

# Specified Risk Material: Public Health Implications

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**National Collaborating Centre  
for Environmental Health**

**Centre de collaboration nationale  
en santé environnementale**



**BC Centre for Disease Control**  
An Agency of the Provincial Health Services Authority

# Outline

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- **Introduction to the National Collaborating Center for Environmental Health (NCCEH) and projects**
- **Background on Bovine Spongiform Encephalopathy (BSE)**
- **Regulations governing the disposal of Specified Risk Material**
- **Possible routes of entry of prions into the human food chain (direct and indirect)**

# NCCEH

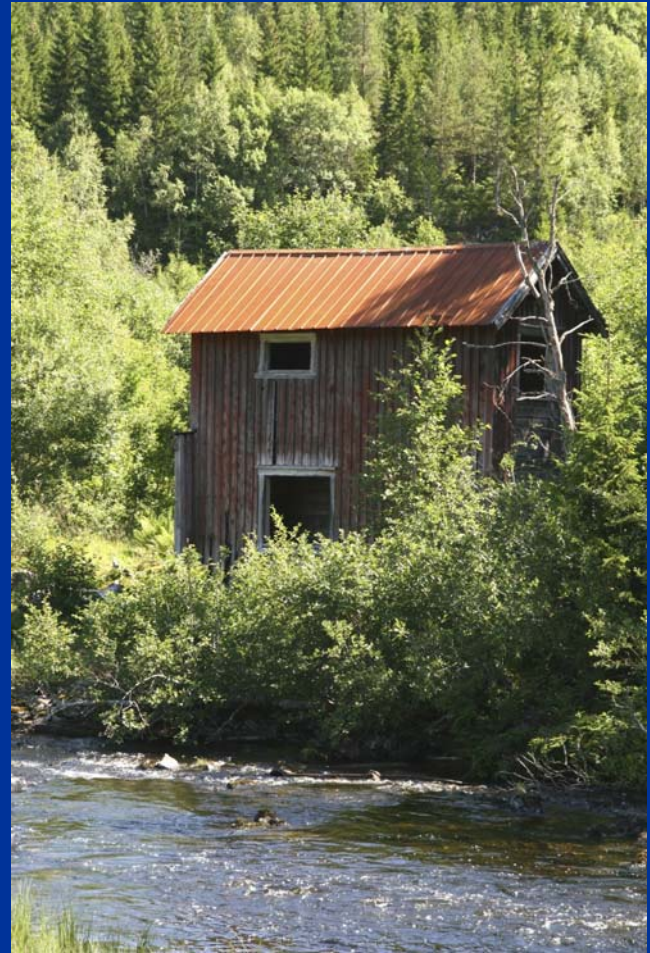
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- **Funded by the Public Health Agency of Canada (PHAC)**
- **One of Six National Collaborating Centres**
- **Each focuses on a different aspect of public health**

# NCCEH

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- **Our scope is EH**
- **Focus on health risks associated with the physical environment (natural and built)**
- **Identify evidence-based interventions to reduce those risks**



# NCCEH

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- **Getting useful information to Environmental and Medical Health Officers**
  - Succinct evidence-based documents on topics ranging from home drinking water filters to indoor radon
  - A directory of Canadian environmental health legislation
  - A directory of training and practicum opportunities
  - Environmental health news
  - Links to useful documents produced by others
  - Course on safe drinking water systems
  - Summaries of recent journal articles in EH
  - List of Public Health Agencies in Canada

# Visit our website @ [www.ncceh.ca](http://www.ncceh.ca)

NCCEH | The National Collaborating Centre for Environmental Health in Canada - Microsoft Internet Explorer

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**National Collaborating Centre for Environmental Health**  
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**What's New**

**HOME**

Welcome to the National Collaborating Centre for Environmental Health (NCCEH) website—bringing together practitioners, policy-makers, and researchers for evidence-based practice and policy.

**What's New**

- [Health effects from mould exposure in indoor environments](#)
- Presentations from our 2009 safe drinking water course - [videos](#) now available
- Small drinking water systems survey - coming soon
- [Contracted reviews](#) on: Impact of pig farms on quality of life\*\*, High burst particulates and cardiovascular effects, Biomonitoring of environmental contaminants, Emerging zoonotic diseases
- [Presentations](#) on: Indoor air quality in First Nations and Inuit

**ENVIRONMENTAL HEALTH NEWS**

Stay informed with the latest news in environmental health.

