Antibiotic Resistance in Massachusetts Bay

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Flow of Antibiotics into the Aquatic Environment

- Animal husbandry
- Agriculture
- Prescriptions
- Hospitals
- Landfills
- Sewage
- Surface run-off
- Leaching
- Aquatic environment

Related processes:
- Animal waste
- General population
- Aquaculture
2 Conditions Ideal for Selecting for Resistance

1) Low concentration

2) Prolonged exposure
Clinical Strategy
Clinical Strategy
Clinical Strategy
Environmental Situation
Environmental Situation
Environmental Situation
Environmental Situation
Why Should We Care if Nonpathogenic Environmental Microbes are Resistance to Antibiotics?

Horizontal Gene Transfer
Massachusetts Bay
## Biomass and Bacteria Estimates

<table>
<thead>
<tr>
<th></th>
<th>DNA&lt;sub&gt;T&lt;/sub&gt;-ng/ml water (biomass)</th>
<th>Copies 16S rRNA genes/ml water (bacteria)</th>
<th>Copies 16S rRNA genes/ng DNA&lt;sub&gt;T&lt;/sub&gt; (bacteria/biomass)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Influent</strong></td>
<td>4750.9 1323.7</td>
<td>9.2x10&lt;sup&gt;10&lt;/sup&gt; 4.1x10&lt;sup&gt;10&lt;/sup&gt;</td>
<td>2.1x10&lt;sup&gt;7&lt;/sup&gt; 1.0x10&lt;sup&gt;7&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Effluent</strong></td>
<td>1714.6 497.9</td>
<td>8.1x10&lt;sup&gt;9&lt;/sup&gt; 1.1x10&lt;sup&gt;10&lt;/sup&gt;</td>
<td>4.8x10&lt;sup&gt;6&lt;/sup&gt; 6.9x10&lt;sup&gt;6&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Nearfield</strong></td>
<td>46.2 28.4</td>
<td>5.6x10&lt;sup&gt;7&lt;/sup&gt; 3.5x10&lt;sup&gt;7&lt;/sup&gt;</td>
<td>1.6x10&lt;sup&gt;6&lt;/sup&gt; 1.7x10&lt;sup&gt;6&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Farfield</strong></td>
<td>35.7 23.1</td>
<td>8.5x10&lt;sup&gt;7&lt;/sup&gt; 4.8x10&lt;sup&gt;7&lt;/sup&gt;</td>
<td>3.0x10&lt;sup&gt;6&lt;/sup&gt; 2.1x10&lt;sup&gt;6&lt;/sup&gt;</td>
</tr>
</tbody>
</table>
Sample Analysis

• DNA extracted

• Real Time PCR
**tet Genes per ml of Water**

![Graph showing log Tc' gene copies/ml water for different locations and genes.](image)

- **Influent**
- **Effluent**
- **Nearfield**
- **Farfield**

Genes per ml of Water:
- tet(A)
- tet(B)
- tet(M)
- tet(O)
- tet(Q)
- tet(W)
*tet* Genes Relative to Biomass

![Graph showing gene copies/ng DNA for various locations and genes](image-url)

- Influent
- Effluent
- Nearfield
- Farfield

Gene copies/ng DNA for:
- tet(A)
- tet(B)
- tet(M)
- tet(O)
- tet(Q)
- tet(W)
**tet** Genes Relative to Bacterial Count

![Graph showing the distribution of tet genes relative to bacterial count across different samples. The graph compares tet(A), tet(B), tet(M), tet(O), tet(Q), and tet(W) genes in Influent, Effluent, Nearfield, and Farfield samples. The y-axis represents log Tc gene copies/16S rRNA gene copies.](image-url)
Conclusions

• Sewage treatment decreases concentrations of antibiotic resistance genes
• Through sewage effluent, antibiotic resistance genes are introduced into the environment in substantially higher concentrations than occur naturally
• This creates reservoirs of increased resistance potential
Acknowledgements

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