

Conference or Workshop Item

Singer, Andrew. 2010 How influenza pandemic control can lead to unpreparedness: modelling the ecotoxicity of pharmaceutical usage. [Other] In: *Influenza 2010: Zoonotic Influenza and Human Health*, Oxford, UK, 21-23 September 2010. (Unpublished)

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Contact CEH NORA team at
noraceh@ceh.ac.uk

How influenza pandemic control can lead to unpreparedness: modelling the ecotoxicity of pharmaceutical usage

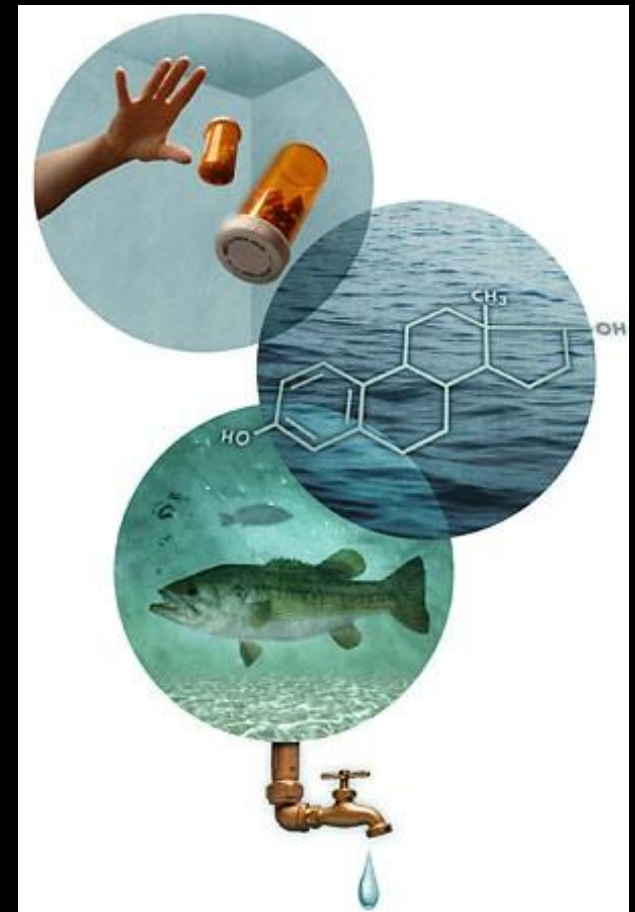


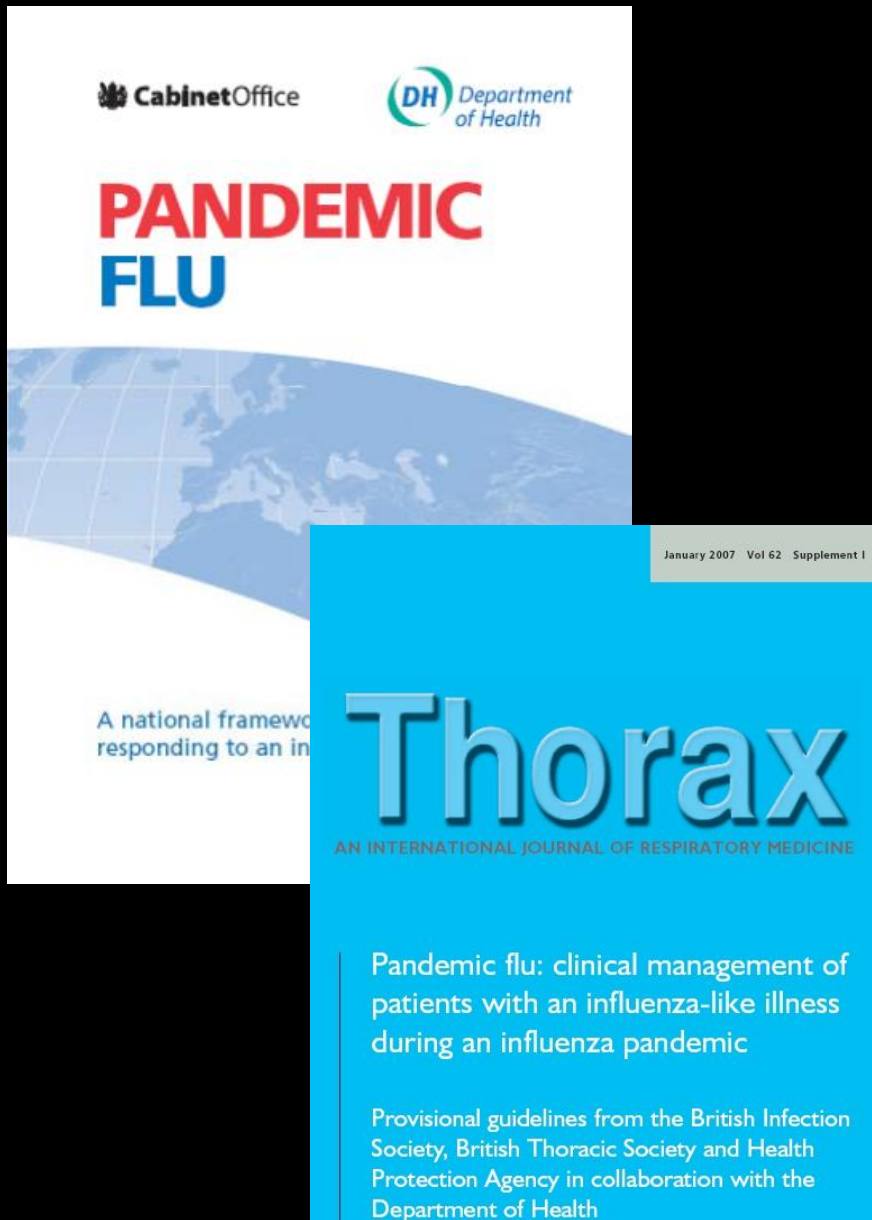
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“Dilution is the Solution to Pollution”

- Many drugs are minimally metabolised in the body.
- As a general rule, if a drug persists in the body it will likely persist in the environment.
- Is there enough water available to dilute projected drug use during an influenza pandemic?
- If not, what’s the potential impact?





What is Pandemic Preparedness?