- Dust, not food, main source of lesser known flame retardants
- Study gives insight into spread of chronic wasting disease
- Low dose makes the poison
- High levels of lead in bone hard on the heart
- Threat down below: polluted caves endanger water supplies, wildlife
- Air conditioning linked to

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# What is BSE?

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- **Bovine Spongiform Encephalopathy (mad cow disease)**
- **Belongs to the group of prion diseases (Transmissible Spongiform Encephalopathies: TSE)**
- **Neurodegenerative diseases affecting both humans and animals**

# Prion diseases

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## Human Prion diseases:

- Creutzfeldt-Jakob Disease (CJD)
- vCJD
- Gerstmann-straussler-scheinker syndrome
- Fatal familial insomnia
- Kuru

## Animal diseases:

- BSE (cattle)
- Chronic waste disease (cervids)
- Scrapie (sheep)
- Transmissible mink encephalopathy
- Feline spongiform encephalopathy
- Ungulate spongiform encephalopathy



# Kuru disease

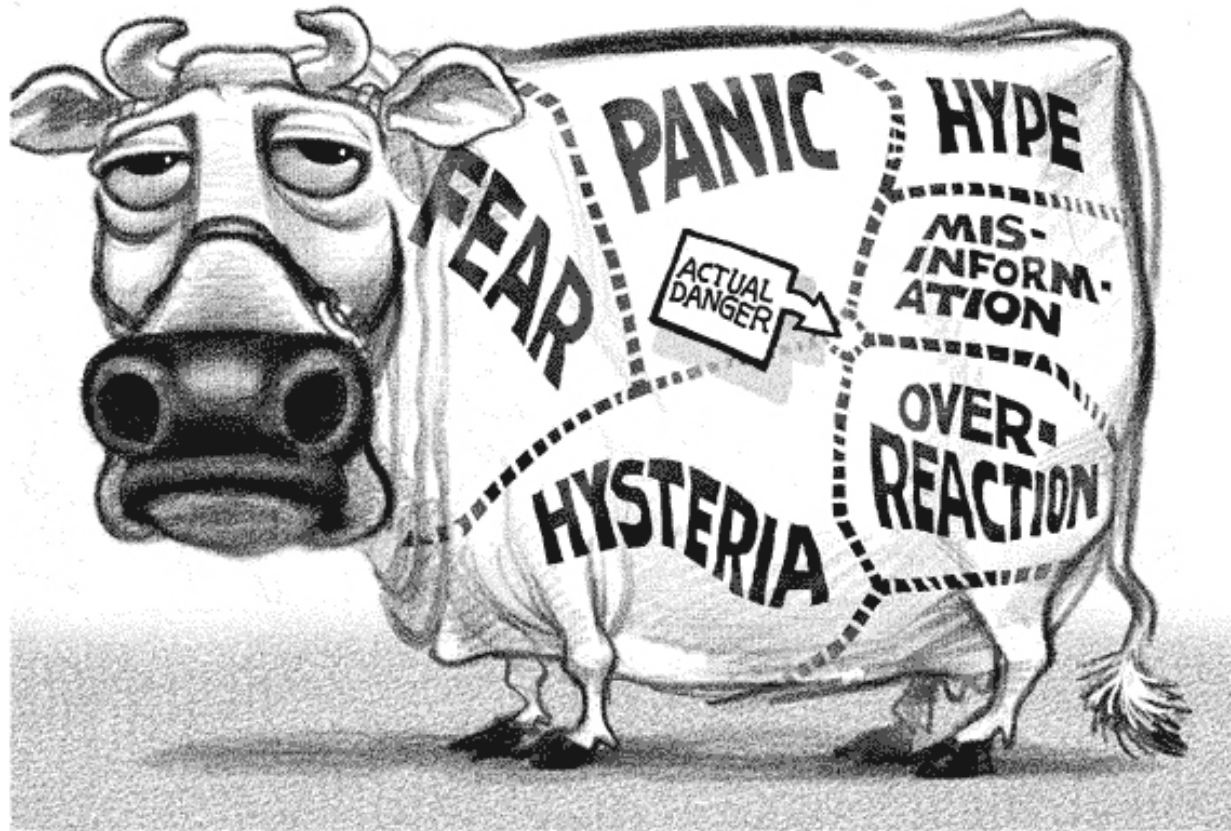
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- **Kuru (Papua New Guinea ,1957) was the first human disease associated with a prion**
- **Carleton Gadjusek received the 1976 Nobel prize for showing that the Kuru was transmitted by the cannibalistic ritual eating of brain from dead relatives**
- **Stanley Prusiner received the 1997 Nobel prize for the discovery of prions**

