Possible effects of climate change on food & waterborne illness

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Why is Salmonella Important?

- The 2\textsuperscript{nd} commonest pathogen causing FWD in EU\textsuperscript{1}
- 71\% of all laboratory confirmed OB in EU\textsuperscript{2}
- 160,649 confirmed cases in EU in 2006\textsuperscript{1}
- Salmonella causes 1.3 million illness & 500 deaths/year in the USA\textsuperscript{3}

- S. Enteritidis & S. Typhimurium\textsuperscript{1,2} – predominant serovars causing human infections

- Major sources\textsuperscript{1,7}: S. Enteritidis – eggs/poultry meat
  
  S. Typhimurium – pigs, poultry & bovine meat
Reported Salmonella Cases in Malta 1990-2008

Year

Rate/100,000
Reported Salmonellosis Cases in Humans in Some EU Countries 2005

Cases/100,000 Population

Country

Cyprus  France  Germany  Ireland  Italy  Luxembourg  Malta  Holland  Portugal  Spain  Sweden  UK  EU mean
Salmonella Growth

- Salmonella grows at room temperatures

- Temperature misuse of food is a major risk factor\textsuperscript{4,5,6}:
  1. Inappropriate storage
  2. Inadequate cooking
  3. Preparation of food too far in advance

- The effect of temperature on growth of salmonella in food is now better understood\textsuperscript{10}

- Laboratory rate of salmonella growth directly related to temperature range of 7.5 - 48°C (optimum 37°C)\textsuperscript{11}
Foodborne Illness & Temperature\textsuperscript{8,15}

- Time series analysis in 10 European populations* comparing atmospheric temperatures and number of salmonella cases in most countries
  - Clear & linear association between temperature and no. of salmonella cases in most countries
  - Threshold (>7.5°C) present in some countries studied
  - The relationship is linear in most countries

- Compared the effect of temperatures in the previous 2 months on disease
  - Lag time effect of a rise in ambient temp & onset of disease was max in the first week and diminishes up to 5 weeks (UK)

- Temperature influences transmission of infection in about 35% of all cases in most of the studied countries

* Poland, Scotland, England & Wales, Estonia, The Netherlands, Czech Rep, Spain, Switzerland, Denmark, Slovak Rep
Foodborne Illness & Temperature

- Five Australian city study\textsuperscript{12}: a clear linear relationship and lag period of 1 month;
  - No threshold temps were found;
  - 5-10\% case rise/°C rise in ambient temp.

- The Netherlands, 2003 – 50\% rise S. Enteritidis;
  - 12.6 \% rise in cases/°C attributed to temperature effect;
  - Lag time effect largest 1\textsuperscript{st} week before tailing off up to 5 weeks;
  - Rise also noted to be due to increased importation of eggs from other EU countries.

- In contrast the effect of temp. rise on campylobacter transmission is weak\textsuperscript{14}

- Food poisonings significantly related to ambient temp. above 7.5°C in the same month & previous month \textsuperscript{16,17}

- Regional studies in UK: no association with relative humidity and amount of rainfall\textsuperscript{8}.

- IID in Malta correlated with peak summer temperatures(2005)
Scatter plot of Salmonella Cases and Temperatures 1990 - 2008 in Malta

$y = 0.61330x - 6.3033$

$R^2 = 0.2529$
Salmonella Cases (aggregates 1990-2008) per Month with Maximum Temps.
## Association Between Cases & Ambient Temperatures

<table>
<thead>
<tr>
<th></th>
<th>Cases</th>
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<th>Cases</th>
<th></th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average temp</strong></td>
<td>0.5124</td>
<td><strong>Min temp</strong></td>
<td>0.5238</td>
<td><strong>Max temp</strong></td>
<td>0.5029</td>
</tr>
<tr>
<td><strong>Average temp: 1 month lag time</strong></td>
<td>0.4936</td>
<td><strong>Min temp: 1 month lag time</strong></td>
<td>0.4807</td>
<td><strong>Max temp: 1 month lag time</strong></td>
<td>0.5003</td>
</tr>
<tr>
<td><strong>Average temp: 2 month lag time</strong></td>
<td>0.3302</td>
<td><strong>Min temp: - 2 month lag time</strong></td>
<td>0.3032</td>
<td><strong>Max temp: 2 months lag time</strong></td>
<td>0.3490</td>
</tr>
</tbody>
</table>

- Pearson’s correlation coefficient values. Stat 2 package
Limitations

- Small numbers
- Under-reporting
- Late notifications
- Variations in surveillance over time
- Improved laboratory techniques
- Physician heightened awareness on investigations
Conclusions

- Higher & sustained temperatures for longer periods of time are likely to lead to increasing cases of salmonellosis.

- The time lag of 1 - 4 weeks of rising salmonella cases suggests that temperatures might be influential earlier in the production phase\textsuperscript{11}!

- New and sustained strategies are needed to combat rising salmonellosis.
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## References

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2. Schmid K et al. WHO surveillance programme for Control of FWD & intoxications in Europe 7th report 1993-1998


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