... to slow the spread of influenza, through:

1) vaccines,

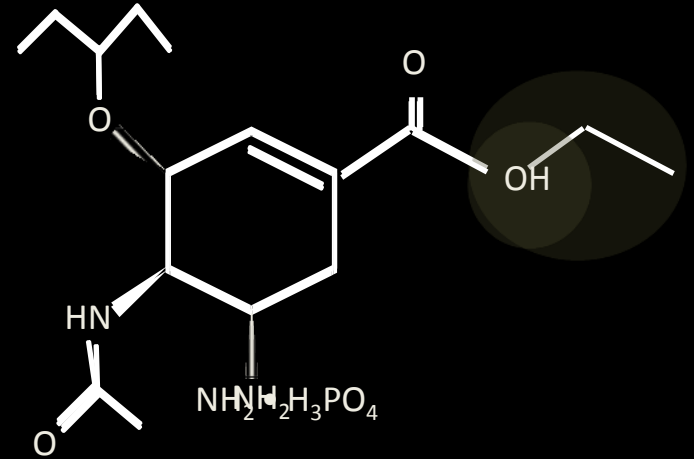
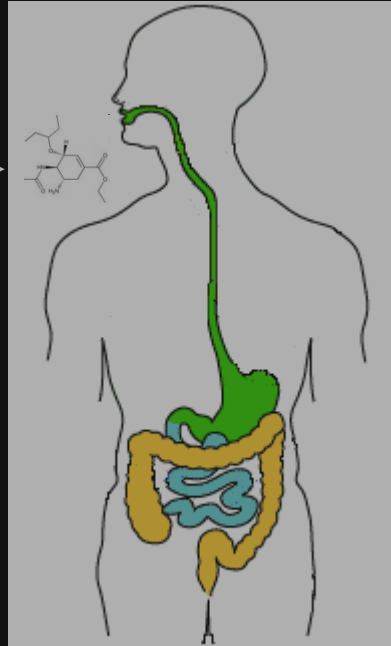
2) non-pharmaceutical measures

3) antivirals



2 x 75 mg/d for 5 days

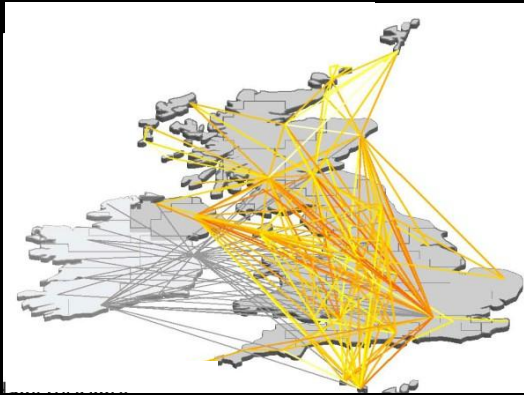
?



Impact Assessment



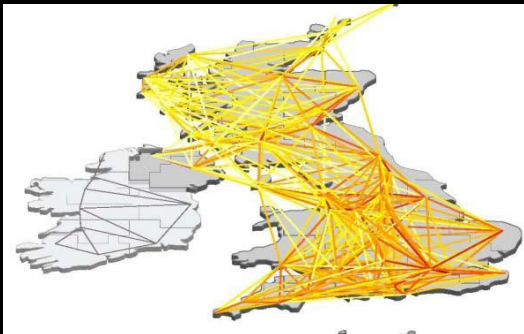
1. epidemic model



GLEaM – Global Epidemic and Mobility model

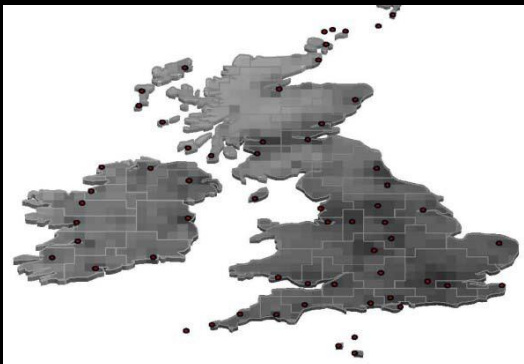
air mobility layer

- 3400 airports in 220 countries
- 20,000 connections
- traffic data (IATA, OAG)
- >99% commercial traffic



commuting mobility layer

- daily commuting data
- >30 countries in 5 continents
- universal law of mobility

