Antibiotic resistance
from a WWTP perspective

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http://www.biomedicine.gu.se/joakimlarsson

European commission, Brussels, October 2018
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Antibiotic resistance is a fast-growing societal challenge

Figure 3.12. Klebsiella pneumoniae. Percentage (%) of invasive isolates with combined resistance to fluoroquinolones, third-generation cephalosporins and aminoglycosides, by country, EU/EEA countries, 2016

Legend:
- 1%
- 1% to < 5%
- 5% to < 10%
- 10% to < 25%
- 25% to < 50%
- ≥ 50%
- No data reported or fewer than 10 isolates
- Not included
The Environmental Dimensions of Antibiotic Resistance

1. Dissemination

The Environmental Dimensions of Antibiotic Resistance

2. Emergence

70 years ago pathogens were almost always sensitive to antibiotics

Aquired resistance through mutations and uptake of resistance genes
Antibiotic resistance in the environment is ancient

\(\text{vanX}\)
\(\text{bla}\)
\(\text{tetM}\)

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Slide courtesy: Gerry Wright

Resistance in harmless bacteria

Resistance in pathogens

Could be a rare or one-time event - anywhere
Where do these critical mobilization and transfer events occur?
REVIEW ARTICLE

Environmental factors influencing the development and spread of antibiotic resistance

Johan Bengtsson-Palme1,4,*, Erik Kristiansen1,2 and D. C. Joakim Larsson1,2

* Corresponding author.
Is there evidence for selection of antibiotic resistance in sewage treatment plants?

- Lots of pathogens
- High diversity of potential donors
- High bacterial density
- Presence of selective agents

Measured concentrations of certain antibiotics in sewage treatment plants (sometimes also downstream) are often greater than Minimal Selective Concentrations.
...but field observations provide a less clear picture.

It is still uncertain if, where and to what degree antibiotics from domestic wastewater selects for antibiotic resistance.


![Image of bar chart showing antibiotic resistance in influent and effluent samples.](image-url)


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**UN Environment**

Antimicrobial resistance from environmental pollution among biggest emerging health threats, says UN Environment

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UN Environment

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06 DEC 2017 PRESS RELEASE ENVIRONMENTAL GOVERNANCE

Antimicrobial resistance from environmental pollution among biggest emerging health threats, says UN Environment
Commitments on pollution control made by the world’s largest pharma companies in conjunction with the UN general assembly in New York in September 2018

AMR Alliance Recommended PNECs for Risk Assessments

<table>
<thead>
<tr>
<th>Active Pharmaceutical Ingredient</th>
<th>PNEC-ENV (µg/L)</th>
<th>PNEC-MIC (µg/L)</th>
<th>Lowest Value (µg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amikacin</td>
<td>N/A</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>Amoxicillin</td>
<td>Testing On-Going</td>
<td>0.25</td>
<td>0.25</td>
</tr>
<tr>
<td>Amphotericin B</td>
<td>N/A</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>Ampicillin</td>
<td>0.87</td>
<td>0.25</td>
<td>0.25</td>
</tr>
<tr>
<td>Anidulafungin</td>
<td>N/A</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>Avilamycin</td>
<td>N/A</td>
<td>8.0</td>
<td>8.0</td>
</tr>
<tr>
<td>Azithromycin</td>
<td>0.02</td>
<td>0.25</td>
<td>0.25</td>
</tr>
<tr>
<td>Aztreonam</td>
<td>N/A</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td>Bacitracin</td>
<td>100</td>
<td>8.0</td>
<td>8.0</td>
</tr>
<tr>
<td>Bedaquiline</td>
<td>0.08</td>
<td>N/A</td>
<td>0.08</td>
</tr>
<tr>
<td>Benzylpenicillin</td>
<td>N/A</td>
<td>0.25</td>
<td>0.25</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>N/A</td>
<td>3.0</td>
<td>3.0</td>
</tr>
</tbody>
</table>

- Risks for antibiotic resistance selection has not been included in the WFD, UWWTD or EQSD
- Inclusions of certain antibiotics on the watch list has been the result of concerns for ecological effects
- Consideration of antibiotic resistance promotion is (at least) equally well motivated both from a PEC/PNEC standpoint and based on public/scientific concern

Global Aquatic Hazard Assessment of Ciprofloxacin: Exceedances of Antibiotic Resistance Development and Ecotoxicological Thresholds

Ciprofloxacin
EQS data overview
Sara Sætraa, O. G. Jørgen Lassen, Marlene Ågerstrand

Report (no 770-18) soon available from The Swedish Agency for Marine and Water Management (www.havochvatten.se) or by contacting Marlene Ågerstrand at Stockholm University: Marlene.Agerstrand@aces.su.se
Pharmaceutical production sites and surrounding environments


30 mg/L ciprofloxacin

30 ng/L ciprofloxacin
Thank you for listening!