

vCJD risk to consumers eating
foods containing small amounts of
processed ruminant product

Modelling and assumptions

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Purpose for presentation

- Present quantitative model parameters for evaluation of vCJD risks
- Focus on the ‘front end’ parameters for risk analysis
- Provide information on evaluating ‘uncertainty’
- Provide information on ‘variability’

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Statement of purpose

- Risk outcomes
 - Pr{individual acquires vCJD | consume}
- Annual number vCJD infections

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Approach

- Link from BSE agent to vCJD
 - No direct evidence linking acquiring vCJD to particular products
 - Presence of BSE agent in products of concern not measurable by current techniques
 - HI established that route from BSE to consumption exists
- Reason to representation of the transmission of the BSE agent to consumption of products of concern and human response to those products

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Quantitative model - structure

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graph LR
  A[Issue statement] --> B[Hazard identification]
  B --> C[Hazard characterization]
  B --> D[Exposure assessment]
  C --> E[Risk characterization]
  D --> E
  
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Quantitative model Structure in risk characterization

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graph LR
  A["Ingestion  
consumption  
exposure  
assessment"] --> B["Probability of BSE  
transmission"]
  B --> C["Probability of vCJD  
annual consumption"]
  C --> D["Number of vCJD  
infections, annual  
consumption in  
population"]
  D --> E["Total vCJD  
cases  
(characterization)"]
  
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Quantitative model Structure in hazard characterization

- Susceptibility
- Infectivity accumulation
- Species barrier
- Dose-response

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Quantitative model Structure in exposure assessment

- Prevalence
- Tissue infectivity
- Sources of infectivity

- Gelatine
- Product
- Consumption

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Quantitative model Prevalence

- Prevalence into food
 - Prevalence BSE-infected bovines in population
 - Screening
- Prevalence in population
 - Inference from countries' BSE surveillance (clinical bovines)
 - Assumed also 4 incubating bovines for every clinical bovine
 - Low, Medium, High prevalence grouping
- Abattoir screening
 - Rapid test
 - 99.7% sensitivity on clinical animals
 - 99% specific
 - Ante-mortem & post-mortem inspections only
 - 2.5% sensitivity on clinical bovines

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Quantitative model Tissue infectivity

- Unprocessed brain tissue
 - 1 booral ID in .1 g
 - Uncertainty: $[10^1, 10^2]$ booral ID per g
- CNS tissue has same infectivity as brain tissue
 - TRG, DRG, spinal cord, CNS emboli
- Relative infectivity in incubating bovine
 - A sensitivity or uncertainty issue
 - Examined sensitivity of result to assumption that relative infectivity in $[1\%, 100\%]$

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Quantitative model Sources of infectivity

- Cross-contamination
 - A CNS emboli in blood
 - B Spinal column cross-contamination
 - C Blood
 - D Edible fats contamination
 - E Dorsal root ganglia
 - F Bone marrow
 - G Spinal column mis-split
 - H Trigeminal ganglia

Infectivity introduced varies with the production process

Tissue restrictions	No tissue restrictions
Bones and attached soft tissues	$[A] \cdot [B] \cdot [C] \cdot [D] + [F]$
Solidly muscle tissues	$[A] \cdot [B] \cdot [C] \cdot [D] + [E] + [G] + [H]$

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Quantitative model manufacture

- Bovines → Batches → Lots
 - $\Pr\{\text{Batch contaminated}\}, \Pr\{\text{Lot contaminated}\} \rightarrow \Pr\{\text{consumer product made from contaminated product}\}$
 - Number infected bovines' tissues into batch, lot
 - Low, medium, high prevalence
 - Binomial
- Infectivity reduction
 - Heating, filtering, decanting
 - In total: $5 \log_{10}$ to $6 \log_{10}$

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Quantitative model Consumption

- Define nominal consumer preparation
- Annual consumption
 - Federal-Provincial Food and Nutrition Surveys 1990-1999
 - Adults, children
- Frequency of consumption
- Single day amount of consumption
 - Inferred annual consumption pattern
 - Accumulation over 3 days

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Quantitative model - computation

- Variability in component definitions
 - Production methods
 - Production practices
 - Sources of infectivity
 - Consumer product characteristics
 - Among groups
 - Among products within group
 - Consumption characteristics
- [minimum, point estimate, maximum]
- Uncertainty
 - Tissue infectivity
 - Incubating bovines
 - Species barrier
 - Dose-response
- Report as sensitivity

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Presenting results in report variability

Table 11 - Risk of dying of scrapie by CJD from consuming one of a single contaminated portion of the product (per kg) from one BSE-infected cow

Product	Incubating	Clinical or near clinical	All
Low	14.1	56.4	70.5
Medium	111.2	444.5	555.7
High	2868.91	11475.2	14344.1

- Product grouping
- BSE prevalence
- Abattoir screening
- Production methods, a range
- Production parameters, a range of ranges

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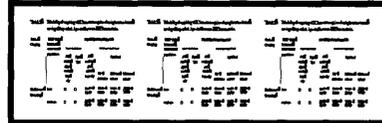
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Presenting results in report uncertainty

Table 11 - Risk of dying of scrapie by CJD from consuming one of a single contaminated portion of the product (per kg) from one BSE-infected cow

Product	Incubating	Clinical or near clinical	All
Low	14.1	56.4	70.5
Medium	111.2	444.5	555.7
High	2868.91	11475.2	14344.1

- Dose-response
- Tissue infectivity
- Incubating bovines
- Species barrier



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Quantitative model Prevalence

BSE-infected bovines (per 10⁶) in bovine population

	Clinical or near clinical	Incubating	All
Low	14.1	56.4	70.5
Medium	111.2	444.5	555.7
High	2868.91	11475.2	14344.1

BSE-infected bovines (per 10⁶) processed for human food

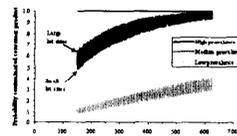
	Rapid test available			Ante mortem & post mortem inspections only		
	Clinical or near clinical	Incubating	All	Clinical or near clinical	Incubating	All
Low	0.34	56.4	56.7	108.3	56.4	70.1
Medium	0.34	444.5	444.8	108.3	555.7	555.4
High	8.72	11508.5	11517.2	2797.7	11476.4	14274.0

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Quantitative model Probability of contaminated consumer product



- Large batches (lots)
- Beef extract with tissues from ≥ 1 BSE-bovine
- Infectivity (g) diluted with tissues with no infectivity (kg)

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Difficulties

- Tissue infectivity
- Dose-response
- Exposure assessment
 - Consumption characteristics
 - Import characteristics

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Risk outcomes

- Individual
 - Pr{acquire vCJD|imported product}
 - Nominal serving
 - (Bouillon) annual consumption
- Population
 - Annual cases vCJD|imported product

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