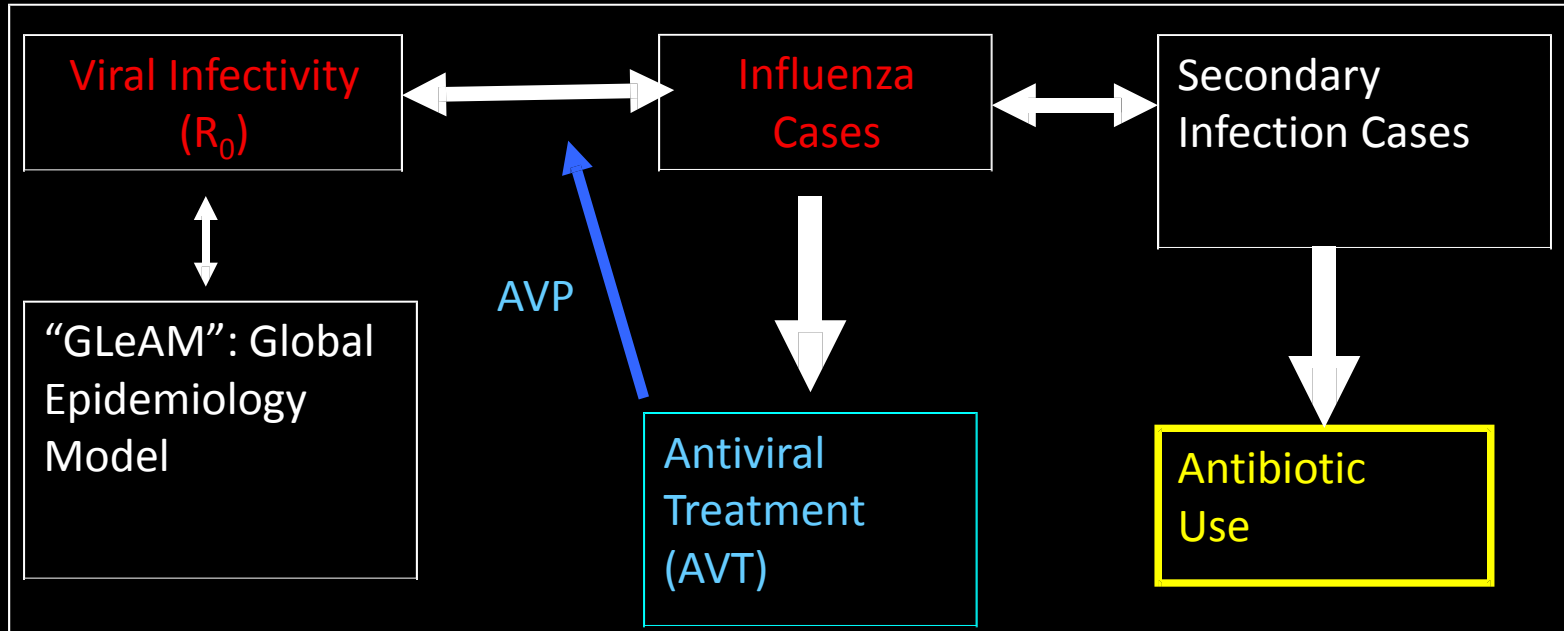


demographic layer

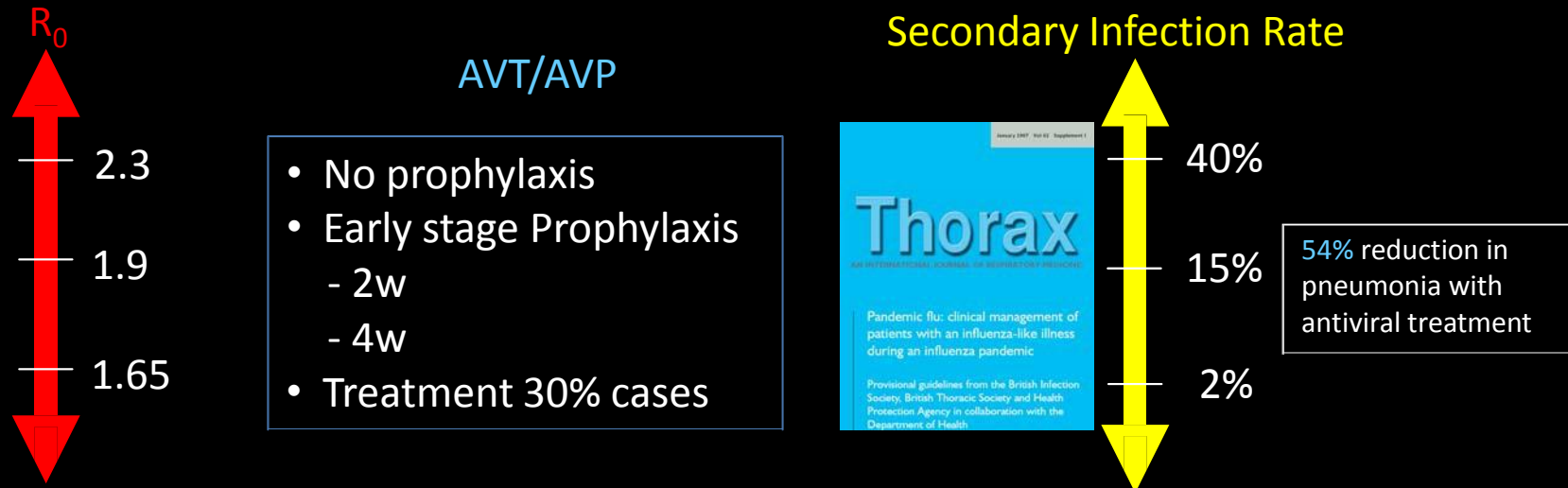
- cells $\frac{1}{4}^\circ \times \frac{1}{4}^\circ$
- tessellation around transportation hubs