# BSE

- Initially reported in the UK in 1986
- Linked to the use of Meat-and-Bone-Meal (MBM, high protein supplement)
- Higher incidence in dairy than in beef cattle
- Oral route of transmission
- Infective dose  $> 1$  g
- Other routes? (atypical cases)





# What does BSE means for Public Health?

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In 1996, Spongiform Encephalopathy Advisory Committee (SEAC) announced a link between the new variant Creutzfeldt-Jakob Disease (vCJD), and exposure to the infective agent (prion) through consumption of beef

# Variant CJD- 2009 Data

vcJD worldwide - Microsoft Internet Explorer

Address <http://www.cjd.ed.ac.uk/vcjdworld.htm>

## VARIANT CREUTZFELDT-JAKOB DISEASE

### CURRENT DATA (SEPTEMBER 2009)

COUNTRY	TOTAL NUMBER OF PRIMARY CASES (NUMBER ALIVE)	TOTAL NUMBER OF SECONDARY CASES: BLOOD TRANSFUSION (NUMBER ALIVE)	CUMULATIVE RESIDENCE IN UK > 6 MONTHS DURING PERIOD 1980-1996
UK	166 (4)	3 (0)	169
France	25 (1)	-	1
Republic of Ireland	4 (0)	-	2
Italy	1 (0)	-	0
USA	3 <sup>†</sup> (0)	-	2
Canada	1 (0)	-	1
Saudi Arabia	1 (1)	-	0
Japan	1* (0)	-	0
Netherlands	3 (0)	-	0
Portugal	2 (0)	-	0
Spain	5 (0)	-	0

<sup>†</sup> the third US patient with vCJD was born and raised in Saudi Arabia and has lived permanently in the United States since late 2005. According to the US case-report, the patient was most likely infected as a child when living in Saudi Arabia.

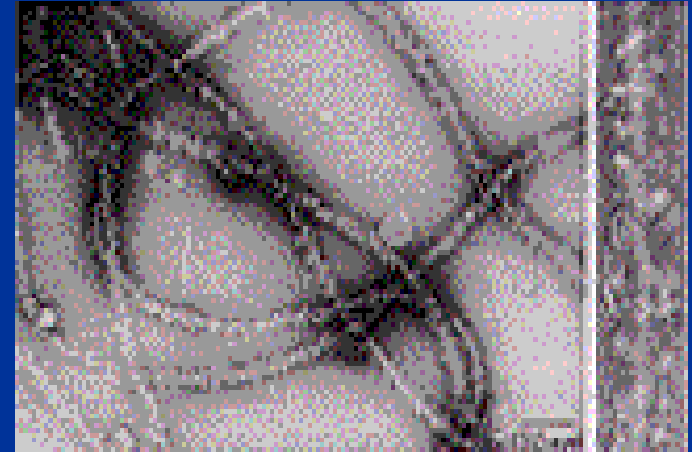
\*the case from Japan had resided in the UK for 24 days in the period 1980-1996.

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# BSE

- Prion protein PrP<sup>res</sup> (Protease resistant Prion Protein) is the causative agent
- PrP<sup>res</sup> is a modified form of a normal membrane associated protein, predominantly located in the Central Nervous System (CNS)
- Long incubation period (5 years for dairy calves), and early clinical diagnosis difficult
- Additional forms of BSE recently identified (atypical: H- and L-type BSE).



