Translating Risk Assessment of Foodborne Viruses into Practice

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Presentation layout

• Viruses – Global public health impact
• Risk analysis framework for managing viruses
• Risk assessment/types/components
• Overview of MRAs on viruses
• Key conclusions, bottlenecks and interventions
• Take home messages
Foodborne viruses – Global health impact

Global illness (morbidity and mortality, DALY)

1. Ischaemic heart disease
2. Cerebrovascular disease
3. Lower respiratory infection
4. Low back and neck pain
5. Neonatal preterm birth
6. Diarrhoeal diseases

Global foodborne illness (incidence, millions)

- Diarrhea - bacteria
- Diarrhea - protozoa
- Norovirus
- Hepatitis A virus
- Helminths
- Salmonella Typhi
- Other foodborne

Plos Medicine 2015, 12(12); Lancet 2015, 388: 1603-1658
An update on the risk of transmission of Ebola virus via the food chain – Part 2
European Food Safety Authority (EFSA)

Abstract

‘Top-down’ (e.g. surveillance-based) and ‘bottom-up’ approaches (e.g. using the standard microbial risk assessment paradigm) were combined to assess the risk of foodborne transmission of ZEBOV to persons in Europe arising from the consumption of raw food other than bushmeat imported from African countries where human outbreaks due to Zaire Ebola virus (ZEBOV) have occurred. Using the ‘top-down’ approach, it was concluded that food other than bushmeat has never been identified as associated with human ZEBOV cases in any of the reported outbreaks. There is no evidence for foodborne transmission of ZEBOV to persons in the European Union (EU). The ‘bottom-up’ approach revealed that the necessary sequence of events in the risk pathway involves many hurdles: 1) the raw food to be exported has to be contaminated with ZEBOV at the point of origin; 2) the imported food needs to contain viable virus when it arrives in the EU; 3) the person has to be exposed to the virus; and 4) the person needs to get infected following exposure. Each of these steps is necessary in order for a case of disease to occur and none have been documented to happen in practice. Due to lack of data and knowledge, which results in very high uncertainty, it is not possible to quantify the risk of foodborne transmission of ZEBOV derived from the consumption of these imported foods, or in fact whether or not this mode of transmission could occur at all. The overall conclusions of both approaches are consistent and suggest that the risk of foodborne transmission of ZEBOV via food other than bushmeat imported into the EU remains a theoretical possibility only and has never been demonstrated in practice. However, the uncertainty in the combined assessment is considered high given the lack of data.

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Keywords: Zaire Ebola virus, ZEBOV, food, vegetables, fruits, survival, foodborne transmission
Foodborne viruses – Risk assessment approaches

**Bottom-up risk assessment**
(food chain-based)

**Top-down risk assessment**
(epidemiology-based, surveillance-based)
Foodborne viruses – Bottom-up risk assessment

**Hazard identification**
- Which hazards in food have the potential to cause an adverse health effect?
  - Mode of production?
  - Routes of contamination?
  - Product formulation?
  - Product association with specific hazards?

**Exposure assessment**
- What is the intake of the hazard through food and if relevant from other sources?
  - Initial concentration?
  - Prevalence?
  - Hazard increases, decreases, or remains stable?
  - Cross-contamination?

**Hazard characterization**
- What is the response to the hazard for different potential doses through food?
  - Dose response curve (epidemiological data)
  - Healthy vs susceptible population?
  - Portion sizes?

**Risk characterization**
- What is the probability and severity of the effect in relation to this hazard in food?
  - Frequency of consumption?
  - Population immunity?
Foodborne viruses – Top-down risk assessment

**Reported risk**
- What is the reported incidence of illness due to this hazard?

**Population risk**
- What is the actual incidence of illness in the community?

**Foodborne risk**
- What is the incidence due to food?

**Foodborne hazard**
- Priorities in terms of products/product groups for managing the hazard?

*National surveillance system:*
- Epidemiological data (outbreaks, notification data)

*Active surveillance:*
- Underreporting rate

*Source attribution:*
- Food
- Environment
- Travel
- Human
- Animal

*National surveillance system:*
- Epidemiological data (outbreaks, notification data)
Foodborne viruses – Overview of bottom-up risk assessments

- 24 publications
- 36 product-virus combinations
- 6 viruses, 8 product groups
- 4/21 qualitative, 3/21 deterministic

**Product groups**
- drinking water
- eggs
- poultry
- forest fruit
- leafy greens
- seafood
- other
- pork

**Viruses**
- Norovirus
- Hepatitis A
- Avian influenza
- Ebola
- Hepatitis E
- Rotavirus
Foodborne viruses – Overview of top-down risk assessments

- Disease burden
- Risk ranking
- Source attribution
- Risk factor studies

Sources of Calicivirus Contamination in Foodborne Outbreaks in Denmark, 2005–2011—The Role of the Asymptomatic Food Handler

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Background. Norovirus (NoV) is the predominant cause of foodborne disease outbreaks. Virus contamination may occur during all steps of food processing, from production to preparation and serving. The relative importance of these different routes of contamination is unknown.

Methods. The purpose of this study was to estimate the proportions of outbreaks caused by asymptomatic and symptomatic food handlers (FHs). Reports of foodborne NoV and sapovirus outbreaks (n = 191) that occurred over a 7-year period were extracted, reviewed, and categorized according to the available evidence for source of contamination.

Results. In 64 (34%) of the outbreaks, contamination from FHs took place during preparation or serving of food. In the majority of these outbreaks (n = 41; 64%), the FHs were asymptomatic during food handling. Some had been in contact with ill household members before handling the food and remained asymptomatic, others developed symptoms after handling the food. In 23 outbreaks (36%), the FHs were symptomatic during food handling. In 21 outbreaks (32%), the FHs were asymptomatic just before handling the food but developed symptoms during or after handling the food. In 7 outbreaks (11%), the FHs were asymptomatic just before handling the food but did not develop symptoms during or after handling the food.
Bottom-up risk assessment – example
Norovirus and hepatitis A in leafy greens and berries

Bouwknegt et al. 2015; IJFM, 198, p. 50-58
Bottom-up risk assessment – example
Norovirus and hepatitis A in leafy greens and berries

- Contact with hands most dominant contamination source => hand hygiene focus of interventions

Bouwknecht et al. 2015; IJFM, 198, p. 50-58
Top down risk assessment – example Sources of calicivirus in Denmark

Caliciviridae
• Norovirus (NoV)
• Sapovirus (SaV)

Franck et al. 2015; JID, 211, p. 563-570
Top down risk assessment – example
Sources of calicivirus in Denmark

Significant contribution of asymptomatic food handlers in outbreaks

Franck et al. 2015; JID, 211, p. 563-570
# Top-down vs bottom-up risk assessments

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<thead>
<tr>
<th>Bottom-up risk assessments</th>
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<tbody>
<tr>
<td>• Interventions</td>
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- More focus on interventions than on risk
- Industry/food chain safety management
- Risk for standard industry practices
- Risk for incidental contamination events
- Public health authorities/governmental food safety management
Most important interventions for the control of viruses

• Setting adequate targets for inactivation
  • e.g. 85-90°C for at least 1.5 min (CAC, 2012)

• Raw material/food production controls
  • GAP, GHP, GMP + validation & verification

• Increased surveillance of high risk food commodities
  • e.g. soft fruits (European Commission, 2012)

• Control spread via food handlers
  • e.g. adequate hand hygiene + suitable period of absence/sickness leave
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