Pharmaceutical Use Model During an Influenza Pandemic

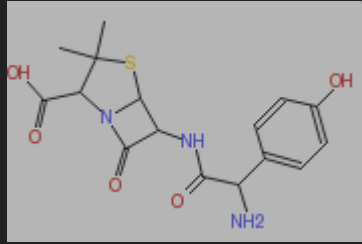


R_0 = number of secondary cases of influenza produced by 1 infected individual

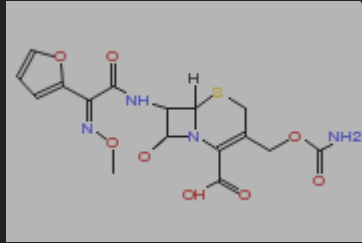


**β-lactam
Cephalosporin**

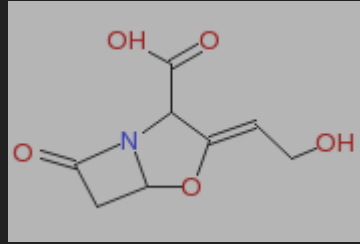
Amoxicillin



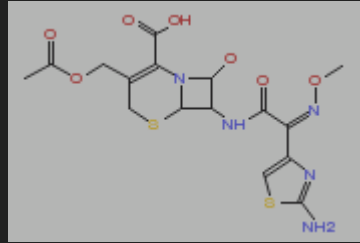
Cefuroxime



Clavulanic acid

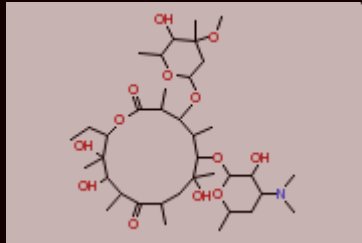


Cefotaxime

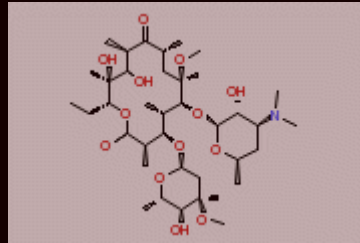


Macrolide

Erythromycin

