there are c. 200 - 300 human cases annually and in England & Wales approx 1000.
- Disease can have severe symptoms e.g. bloody diarrhoea, HUS and occasionally death.
- Young children, the elderly and people living in rural areas are at greatest risk.
Approach

• To tackle the problem through a number of discrete work packages
• Integration of social and natural science approaches
• The study areas are North Wales and the Grampian region of Scotland
Structure of the project

- Work Packages
  1. Evaluation of E. coli O157 carriage within rural communities
  2. Modeling E. coli O157 survival with ingenuity
  3. Risk assessment modeling & initial mitigation strategy
  4. Economic cost of impacts and intervention
  5. Testing initial risk management strategies: social and economic impact
  6. Evidence-based policy formulation and dissemination
Regulators - DEFRA, SEERAD, EA, SEPA, DH, FSA, Local Authorities

Land users - farmers, contractors, forestry, tourists, NFU, NUFL

Food industry - abattoirs, supermarkets, catering contractors, butchers, meat processing, QMS

Environmental and tourism NGAs - SNH, CCW, Natural England, Tourist boards

Education - Education authorities, Schools

Communicators - Media (TV, newspapers, radio, etc), opinion formers

Consumers - Public

Work Packages

1. Evaluation of E. coli O157 carriage within rural communities
2. Linking E. coli O157 survival with infectivity
3. Risk assessment modelling & initial mitigation strategy
4. Economic costs of impacts and intervention
5. Testing initial risk management strategies; social and economic impacts
6. Evidence-based policy formulation and dissemination

Key Deliverables

Integration

Critical data on persistence, transmission, infectivity
Risk Assessment maps and socio-economic models
Predictive modelling across agroclimatic and edaphic ranges

Figure 1. Schematic representation of our integrated RELU project. We include the range of stakeholders to be engaged in this project and required to affect rural management and policy change linked to minimizing risk associated with E. coli O157
How the bits fitted together
QMRAs - Cattle Camping

- Vaccinate cattle to control pathogen colonisation and faecal excretion of E. coli O157.
- Remove high shedding animals prior to slaughter (possibly using some form of cow-side test).
- Remove farm animals from proximity of private water supplies (e.g. at least 50m from well, borehole or other water source).
- No slurry or livestock manure to be applied to high risk fields (i.e. high risk of transport into adjacent areas).
- Monitoring of private water supplies to identify those with either high indicator counts, or those in areas of high disease risk.
- Encourage farmers and farm visitors to wash hands following contact with farm animals.
- Prevent children under the age of 11, and other vulnerable groups, coming into contact with animals at petting farms.
- Prohibit recreational activities (such as walking and camping) to land where manure, slurry or abattoir waste is applied.
- No application of manure to land at high risk of direct flow to watercourses (e.g. adjacent to a watercourse).
- Locate solid manure heaps and slurry pits at least 50m away from watercourses, field drains and ready-to-grow crops.
- Only treated or batch stored solid manures and slurries should be applied to land before draining planting.
- No application of manure to ready-to-eat crops within 12 months of harvest and 6 months of drilling/planting.
- Select randomly a property on PWS.
- Determine the number of cattle/sheep in the proximity of PWS.
- Calculate bacterial ratio in faeces:
  \[ R = \frac{\text{Average conc. of } O157}{\text{Average conc. of } E. coli} \]
- Calculate Concentration of O157 in water:
  \[ CO157 = R \times C_{E. coli} \]
- Select a random positive E. coli concentration from a PWS.
- Determine the number of O157 in a glass of water.
- The dose response generates the probability of illness:
  \[ Pill = \frac{Y e s}{S T A R T} \]
  \[ N o \]

- Spring: 9/138
- Summer: 3/23
- Autumn: 2/33
- Winter: 3/181

Intervention Average | Intervention description
--- | ---
19 | 9.04
3 | 7.85
2 | 7.52
13 | 6.30
6 | 6.02
11 | 5.87
4 | 5.03
8 | 4.56
9 | 4.23
23 | 4.22
22 | 4.12
7 | 3.53
20 | 3.33
2 | 3.30
16 | 3.12
14 | 1.66
10 | 1.47
30 | 1.20
24 | 1.10
17 | 1.06
18 | 0.58
12 | 0.55
28 | 0.54
WP6 Evidence for policy: the process

