UWWTD (1991)
What are the health benefits?

12:35 to 12:55

David Kay
Aberystwyth University, UK.
16th November 2018, Brussels.
Context of the Present Assessment

- Retrospective look at the UWWTD
- What are the health benefits if any?
- Is there scope and rationale for enhancing this aspect in any revision?
The present UWWTD and Health

• Article 1 Page 35
  – *The objective of the Directive is to protect the environment*

• Annex I Part C
  – *protect the health of staff working in collecting systems and treatment plants*
The present UWWTD and Health

• Article 3
  – Collecting systems – health benefits

• Article 4
  – Treatment systems – health benefits

• Article 5 and Annex II
  – Sensitive and Less Sensitive area identification based on nutrient concentration and presence of eutrophic conditions – health benefits
Causes of deaths among children under 5 years, 2016

Postneonatal 1-59 months
- Pneumonia: 13%
- Injuries: 6%
- HIV/AIDS: 1%
- Malaria: 5%
- Measles: 1%
- Diarrhoea: 8%
- Prematurity: 2%

Neonatal (0-27 days)
- Pneumonia: 3%
- Intrapartum-related complications, including birth asphyxia: 11%
- Neonatal sepsis: 7%
- Congenital anomalies: 5%
- Neonatal tetanus: 1%
- Other: 3%
- Prematurity: 16%

Other group 1 conditions: 10%
Congenital anomalies and other non-communicable diseases: 8%

Figure 3. Diarrheal disease from water, sanitation, and hygiene: DALYs per 1,000 children (under 5 years old) by region.
Figure 2. Scenarios determining transmission of fecal–oral pathogens.
Democratic Republic of Congo DRC vs Germany

- Under 5 deaths due to Diarrhoea in 2016
  - DRC number 32,493 or 10/1000
  - Germany number 10 or 0/1000

http://www.who.int/gho/countries/cod/country_profiles/en/
Conclusion Sewage Collection

- Collection alone will reduce the faecal-oral pathogen load and hence risk of pathogen exposure.

BUT

- These estimates do not include recreational exposures to surface waters and/or shellfish consumption.
What of Secondary Treatment effects on recreational waters?

Faecal indicator organism concentrations in sewage and treated effluents

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## Intestinal enterococci concentrations of treated effluents

Table 2 – Summary of faecal indicator organism concentrations (cfu 100 ml⁻¹) for different treatment levels and individual types of sewage-related effluents under different flow conditions: geometric means (GMs), 95% confidence intervals (CIs) and results of t-tests comparing base- and high-flow GMs for each group and type; (in footnote) results of t-tests comparing GMs for the two untreated discharge types and the two tertiary-treated effluent types (the results of other comparisons for the groups and other effluent types are present in Tables 3 and 4).

<table>
<thead>
<tr>
<th>Indicator organism</th>
<th>Treatment levels and specific types</th>
<th>Base-flow conditions</th>
<th>High-flow conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Geometric mean</td>
<td>Lower 95% CI</td>
</tr>
<tr>
<td>Enterococci</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Untreated</td>
<td>254</td>
<td>1.9 × 10⁶ (+)</td>
<td>1.6 × 10⁶</td>
</tr>
<tr>
<td>Crude sewage discharges&lt;sup&gt;d&lt;/sup&gt;</td>
<td>254</td>
<td>1.9 × 10⁶ (+)</td>
<td>1.6 × 10⁶</td>
</tr>
<tr>
<td>Storm sewage overflows&lt;sup&gt;d&lt;/sup&gt;</td>
<td>128</td>
<td>1.3 × 10⁶</td>
<td>1.1 × 10⁶</td>
</tr>
<tr>
<td>Primary</td>
<td>61</td>
<td>2.4 × 10⁶</td>
<td>2.1 × 10⁶</td>
</tr>
<tr>
<td>Primary settled sewage</td>
<td>26</td>
<td>6.2 × 10⁵</td>
<td>3.2 × 10⁵</td>
</tr>
<tr>
<td>Settled sewage tank</td>
<td>41</td>
<td>9.3 × 10⁵</td>
<td>5.3 × 10⁵</td>
</tr>
<tr>
<td>Secondary</td>
<td>871</td>
<td>2.8 × 10⁴ (-)</td>
<td>2.5 × 10⁴</td>
</tr>
<tr>
<td>Trickling filter</td>
<td>483</td>
<td>4.1 × 10⁴</td>
<td>3.5 × 10⁴</td>
</tr>
<tr>
<td>Activated sludge</td>
<td>262</td>
<td>2.1 × 10⁴ (-)</td>
<td>1.8 × 10⁴</td>
</tr>
<tr>
<td>Oxidation ditch</td>
<td>35</td>
<td>2.0 × 10⁴</td>
<td>1.0 × 10⁴</td>
</tr>
<tr>
<td>Trickling/sand filter</td>
<td>11</td>
<td>2.1 × 10⁴</td>
<td>1.0 × 10⁴</td>
</tr>
<tr>
<td>Rotating biological contactor</td>
<td>80</td>
<td>9.6 × 10³</td>
<td>6.7 × 10³</td>
</tr>
<tr>
<td>Tertiary</td>
<td>177</td>
<td>3.0 × 10²</td>
<td>1.8 × 10²</td>
</tr>
<tr>
<td>Bedded/grass plot&lt;sup&gt;g&lt;/sup&gt;</td>
<td>73</td>
<td>1.9 × 10¹</td>
<td>7.1 × 10¹</td>
</tr>
<tr>
<td>Ultraviolet disinfection&lt;sup&gt;g&lt;/sup&gt;</td>
<td>104</td>
<td>8.3 × 10¹</td>
<td>4.6 × 10¹</td>
</tr>
</tbody>
</table>
But how do these FIO data relate to health?
Historical Epidemiology