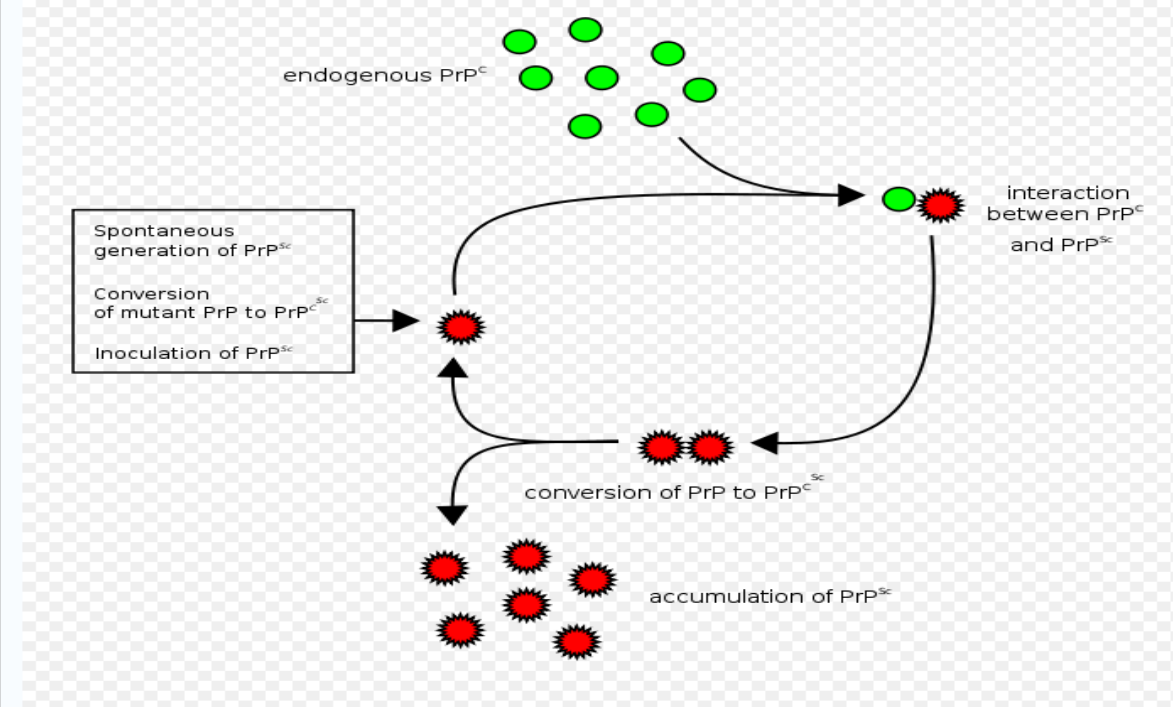
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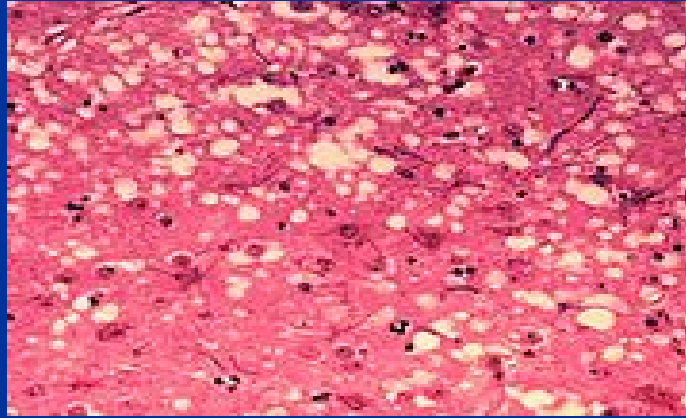
  
 

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Prion\_propagation.svg (SVG file, nominally 879 × 766 pixels, file size: 26 KB)



**Microscopic "holes" are characteristic of prion-affected tissue sections, causing the tissue to develop a "spongy" architecture**



