Network analytical tools for monitoring global food safety

Tamás Nepusz, Andrea Petroczi, Glenn Taylor
Declan Naughton

School of Life Sciences
Kingston University, London
AIMS

1. To analyse trends in global food alerts
2. To provide a user-friendly tool to inform “emerging” nations of patterns in global alerts
3. In the longer term, to develop a tool that analyses global data in ‘real’ time to warn of emerging incidents on a weekly basis
EU Food Safety Notifications

RASFF Portal
https://webgate.ec.europa.eu/rasff-window/portal/

Notifications list: 3705 results

Search criteria | Notified from 01/01/2011 | Notified till 31/12/2011

<table>
<thead>
<tr>
<th>Classification</th>
<th>Date of case</th>
<th>Last change</th>
<th>Reference</th>
<th>Country</th>
<th>Subject</th>
<th>Product Category</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>alert</td>
<td>13/12/2011</td>
<td>02/03/2012</td>
<td>2011-1827</td>
<td>IT</td>
<td>aflatoxins (B1 = 328; Tol. = 343 μg/kg - ppb) in roasted potatoe nuts with raw material from Iran, via Germany; Salmonella Riesen (present 25g), Salmonella Sorensen, Salmonella spp. and Salmonella Yonuba in soybean meal from Brazil, via the Netherlands and via Denmark</td>
<td>nuts, nut products and seeds</td>
<td>food</td>
</tr>
<tr>
<td>information for follow-up</td>
<td>03/08/2011</td>
<td>02/03/2012</td>
<td>2011-1222</td>
<td>FI</td>
<td></td>
<td>feed materials</td>
<td>feed</td>
</tr>
<tr>
<td>alert</td>
<td>13/05/2011</td>
<td>02/03/2012</td>
<td>2011-0531</td>
<td>GB</td>
<td>too high level of radioactivity (Ca=137; 495 Bq/kg) in dried wild mushrooms from Bulgaria, via the Netherlands and via Denmark</td>
<td>fruits and vegetables</td>
<td>food</td>
</tr>
<tr>
<td>alert</td>
<td>08/02/2011</td>
<td>02/03/2012</td>
<td>2011-0169</td>
<td>DE</td>
<td>aflatoxins (B1 = 38.9; Tol. = 59.8 μg/kg - ppb) in ground hazelnuts from the Czech Republic, with raw material from Georgia</td>
<td>nuts, nut products and seeds</td>
<td>food</td>
</tr>
<tr>
<td>information for attention</td>
<td>11/01/2011</td>
<td>02/03/2012</td>
<td>2011-0220</td>
<td>BE</td>
<td>benzo(a)pyrene (21.3 μg/kg - ppb) in smoked fish (Barracuda spp and Sardinelia spp) from Ghana</td>
<td>fish and fish products</td>
<td>food</td>
</tr>
<tr>
<td>border rejection</td>
<td>12/07/2011</td>
<td>02/03/2012</td>
<td>2011-1611</td>
<td>ES</td>
<td>poor temperature control - rupture of the cold chain - of poultry meat preparations from Brazil; migration of oxidized soybean oil (ESBO) (176 mg/kg - ppm) from lids of jars containing chicken fillets from Portugal, via Italy, with lids from Spain</td>
<td>poultry meat and poultry meat products</td>
<td>food</td>
</tr>
<tr>
<td>alert</td>
<td>27/12/2011</td>
<td>01/03/2012</td>
<td>2011-1920</td>
<td>LU</td>
<td></td>
<td>food contact materials</td>
<td>FCM</td>
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<tr>
<td>information for follow-up</td>
<td>13/12/2011</td>
<td>01/03/2012</td>
<td>2011-1839</td>
<td>GB</td>
<td>high content of aluminium (24.1 μg/kg - ppb) in chicken soups, broth, sauces, sauces and condiments</td>
<td></td>
<td>food</td>
</tr>
</tbody>
</table>

Good for specific searches but ‘How to interrogate > 3.5 x 10^{28} data pairs ?’
Major roles of nations

For each notification a nation can:

- Report – act as Detector
- Supply – act as Transgressor

Roles and changing patterns of Detector/Transgressor are key for forecasting
Need for more complex analyses?

RASFF notifications by country between 2003-2008.

Gate keepers of EU food safety: Four states lead on notification patterns and effectiveness
Food and Chemical Toxicology, (2010) 48(7), pp. 1957-1964
Networks: Advantages.....?

Networks
- Based on some relationship (edge) between two nodes (e.g. countries), with edges having ‘weights’ (i.e. number of reports)

Network Analysis
- Capture complexity: takes simultaneously the number of reports and the number of countries involved into consideration
- Good visualisation
- Mathematical expression of network properties
- Can be tailored to type of notification

Increase in alerts against food from China from ‘03 – ‘08
Network analyses tool for identifying the role and impact of country involvement
Network tool is open access

http://staffnet.kingston.ac.uk/~ku36087/foodalert/
Selectable Functions

Nation of interest

Filters
• All
• Metals
• Microorganisms
• Mycotoxins
• Bacteria
• Border Rejections

Other
• Timeline
• Hits or PageRank
• Edge weight
• Neighbour nodes
• Save as
• Export
Trends in detector and transgressor indices for the top four reporting countries
Total v Border Rejections (Jan 01 2008)
Countries identified by detector impact

Gate keepers of EU food safety: Four states lead on notification patterns and effectiveness
Food and Chemical Toxicology, (2010) 48(7), pp. 1957-1964
Network analytical tool for monitoring global food safety highlights China.
Trend lines in TIs for major transgressors for all RASFF notifications between Aug 2003 and May 2008
Summary – network study

• Demonstrate which countries are the major transgressors and detectors
• Monitor changes over time
• Demonstrate the impact of these countries
• User-friendly tool to analyse the contribution of each country and relation to others
• Allows selection by reasons for alert (taxonomy)
‘prediction tool’

• Automatic feeds each day/week
• Flag system
  – Red increased quantities and numbers of key alerts – or key country of origin
  – Orange increased quantity or numbers of key alerts - or key country of origin
  – No flag – usual pattern of alerts from usual countries
Acknowledgements

• Hampshire Country Council
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