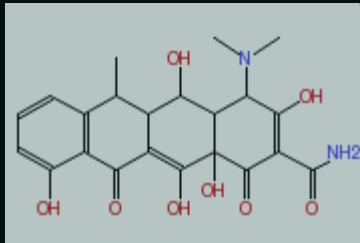


Clarithromycin



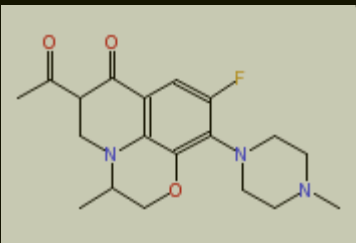
Tetracycline

Doxycycline

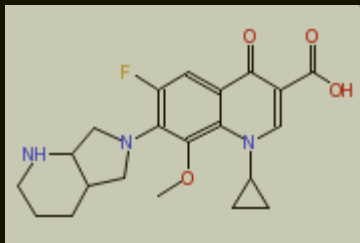


Quinolone

Levofloxacin

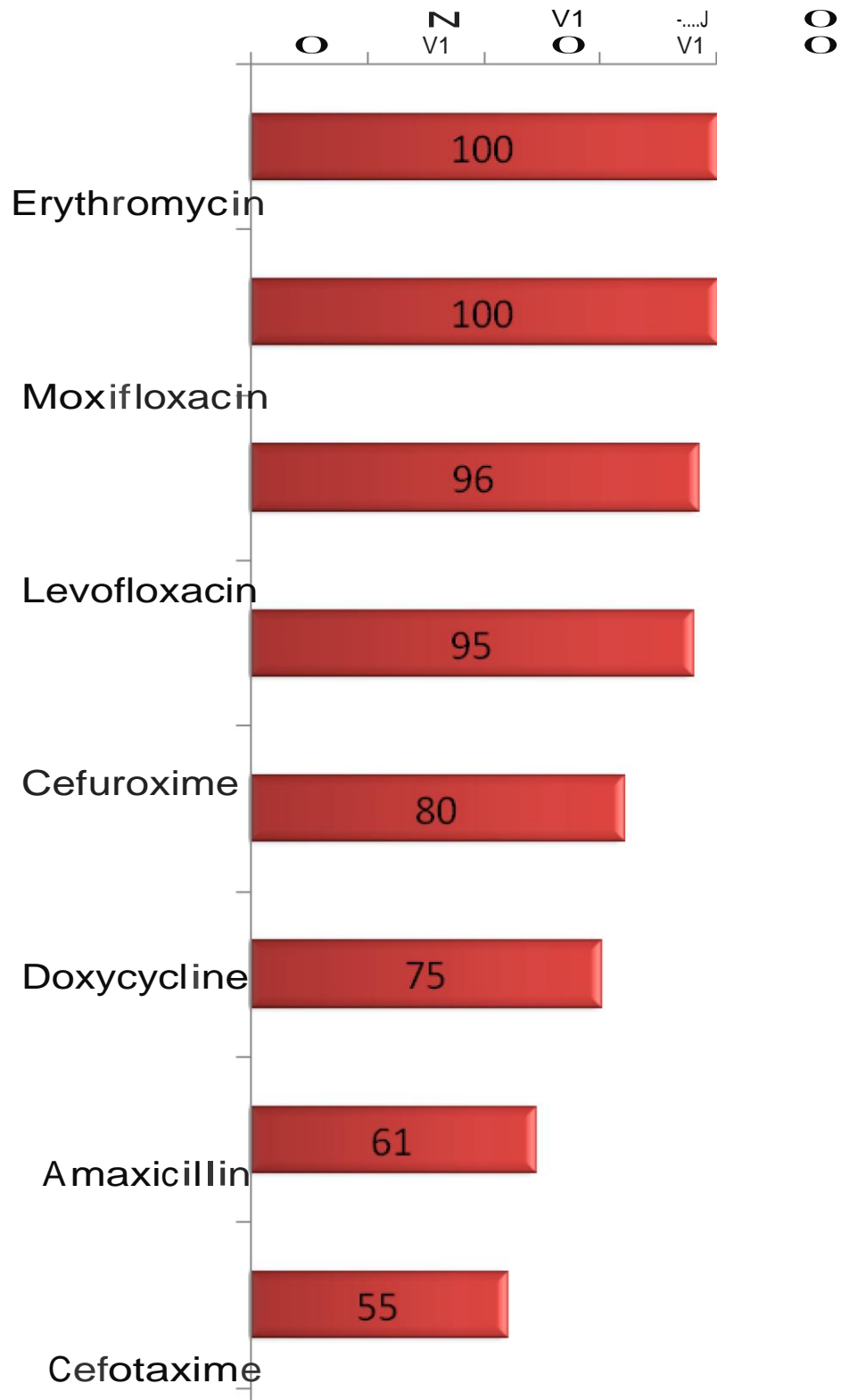


Moxifloxacin

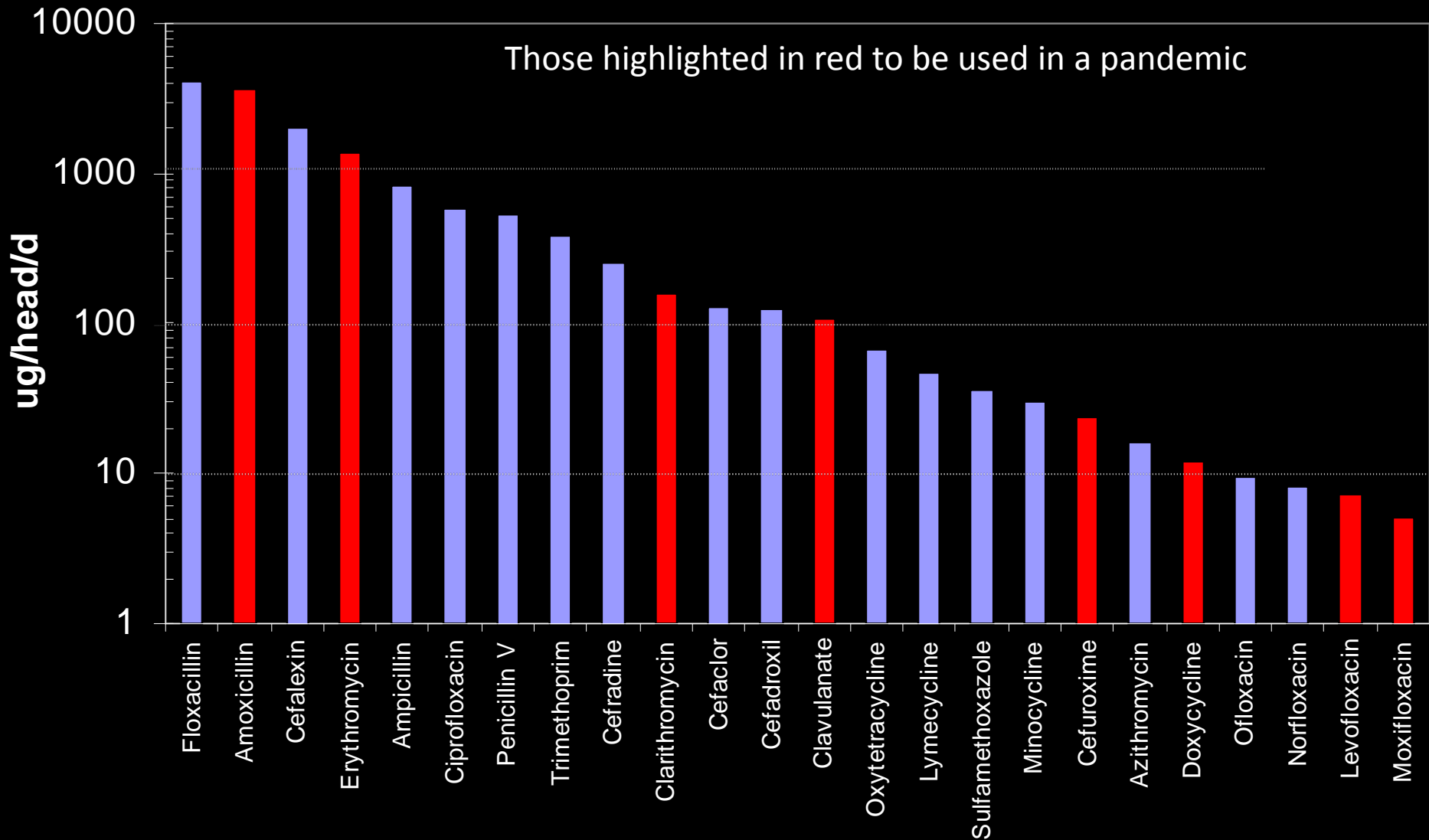




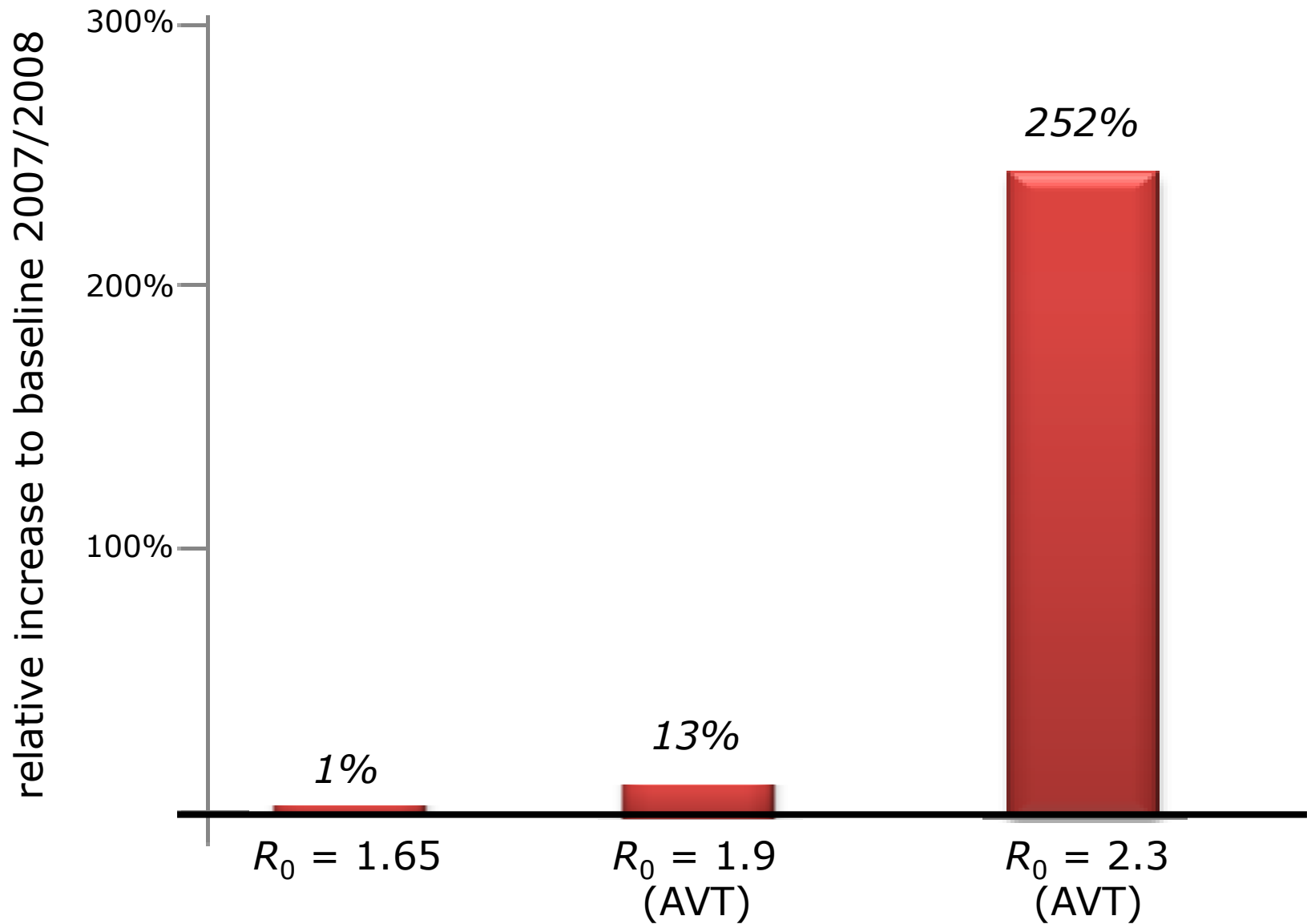
% excreted as parent or conjugate



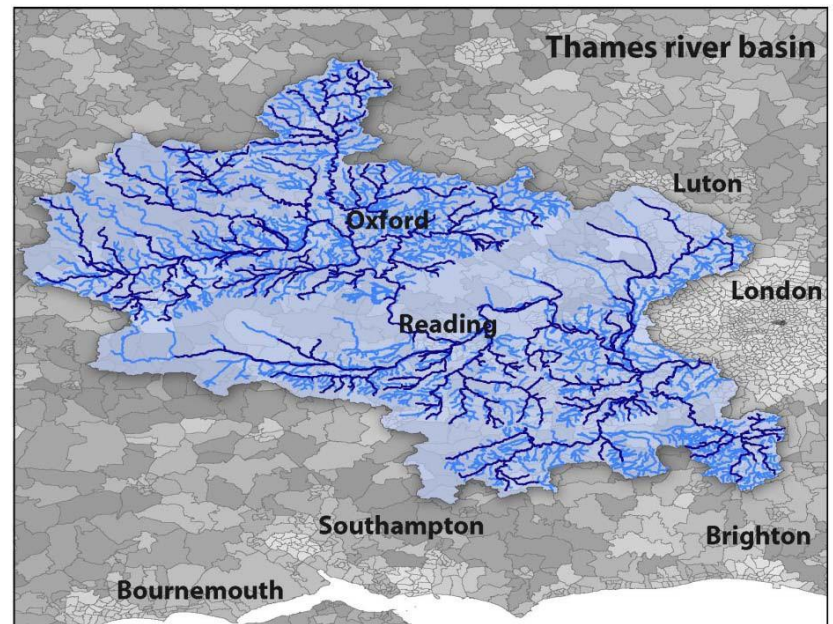
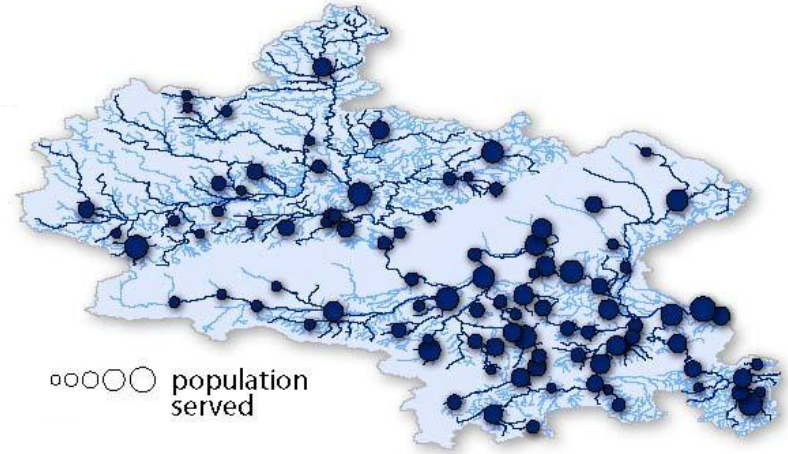
Baseline Antibiotic Use (excreted in England)