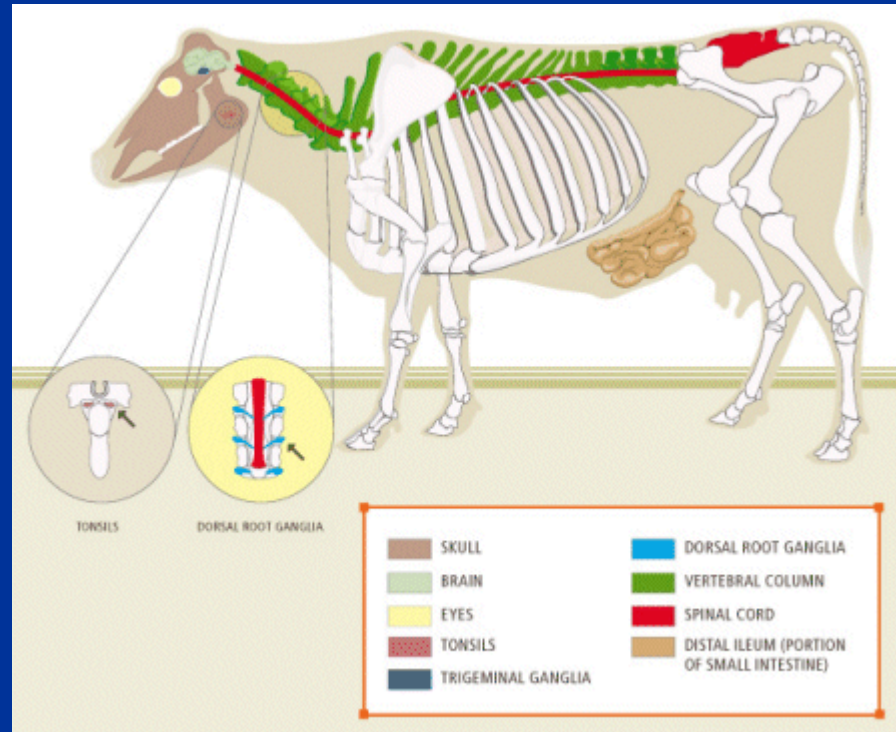
# BSE

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- PrP<sup>res</sup> very difficult to inactivate
- Uneven distribution in tissues of infected animals (Specified Risk Material)
- Specified Risk Material (SRM) include 99% of the infectivity



# Specified Risk Material (SRM)



Source: CFIA

# Public Health Protection

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**SRM have been the basis for measures to  
protect consumers from infected  
tissues of pre-clinically affected cattle**

# BSE events & Canadian Government Initiatives



1993

1997

2003

2007

2008



- First case of BSE, in an imported cow (1987)

- Ruminant-to-ruminant feed ban
- Primary goal: **protect Animal Health**

- First identified case of BSE, found in a Canadian-born cow

- Human food chain Ban
- Primary goal: **protect Public Health**

- 15 other indigenous cases between 2003-2009

- Enhanced Feed Ban + regulations on SRM disposal
- Primary goal: **protect Animal Health**

- Permit for handling SRM
- Primary goal: **protect Animal and Public Health**

# Human Exposure to Prions?

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**Etiological links challenged by:**

- **absence of detection in food**
- **absence of historical samples to test for infectivity**
- **lack of knowledge regarding the dose of prion that causes vCJD**

# Upstream Indicators of Human Exposure

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- No native case of vCDJ
- 15 indigenous cases of BSE (11 born after the 1997 feed ban including two cases of atypical strain)

*A stricter feed ban was introduced in 2007, however it is too early to draw any conclusions to the effectiveness of the enhanced feed ban*

# Low level of prions in Canadian herds

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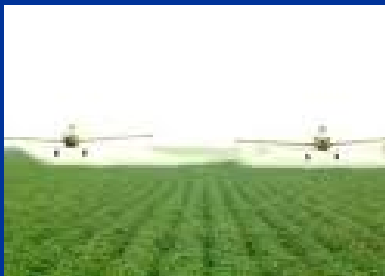
- The Canadian BSE surveillance program only tests higher- risk animals
- Higher risk animals are: 4-D categories of >30 months old and animals of all ages displaying clinical signs
- Prevalence of prions is probably underestimated (Japanese situation)



# Possible routes of human exposure

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- **Direct consumption:**  
**meat-related products**
- **Indirect consumption:**  
**crops, ground water, wastewater and air**





**Direct consumption**

# Possible breaches of SRM regulations

- Federally registered plants
- Provincial slaughter houses
- Unlicensed plants or illegal slaughter houses



# Slaughter houses in Canada

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## Federally registered plants

- Account for 95% by volume of meat produced in Canada
- Market their meat internationally and inter-provincially
- Subject to CFIA inspections
- On-site veterinarian ensures compliance with the legislation and supervises operations

## Provincial slaughter houses

- Market meat within their province
- May or may not be licensed
- May or may not have compulsory meat inspections



# **Voluntary breaches of the SRM regulations**

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## **Illegal slaughter houses**

- **Unlicensed slaughter houses**
- **Establishments doing custom slaughter**
- **Cattle slaughtered on farms**

