I don't know Frank, these gals look like trouble.

Microbial Risks in Seafood

Dr. Mags Crumlish
Institute of Aquaculture
SUII Workshop (Safe & Nutritious Food)
January 2016
What is Food Safety?

• Centuries we have prepared and cooked food
• Understand that there are hazards inherent to food
  – 150 years ago the theory of germs
• Food hazards classified into
  – Physical
  – Chemical
  – Biological
• By far the greatest is the biological
  – Viruses & bacteria
• FOODBORNE DISEASES
Aspects of Food Safety

• 3 major components:
  – Perception
  – Regulation
  – Science (evidence)

• Foodborne pathogens is the focus of this presentation
  – Pathogen
  – Environment
  – Food production & distribution
  – Consumers
Microbial Risks & Food Security

• WHO 3 Pillars of Food Security
  – Safe                 Available               Accessible

• Emerging human health issues
  • Contamination through consumption
  • Contamination through contact/environment

• Immunocompromised individuals
  • Medical conditions (cancer, diabetes, liver disease)
Foodborne Pathogens & Diseases

• Use the term “emerging” infectious disease:
  – New appearance in a population
  – Increased incidence/prevalence
  – Larger geographical location

• WHO describes appearance of foodborne diseases:
  – Change in microorganisms
  – Alterations in human pop & lifestyle
  – Globalisation of food supply networks
  – Introduce pathogens into new areas
  – Exposed to unfamiliar foodborne organisms when travelling
Biological Hazards and Human Illhealth

• Agents are usually described as
  – Zoonotic
  – Foodborne
  – Environmental

• Not always so simple
  – E.g. salmonella classic foodborne pathogen but can be zoonotic
  – E.g. L. monocytogenes has animal and environmental origins – zoonotic, foodborne and environmental!
Global Burden of Food Poisoning?

- People getting sick from eating contaminated food
- 2010 (WHO report)
  - 528 million cases
    - Represented 22 different food-borne diseases
  - 351 associated deaths
    - 52,000 from Salmonella infections
    - 37,000 deaths from *E. coli*
    - 35,000 deaths from Norovirus
- 40% of those affected were under 5
Surveillance pyramid shows realistic data when measuring burden of infection in a population (Tauxe et al 2010 Int. J. F. Micro 139 (S16-S28))
Cost of Food-Borne Infections

• In the UK this is estimated at £1.5 billion per year
  – Lost working days
  – Medical care
  – Approximately 20,000 people get hospital treatment
  – 500 death caused by foodborne illness

• Development of new *Foodborne Disease Strategy*
  – Campylobacter & *L. monocytogenes* (high)
  – *E. coli* 0157, Salmonella & Norovirus (high)
  – *Clostridium perfringens* (low)

Source FSA UK (food.gov.uk)
Modern Food Production

1957  1978  2005

56 d  905 g  1,808 g  4,202 g
Global Aquatic Food Production

Figure 1.1: World aquaculture production by continent in 2008 (China treated separately). Land areas are adjusted proportionally to reflect production volumes.
Global Seafood Trade Flow

Complexity!
Food Supply & Aquaculture

- Aquatic food is truly a global product
- Increasing complexity in our supply chains
  - Increased exposure
- Awareness of microbial risks

Source: www.123rf.com

Source: www.glogster.com
Food Poisoning and Seafood

• Seafood is also at risk to pathogen exposure causing human illhealth

• Source usually include:
  – Faecal contamination of the environment (shellfish)
  – Consumption of contaminated raw product
    • Home, processed, retail or catering

• In general compared with other food sources
  – Seafood it is rare
  – Higher incidence with contaminated shellfish
Product Safety - microbes

• Microbial agent must be pathogenic to humans
• Must be able to survive through food chain or distribution system
• The pathogen or toxins must be at sufficient level to cause disease
• High risk foods
  – Sold or consumed as raw or “fresh”
• Establishing infection varies with pathogen
  – Bacteria v’s viral
Highly contagious
Winter vomiting
< 20 particles infected
Aquatic environments
Contamination
R-T-E products
Fresh
  shellfish/fruit/salad

Salmonella spp. (www.globalmeatnews.com)

E. coli (www.cdc.gov)

Vibrio parahaemolyticus (www.kswfoodworld.worldpress.com)

Campylobacter spp. (www.foodqualitynews.com)

Listeria monocytogenes (www.foodhaccp.com)
Vibrio species & Seafood

- Significant % infections (consumption)
  - *V. parahaemolyticus* & *V. vulnificus*
  - Acquired through ingested shellfish (raw or undercooked)
  - GI infections (self-limiting) more common
    - CS 4-90h post consumption
  - Serious condition in immunocompromised people
    - Septicaemia, cellulitis & necrotising fasciitis

- *V. parahaemolyticus*
  - Small number of total strains hazardous to health
  - Bioaccumulate in the shellfish
  - Contamination of fish (*V. vulnificus*)
Cellulitis & Necrosis

Source: www.NHS.com

Vibrio infection
(www.consultant360.com)

www.wikipedia.org
Biggest risk to foodborne illhealth....people!
AMR

• AMR is a hot topic in human health
  – Lack of novel products
  – Increased resistance to existing products
  – Increasing prevalence of AMR strains/species

• UK move towards a “One Health” approach
  – Medical and veterinary fields
  – Tackle AMR

• Foodborne bacterial diseases of importance
  – Salmonella, *E. coli* and Campylobacter

Further reading: Vet Record November 21st 2015, pg 511-512
# Models for Food Safety

<table>
<thead>
<tr>
<th>Model type</th>
<th>Identifies...</th>
<th>Used for...</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Microbial risk assessment (MRA)</strong></td>
<td>Hazards, exposure assessment</td>
<td>Relationship of pathogen occurrence in food chain</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Predict health risks from pathogen in food</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Risk-based standards for food production</td>
</tr>
<tr>
<td><strong>Predictive microbiology</strong></td>
<td>Growth/survival/death</td>
<td>Intrinsic/extrinsic properties of food</td>
</tr>
<tr>
<td><strong>Dynamic Infectious Disease</strong></td>
<td>Incidence and spread</td>
<td>Spread of disease in human/animal populations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Contact patterns &amp; protective immunity</td>
</tr>
<tr>
<td><strong>Risk factor analysis</strong></td>
<td>Analytical epidemiology</td>
<td>Response occurrence in populations</td>
</tr>
<tr>
<td><strong>Attribution Models</strong></td>
<td>Estimate contribution of putative sources to response</td>
<td>Burden of illhealth</td>
</tr>
<tr>
<td><strong>Multi-criteria analysis</strong></td>
<td>Values of variables</td>
<td>Support decision makers with making evaluations</td>
</tr>
</tbody>
</table>

Adapted from Havelaar et al. (2010) Int. J. F. Micro 139
Public Health Risk

• Can we eradicate food-borne infections?
• Control risk
• Combined approach
  – Seafood included
• Pro-active
  – Integrate surveillance
  – Advanced testing methods
• Seafood sector
  – RTE and chilled foods
Please cover the eyes of your children.
Here we have another classic example of cross-contamination:
striping the red candy canes without washing your hands after
striping the green. I've seen it all too often . . .

FOOD SAFETY REMINDER: To avoid cross-contamination, wash your hands whenever you begin a
new food preparation task. Dangerous germs and food allergens can cross-contaminate
ready-to-eat foods if you do not properly wash your hands before switching tasks.