- Researchers carry out work

- Condense into WP pro-forma
  - Iterative process

- Accept by WP6

- Integrate all six WPs pro-formas
  - Iterative process

- Communicate with policy
  - Iterative process
Proforma headings

- Findings
- Confidence, error estimates
- Meanings
- Policy implications
- Trade-offs, practicality
- Annexes detailed data
Excerpt from WP2 pro-forma: Persistence of *E. coli* O157 in 8 soil types

- O157 persists in soils for 120d, reactivates in 5-9h
- P < 5%; soil microcosms in triplicate
- O157 from soil can potentially reactivate in the human gut
- Code of good agricultural practice for farmers, growers and land managers
- Field conditions more complex than soil microcosms in the laboratory
- Annex contains data on persistence, metabolic activity, soils etc
Excerpt from WP1a pro-forma: Stakeholder perceptions of risk

- Visitors view O157 as a food hazard not as a dysentery associated with cattle
- 573 respondents described how they reduced their risk of illness from O157
- Visitors in rural areas are naïve
- Public access and land management
- Trade-offs, practicality, tourist economy
- Annex contains 59,201 words and 50 hours of interviews
E. coli O157 and Policy events

JSAC/SE Joint Task Force on E.coli O157
Membership and Consultation Process

Structure of task force
- Chair: appointed by Marnie
- Core participants appointed by the Minister for working and supporting delivery options
- Non-core participants are invited to contribute
- Secretariat to co-ordinate working arrangements

Working practices
- Commence from evidence published at the E.coli O157 forum on 28 June 2000
- Invite participants (and make committee on paper) to provide relevant supplementary evidence
- Submitted evidence to be collated and sent out for FSA web site
- Feedback from being considered and used.
- Opening meeting for all participants in late September
- Sector meeting in autumn (October) and to (November)
- Sector meeting in spring (April) and to (May)
- Concluding meeting in early June to late June
- Expert group will meet about their respective day (no minimisation and duplication) but they can welcome other sector dates, if necessary
- Individual Sector groups will be offered a contact
- Use of web site and exchange of papers, by e-mail or electronic conferencing as agreed to ensure continuous communication

Opportunities
- Aim for practical action points
- Sector LEA: SE relevant thinking, taking two complete, whole-focused zone into new zones
- LEA: develop the bigger picture beyond food
- Process: Joint and government FSA, SE and Wh pulled
- Formalising the need to integrate work
- Plan: though need for advice and education to public and others

Standards / Barriers
- Undertake study of emerging concerns of patient support groups
- Underestimation of second tier outcomes being, low sector approach
- Tensions between core group working and wider context: create and maintain a balance
- Amounts of money to be provided and negotiated, but meetings not to be too large
- Potential consequences for policy, legislation, advice and resources.
Who to communicate with in policy?

- Two way process – who can we communicate with who has access to policymakers? – appropriate for our ‘purpose’
- Purpose defined as the communication of scientific findings/knowledge which the evidence shows to have *added value* in *reducing cost/impact/incidence/severity*? in a regulatory/policy domain
- Advisory and Standing Committees/Experts
- FSA (Food Standards Agency), ACMSF (Advisory Committee on the Microbiological Safety of Food) DEFRA (Department of the Environment Food and Rural Affairs)
- National Farmers Union, Quality Meat Scotland
- Public Health
What

• What is the evidence that shows scientific provenance for the ‘added value’ that our findings can offer?
• How to collate/integrate it?
• Proforma of proformas-each WP; key points selected and summarised.
• Key information that stakeholders require (info already cut)
• Do they need to do something about it?
• What is it that they can do about it?
• Iteration?
How

• Frameworks (Textual): Proforma of proforma, DPSEEA model, Renn IRGC framework
• Device (Tool) e.g. Graphs- Spider diagram (trade-offs); graphs (practicality vs effectiveness)
Two-axis framework for intervention

- Expert-elicited effectiveness and practicality
- QMRA quantitative microbial risk assessment

- Cost of intervention
- Savings by morbidity reduction
- Probability of morbidity/mortality
- Virulence of E. coli O157*
- Practicality of intervention
- Susceptibility population Ig*
- Protective behaviour population*
Four-axis framework
Toolkit and visualisation of faecal indicator organism loss on farms

Oliver et al. 2009 ‘Sustainable and Safe Recycling of Livestock Waste’ RELU

The plotted coordinates and colour of the polygon represents the overall riskiness in this case ‘high’

Transfer potential

Obstacles

Infrastructure

E. coli burden

Shape denotes importance of individual factors and this visualises types of mitigation that might take place
How

• Frameworks (Textual): Proforma of proformas, DPSEEA model, Renn IRGC framework
• Device (Tool) e.g. Graphs- Spider diagram (trade-offs); graphs (practicality vs effectiveness)
IRGC’S Risk Governance Framework

Getting a broad picture of the risk

Who needs to do what, when?