Guidelines for safe recreational water environments
VOLUME 2
COASTAL AND FRESHWATERS
UK RCT studies 1989-1992
Logistic Regression

1 NWR = Non-water related risk level
   $pGI = 0.17$, $FS = 73$ cfu / 100 ml

2 PPT = Person to Person Transmission risk level
   $pGI = 0.34$, $FS = 137$ cfu / 100 ml
<table>
<thead>
<tr>
<th>Range</th>
<th>Description</th>
<th>GI Illness Risk</th>
<th>AFRI Illness Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤40</td>
<td>This range is below the NOAEL in most epidemiological studies.</td>
<td>&lt;1%</td>
<td>&lt;0.3%</td>
</tr>
<tr>
<td>41–200</td>
<td>The 200/100 ml value is above the threshold of illness transmission</td>
<td>1–&lt;5%</td>
<td>0.3–&lt;1.9%</td>
</tr>
<tr>
<td>201–500</td>
<td>This range represents a substantial elevation in the probability of all adverse health outcomes</td>
<td>5–10%</td>
<td>1.9–3.9%</td>
</tr>
<tr>
<td>&gt;500</td>
<td>Above this level, there may be a significant risk of high levels of minor illness transmission.</td>
<td>&gt;10%</td>
<td>&gt;3.9%</td>
</tr>
</tbody>
</table>
pGI
Risk/Water Quality thresholds for WHO and EU Standards

Equivalent intestinal enterococci concentration:
* 95th percentile
** 90th percentile
Recent Developments

• EU commissioned WHO to advise on revision of the BWD (as required in Article 14 of the 2006 BWD).
• Consultation meetings in Brussels and Geneva 2017/8
• Report now with the Commission.
• Acclimatize Results
Cemaes Bay
EU Regional Development Fund Project

Dr Mark Wyer
Professors David Kay
Monitoring sites
DSP results – enterococci

- Large variation ≈ 2 orders in each day (max: 3.6 orders)
- Elevation in response to event conditions – even relatively small events
FIO: Infrastructure

A. *E. coli*

- Llanfechell STW FE
- STW Inlet/storm overflow
- Biological filtration STW final effluent

B. Intestinal enterococci

- Llanfechell STW FE
- STW Inlet/storm overflow
- Biological filtration STW final effluent

† - statistically significant difference
Eutrophication and Health Effects
BWD 2006

Article 8

Cyanobacterial risks

1. When the bathing water profile indicates a potential for cyanobacterial proliferation, appropriate monitoring shall be carried out to enable timely identification of health risks.

2. When cyanobacterial proliferation occurs and a health risk has been identified or presumed, adequate management measures shall be taken immediately to prevent exposure, including information to the public.
### TABLE 8.3. GUIDELINES FOR SAFE PRACTICE IN MANAGING RECREATIONAL WATERS

<table>
<thead>
<tr>
<th>Guidance level or situation</th>
<th>How guidance level derived</th>
<th>Health risks</th>
<th>Typical actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relatively low probability of adverse health effects</td>
<td>- From human bathing epidemiological study</td>
<td>- Short-term adverse health outcomes, e.g., skin irritations, gastrointestinal illness</td>
<td>- Post on-site risk advisory signs</td>
</tr>
<tr>
<td>20,000 cyanobacterial cells/ml or 10 µg chlorophyll-a/litre with dominance of cyanobacteria</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate probability of adverse health effects</td>
<td>- From provisional drinking-water guideline value for microcystin-LR and data concerning other cyanotoxins</td>
<td>- Potential for long-term illness with some cyanobacterial species</td>
<td>- Watch for scums or conditions conducive to scums</td>
</tr>
<tr>
<td>100,000 cyanobacterial cells/ml or 50 µg chlorophyll-a/litre with dominance of cyanobacteria</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High probability of adverse health effects</td>
<td>- Inference from oral animal lethal poisonings, Actual human illness case histories</td>
<td>- Potential for acute poisoning</td>
<td>- Immediate action to control contact with scums; possible prohibition of swimming and other water contact activities</td>
</tr>
<tr>
<td>Cyanobacterial scum formation in areas where whole-body contact and/or risk of ingestion/aspiration occur</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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* Derived from Chorus & Bartram, 1999.

* Actual action taken should be determined in light of extent of use and public health assessment of hazard.

* The provisional drinking-water guideline value for microcystin-LR is 1 µg/litre (WHO, 1998).
Potential Overlap/Co-ordination

• WFD (2000/60/EC) Health Protection

• Protected Areas (Article 4 Annex IV)
  o (ii) areas designated for the protection of economically significant aquatic species;
  o (iii) bodies of water designated as recreational waters, including areas designated as bathing waters under Directive 76/160/EEC;
  o (iv) nutrient-sensitive areas, including areas designated as vulnerable zones under Directive 91/676/EEC (Nitrates Directive)

• Lists of Measures (Article 11 Annex VI)
  o (i) The Bathing Water Directive (76/160/EEC);
  o (iii) The Drinking Water Directive (80/778/EEC) as amended by Directive (98/83/EC);
  o (vii) The Urban Waste-water Treatment Directive (91/271/EEC);
  o (ix) The Nitrates Directive (91/676/EEC);
Conclusions

• UWWTD has significant health benefits
• Mostly unquantified
• End of pipe microbial standards could be useful
• Disinfection of storm flows is an emerging technology
• Linking effluent N+P quality with eutrophication parameters would be useful
Any Questions?

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