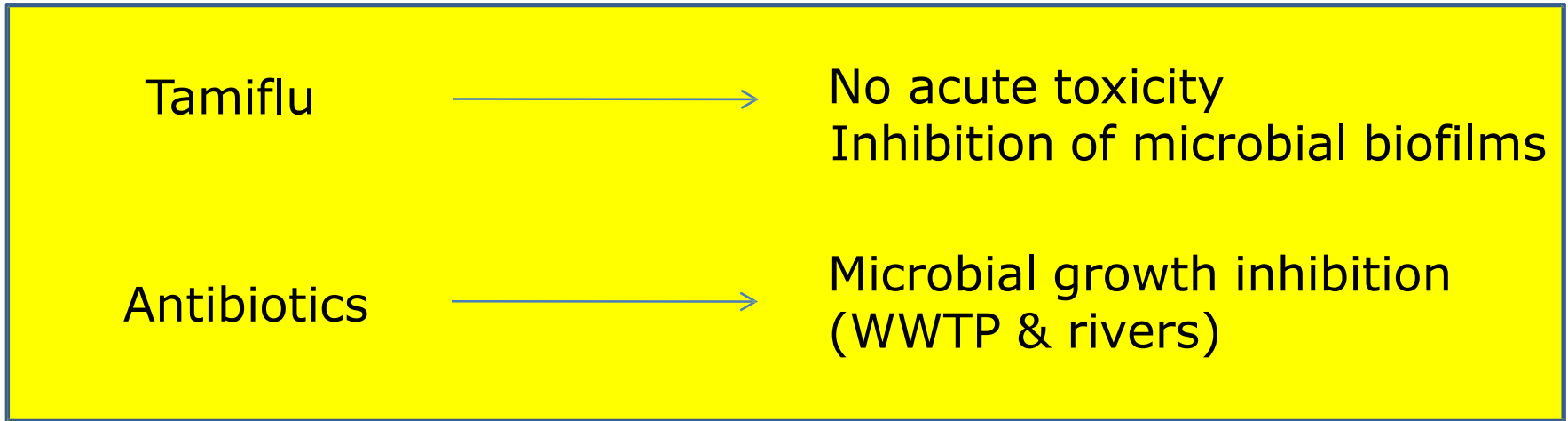
results: antibiotics in WWTPs



LF2000-WQX works

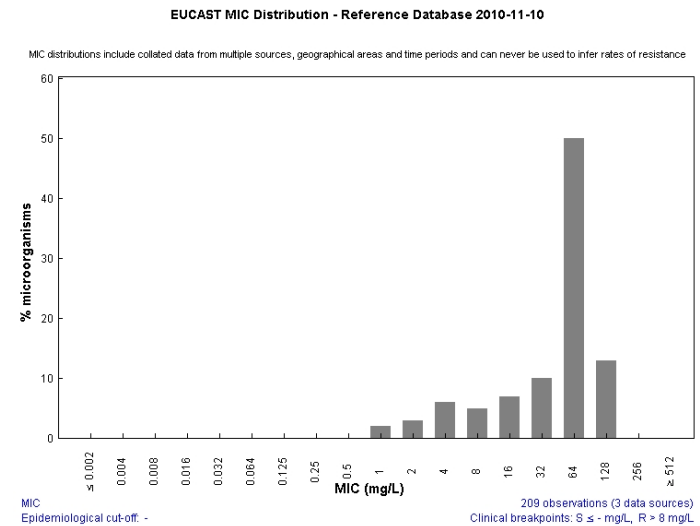


Determining Impact

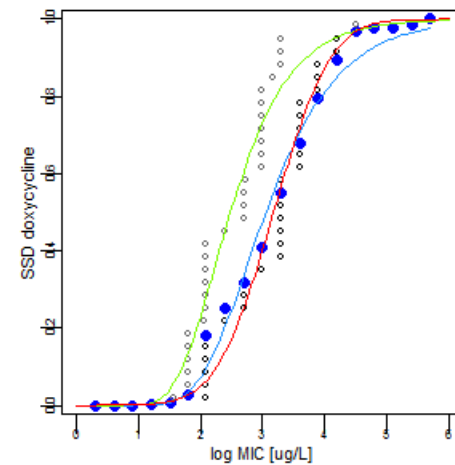
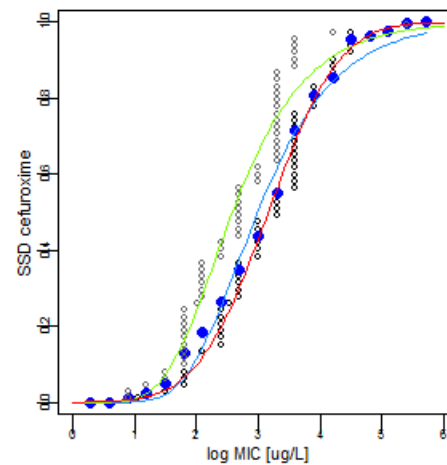
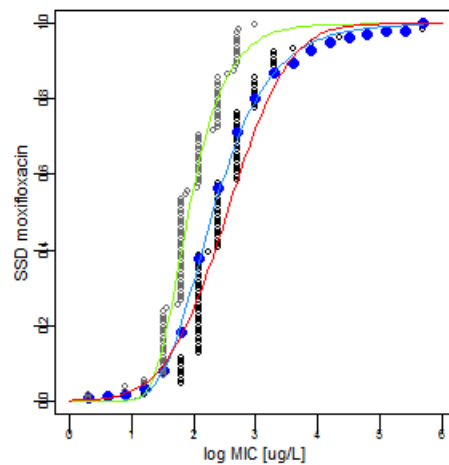
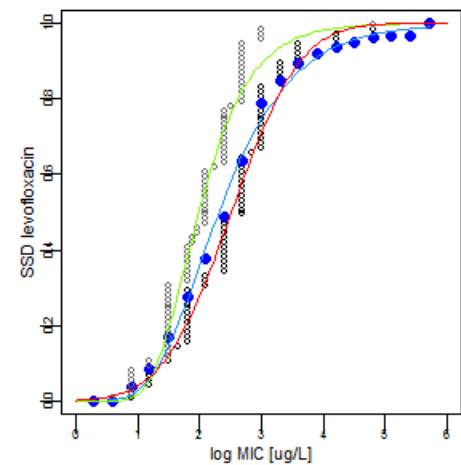
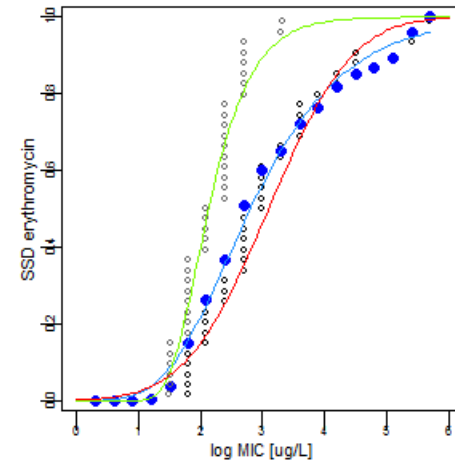
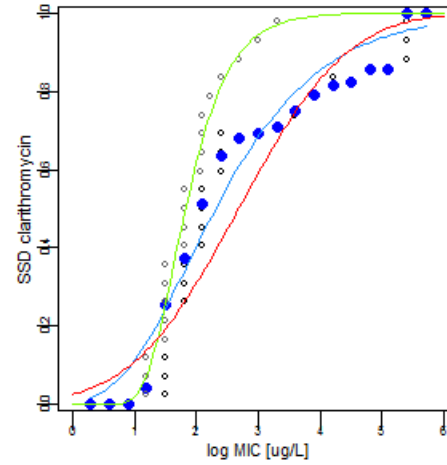
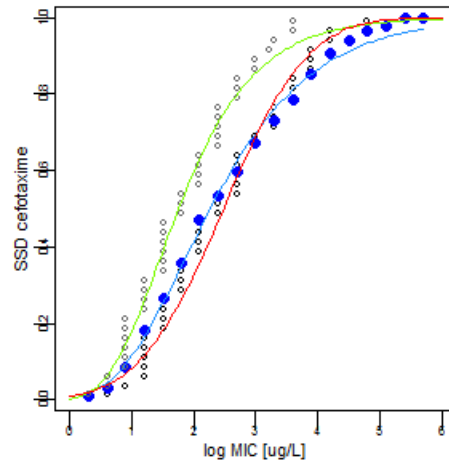
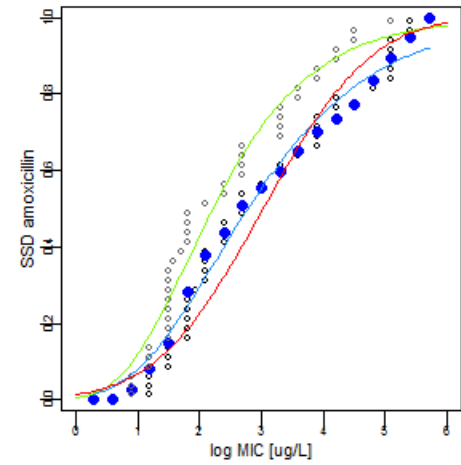