# Involuntary breaches of the SRM regulations

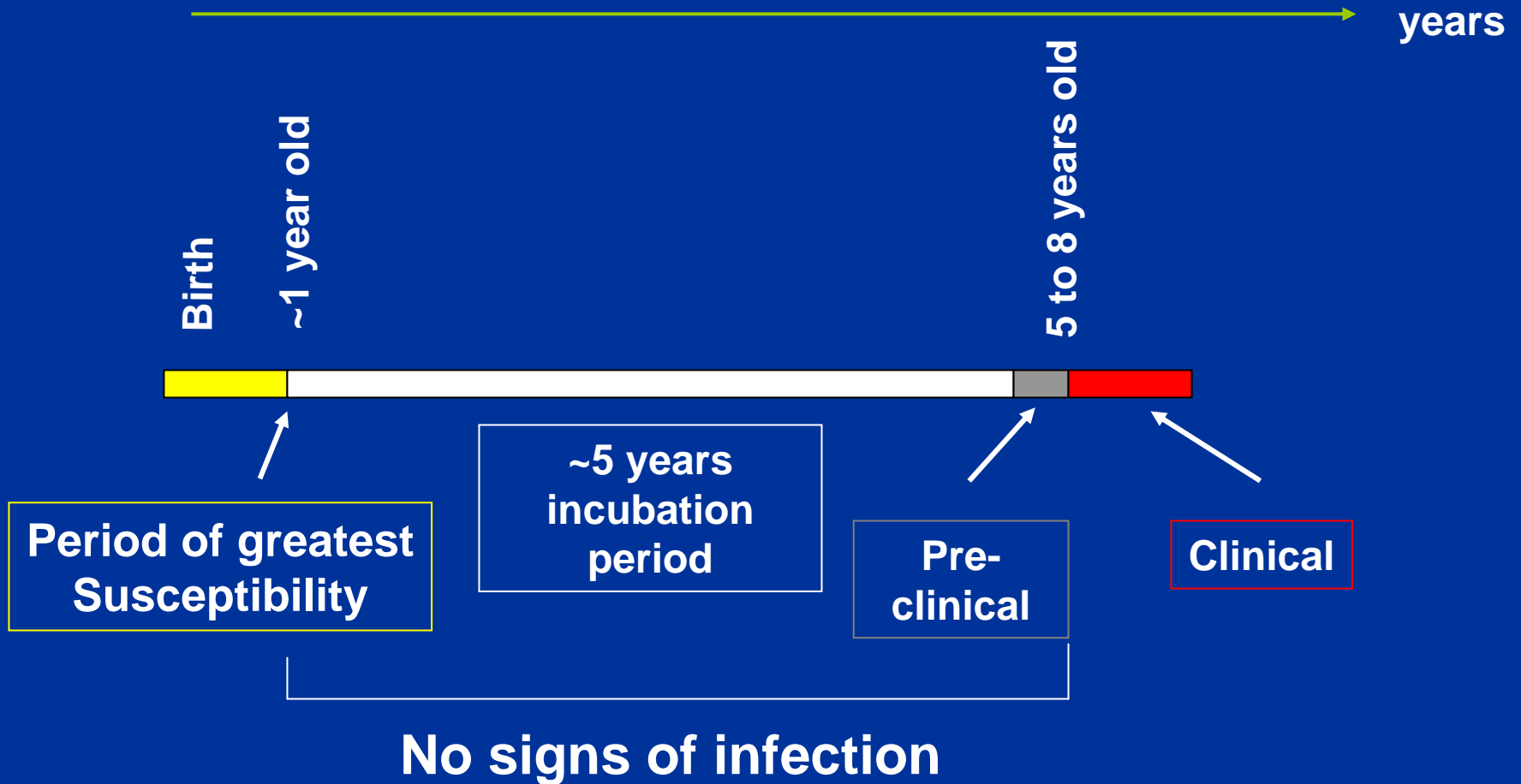
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During the pre-slaughter screening step

3 animal groups:

- Non infected (the majority)
- Infected but not detectable (incubating of the disease)
- Pre clinical/clinical group (detectable)

# Progression of BSE in infected cattle



# What are “infected” cattle?

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**If clinical signs present:**

- **95% probability of correctly identifying an ambulatory animals with clinical signs**
- **85% probability for downer cattle**
  
- **Removal of non-ambulatory cattle from human supply led to reduced exposure to BSE-contaminated material by 3% in the US**

# What are “infected” cattle?

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**Animals less than 30 months old can be BSE positive:**

- In Japan, there have been two cases of BSE found in 21 and 13 month old bulls**
- In the UK, there have been 49 cases of BSE in cattle younger than 30 months**