Who needs to know what, when?

Is the risk tolerable, acceptable or unacceptable?

The knowledge needed for judgements and decisions

Communication

Pre-assessment

Management

Characterisation and evaluation

Appraisal
Pre-Assessment

1. Problem Framing

<table>
<thead>
<tr>
<th>Illness Prevention</th>
<th>Individual Sovereignty</th>
</tr>
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<tbody>
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<td>Zero tolerance</td>
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2. Early Warning/Screening
- Outbreaks (Godstone Farm, New Deer Scout Camp etc.)
- HUS surveillance / GI pathogen surveillance in stool samples (clinical/GP)
E. coli outbreak: Another child in hospital

Fourteen children are now being treated in hospital after an E. coli outbreak at a petting farm, the Health Protection Agency has said.

The agency said 10 of the children, who were aged between 1 and 17 years old, had been hospitalised and three had been treated at home.

The outbreak came to light after the death of a girl aged three, who was treated at the Royal Hospital for Sick Children in Glasgow.

The agency said it was still investigating the outbreak and had not yet confirmed that the E. coli strain was responsible.

The children were being treated at hospitals across the UK, including the Royal Hospital for Children in Belfast, the Royal Manchester Children's Hospital, the Royal London Hospital and the Royal Hospital for Sick Children in Edinburgh.

The agency said it was carrying out a thorough investigation to determine the cause of the outbreak.

It said it was important for people to be aware of the symptoms of E. coli and to seek medical advice if they had any.

"E. coli can cause a range of illnesses, from mild milder symptoms to more serious conditions like meningitis," the agency said.

The outbreak was the latest in a series of E. coli outbreaks in the UK in recent months.

In August, a child was hospitalised after an outbreak at a petting farm in Oxfordshire.

In July, a child was hospitalised after an outbreak at a petting farm in Scotland.

In June, a child was hospitalised after an outbreak at a petting farm in Wales.

The Health Protection Agency said it was continuing to monitor the situation and would provide updates as necessary.

In a statement, the agency said: "We are monitoring the situation closely and will keep this page updated with any new information."
Pre-Assessment

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2. Early Warning/Screening
- Outbreaks (Godstone Farm, New Deer Scout Camp etc.)
- HUS surveillance / GI pathogen surveillance in stool samples (clinical/GP)

3. Determination of Scientific Conventions
- Risk Assessment (Epidemiology, microbiology methods etc.)
- Concern Assessment (Valid & reliable methods for measuring perceptions & concerns)
Risk Appraisal

1. Risk Assessment

*Epidemiology (WP3)*
- Rare but severe disease
- High incidence in rural areas & young children

*QMRA*
- Exposure assessment (RELU PhD)
- Survival/infectivity in the environment (WP2)
- Human immunity/susceptibility (WP1b)
- Dose response
- Estimation of risk (WP3)

2. Concern Assessment (WP 1b)
- aware of it: visitors 35%; farmers 75%
- concerned about it: less than 50%
- concern for risk of illness in family was independent of pathogen
- farmers particularly concerned for their children

3. Socio-economic Impacts (WP 4)
- Health care/ Social costs
- Costs to industry/ regulatory authorities
Characterisation and Evaluation

Acceptable, Tolerable and Intolerable Risks (Traffic Light Model) International Risk Governance Council (IRGC), 2005 Ortwin Renn
Risk Management

1. Identification of options (WP5, WP3)
   - literature, farmers, experts etc.

2. Assessment & Evaluation of Options (WP5, WP3)
   - Efficacy, Practicality, costs
   - Methodologies – Expert elicitation, farmer/consumer focus groups.
   - Communicating findings to risk managers (WP6)

3. Selection, Implementation and Monitoring
   - Risk Managers (DEFRA, FSA, etc)
   - How far do the researchers go?

Communications

- Must be two way and throughout the process
- Create confidence in “governing institutions”
- Involvement in decisions and conflict resolution
Potential questions for discussion:

- How much data and detail are enough to inform?
- What does integration mean?
- Where do the researchers start and stop?
- Has the right research been done to fill the gaps?
- Who decides whether an intervention is needed?