toxicity (0-100%)

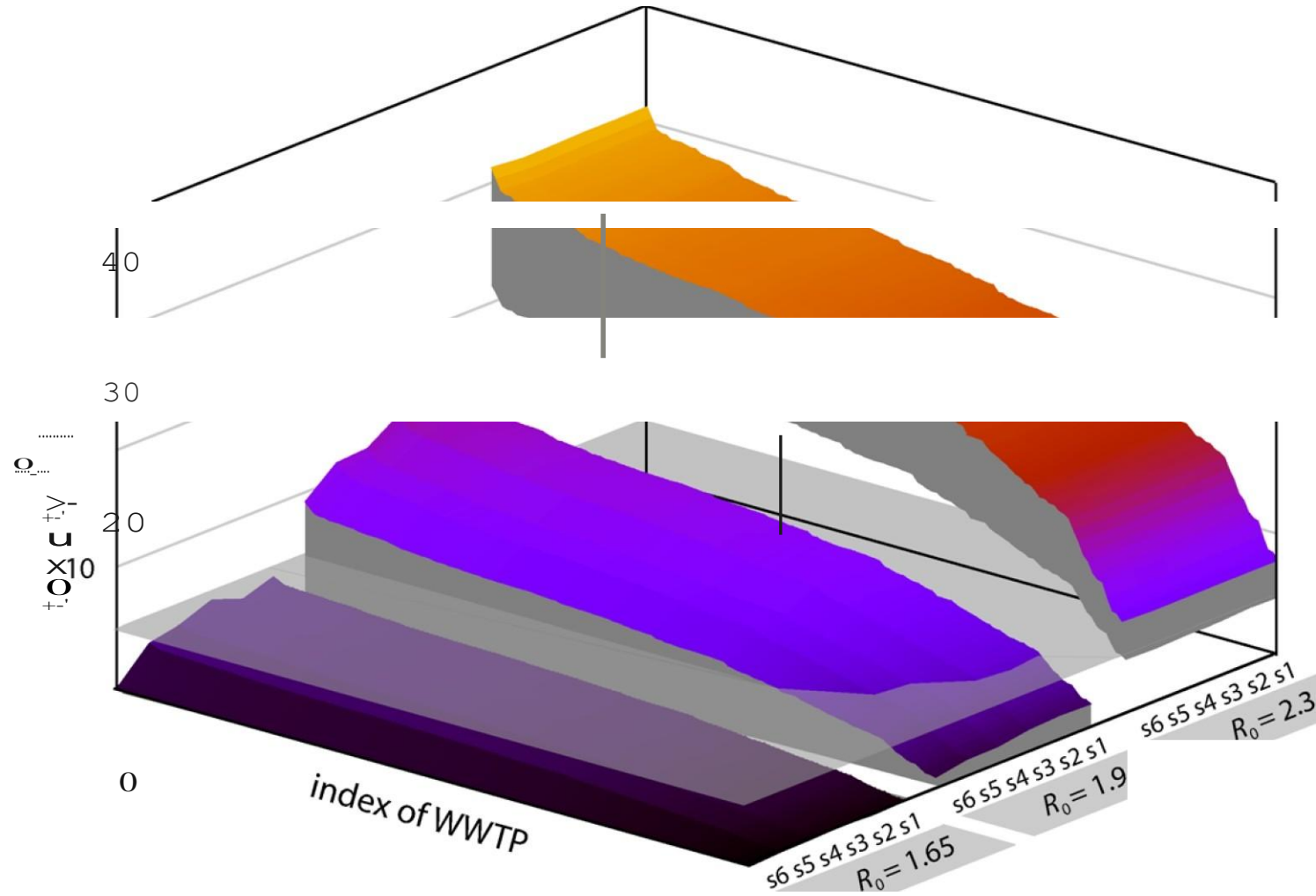
'Potentially affected fraction'
of sewage or river microbial
species