# What are “infected” cattle?

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- In Canada, the majority of cattle slaughtered are less than 30 months old
- The distal ileum is removed in cattle of all ages while other SRM is taken out from Over Thirty Months (OTM)
- It is possible for prions of infected cattle with no clinical signs and < 30 months to be introduced into the food chain

# What are “infected” cattle?

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- **Cattle can also be BSE positive, OTM and show no clinical signs**
- **In Japan, 9 of the 15 BSE cases in cattle did not show any clinical signs**

(Iwata et al., 2006)

# **Non compliance with SRM regulations**

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**Non compliance (inadvertent or voluntary) during the stunning and slaughtering process:**

- **Cross-contamination of muscle with CNS tissues**
- **3% non compliance in Federally registered plants (2% considered minor)**

# **Canadian population could be exposed to low levels of prions**

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**As indicated by:**

- The occurrence of BSE in Canadian herds**
- Possible breaches that may occur in the SRM regulations**

**Canadian population could be exposed to very low levels of prions**

**The risk of Canadians contracting vCJD when exposed to contaminated cattle products is currently under study by Dr Dan Krewski**

**Indirect consumption**

# Other food?

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**Products that have been in contact or fertilized with infected material**

- **crops**
- **compost (most provinces don't have any farm management regulations)**

# Wastewater

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**Prion may enter wastewater through:**

- **Slaughter house drains**
- **Rendering and meat packing plants**

**One study indicates that prions are not likely to be discharged into local bodies of water (Hinckley et al., 2008)**

# Wastewater and ground water

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- **Ground water and wastewater contamination may occur through improper SRM disposal**
- **To be approved by CFIA, SRM disposal methods must present a very low risk of potential BSE transmission to ruminants**



# Regulatory Gap?

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## Highly regulated environment

- a risk of 1 in 10,000 or less of potential transmission to ruminants is not tolerated

## Unregulated environment

- illegal abattoirs, cattle producers
- On farm (this matter falls under provincial regulation)

**Current federal regulations favour the on-farm disposal of SRM**

# Regulatory Gap?

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**What will happen in cases of Foot-and-Mouth-Disease (FDM)?**

- **Mass composting is not permitted for SRM removal, because associated with a probability of 1/1000 to 1/10,000 of possible transmission to ruminants**
- **However, the same level of risk is tolerated on farms**

# Regulatory Gap?

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- **It is important that provinces have emergency response plans in place**
- **Agriculture and Agri-food Canada is consulting with stakeholders to identify the best options for SRM disposal in each province (Senate, 2005).**

# Air

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- **Main concern comes from the incineration of SRM**
- **Controlled incineration using two-chamber fixed facilities is the only incineration approved by CFIA**
- **Open pile and air curtain are not permitted**
- **No regulation prevents burning SRM on farms**

# CONCLUSION

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- Possible routes of entry into the food chain include direct and indirect consumption of prions:

## Direct consumption:

- ✓ There is a low level of prions in Canadian herds
- ✓ The Canadian population may be exposed to a very low levels of prions through meat consumption

## Indirect consumption:

- ✓ Linked to survival of prions in the environment.
- ✓ Major issues in determining risk for humans is the lack of scientific evidence and clear transmission related to prion survival in the environment

# CONCLUSION

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- **SRM disposal laws are based on a risk of transmission to ruminants (animal health risk not public health risk)**
- **Discrepancy between the highly regulated environment that falls under the scrutiny of the federal government and the poorly regulated environment that falls under the provincial government**
- **Important that provinces have an emergency response plan in case of Foot-and-Mouth-Disease (FDM)**

# References

- Cohen JT, Gray GM. 2005. Harvard Risk assessment of bovine spongiform encephalopathy update
- CFIA. 2006. Industrial treatment of specified risk material: a qualitative assessment of BSE transmission and spread to domestic ruminants.
- Hinkley GT, Johnson CJ, Jacobson KH et al. 2008. Persistence of pathogenic prion protein during simulated wastewater treatment processes. *Enviro. Sci. Technol.* 42:5254-5259
- Iwata N, Higuchi Y, Nohtomi K. et al. 2006. Distribution of PrP<sup>Sc</sup> in cattle with bovine spongiform encephalopathy slaughtered at abattoirs in Japan. *Jpn J Infect Dis* 59:100-107



**Any question?**