Ecotoxicity: Species sensitivity distributions based on Minimum Inhibitory Concentrations



results: toxicity in WWTPs

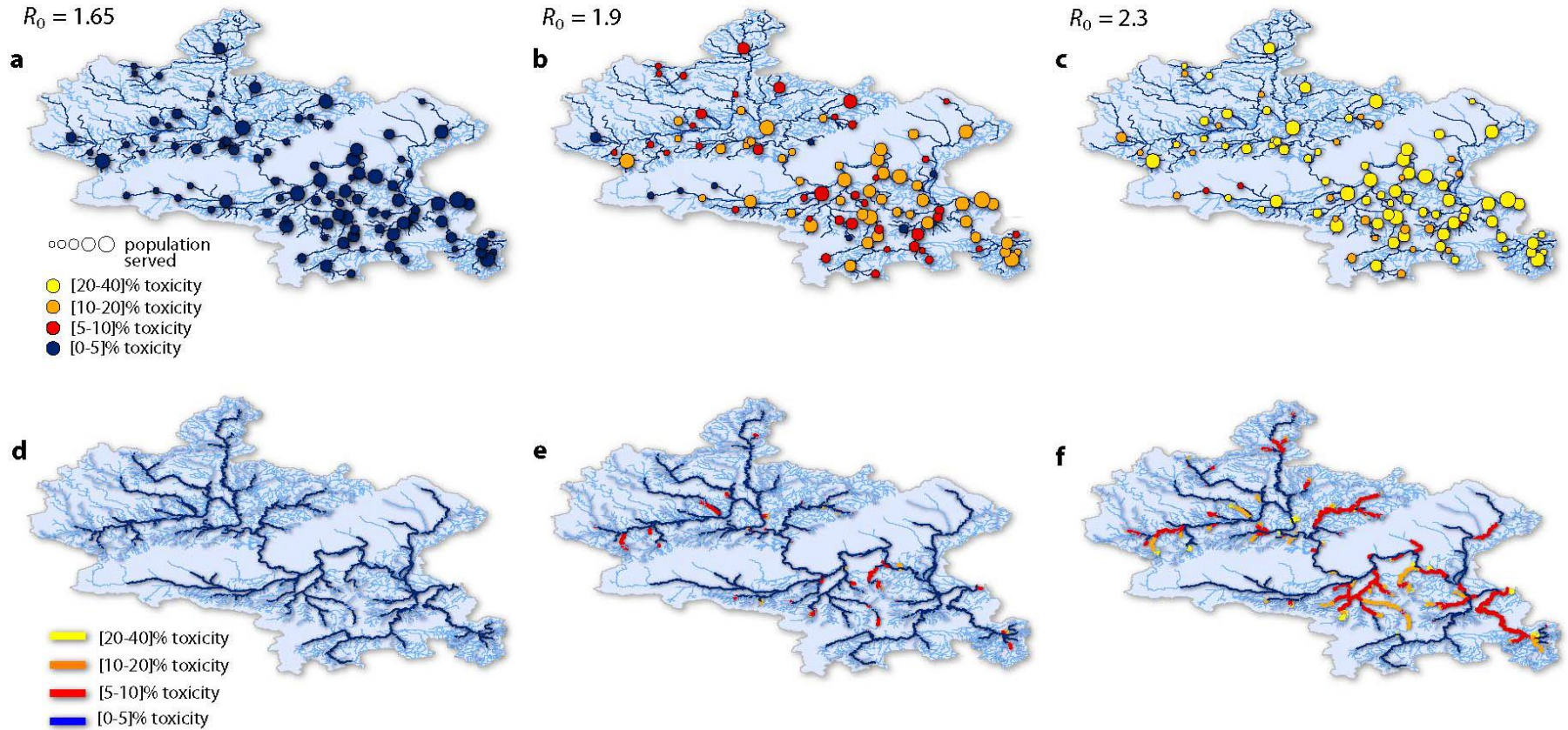


Spatial distribution of toxicity in WWTPs & Rivers

% of sewage plants >5% PAF

≤ 85

≤ 100



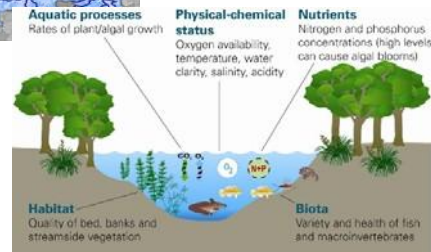
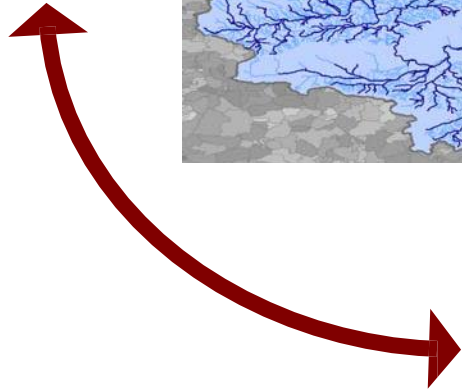
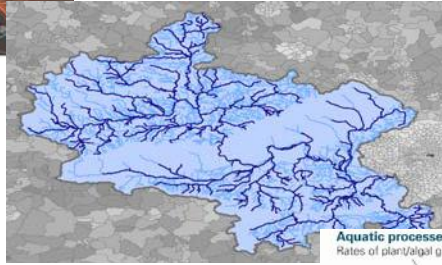
% of Thames River length >5% PAF

≤ 10

≤ 40



Impact



antiviral and antibiotics resistance

Solutions ?

VACCINATION!!

Pandemic usage of Pharmaceuticals

The image shows a screenshot of the PREPARE website. The header features the PREPARE logo on the left and a search bar on the right. Below the header is a navigation menu with links for HOME, ABOUT, LITERATURE, WORKSHOPS, LINKS, and CONTACT US. A breadcrumb trail indicates 'You are here: Home'. On the right side of the header, there are social media icons for RSS and Twitter, with labels 'Subscribe' and 'Follow'. The main content area is divided into three sections: a large 'WELCOME TO PREPARE' section on the left, a 'FEATURED ARTICLE' section at the bottom left, and a 'FEATURED AUTHOR' section on the right. The 'WELCOME TO PREPARE' section contains introductory text and a photograph of a stream in a forest. The 'FEATURED ARTICLE' section features a photograph of fish and the title 'Dissipation and removal of oseltamivir (Tamiflu) in different aquatic environments'. The 'FEATURED AUTHOR' section includes a portrait of Andrew Singer and a brief description of his research interests. The 'TWITTER' section at the bottom right contains a tweet about the virus's infectiousness.

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WELCOME TO PREPARE

PREPARE is a UK Natural Environment Research Council knowledge exchange initiative with the overall aim to integrate the information and expertise required to assess the implications of pharmaceutical usage during a major disease outbreak for the environment, and the risk posed to current wastewater infrastructure.

The PREPARE Initiative aims to inform policy, regulation and emergency planning to ensure that ecotoxicologic and human health risks associated with pharmaceutical usage under pandemic and epidemic conditions are thoroughly assessed utilising all and currently available knowledge.



FEATURED ARTICLE




Dissipation and removal of oseltamivir (Tamiflu) in different aquatic environments

Chemosphere 79(8):891-897

Cesare Accinelli, Maria Ludovica Saccà, Jerker Fick, Mariangela Mencarelli, ...

FEATURED AUTHOR



Andrew Singer has a broad research interest focused around soil, water and air pollution. Throughout his academic ...

Read Andrew's most recent article: [Dissipation and removal of oseltamivir \(T... or, read Andrew's full bio](#)

TWITTER

Virus can remain infectious for up to two weeks at low temperatures <http://ow.ly/2Cwn3 # 2010/09/10>

Strategic Review of Health

Thanks to Collaborators...and you!

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