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 (Unpublished)

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

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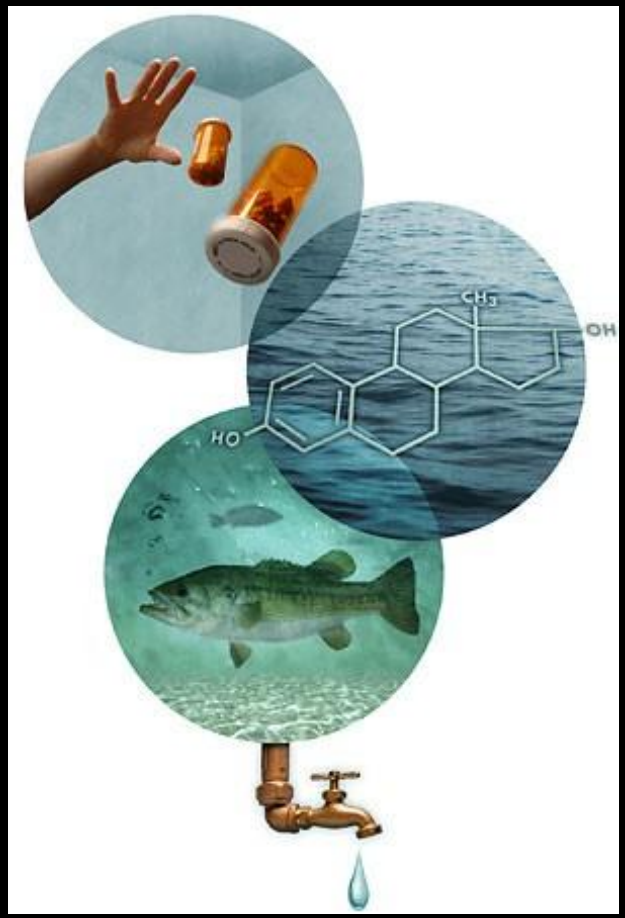
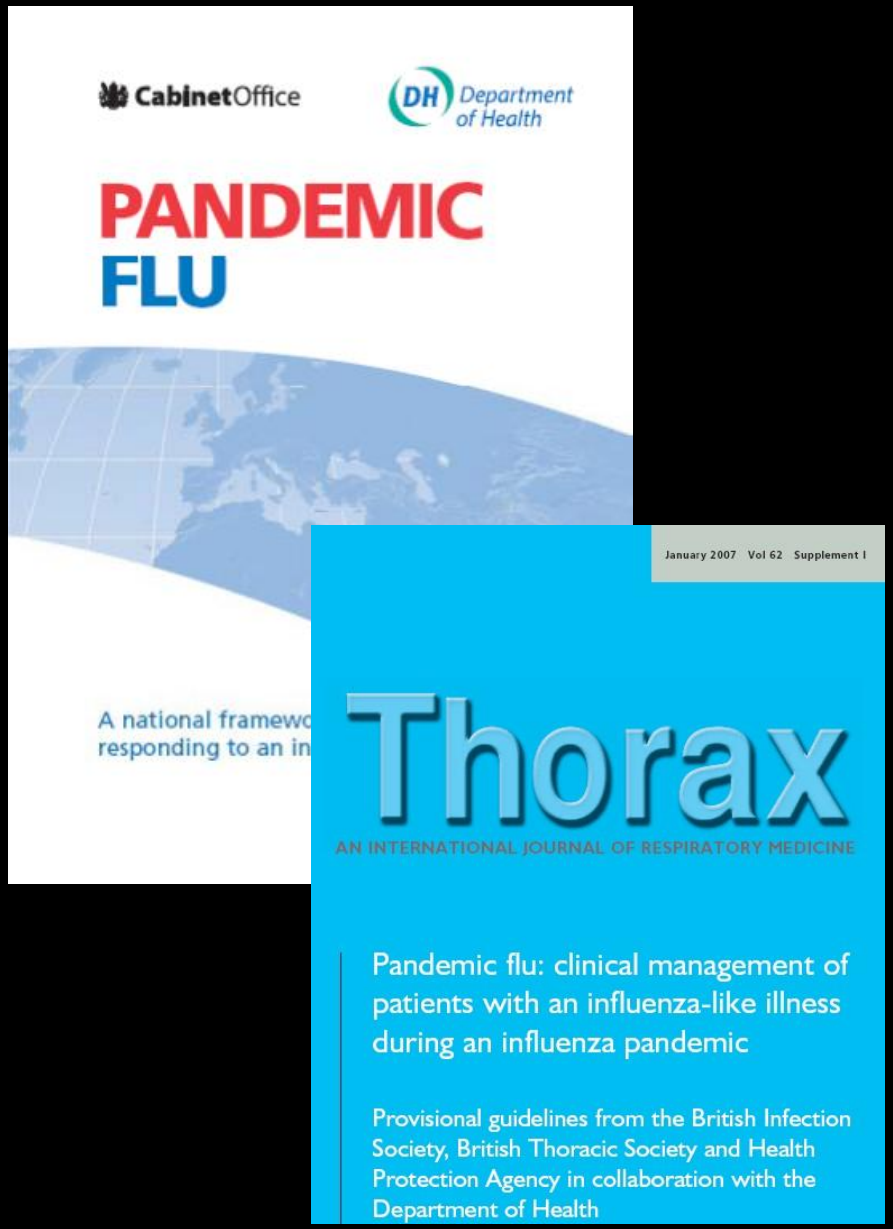
“Dilution is the Solution to Pollution”

- 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

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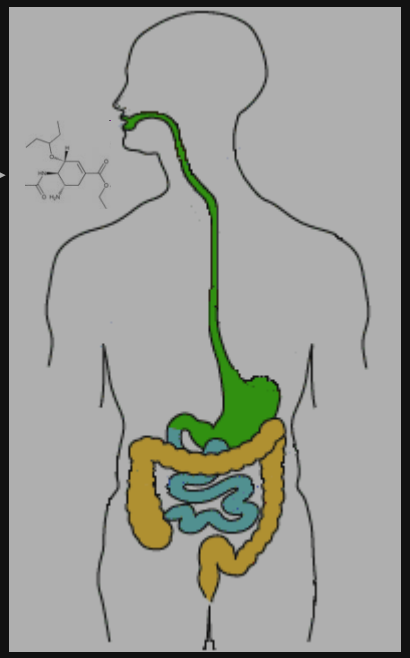
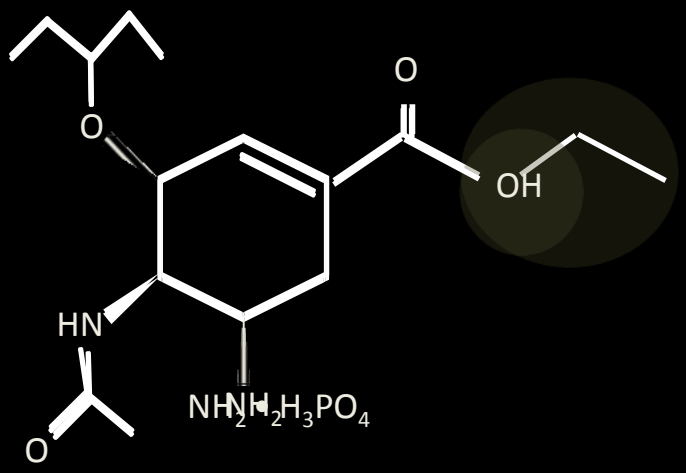


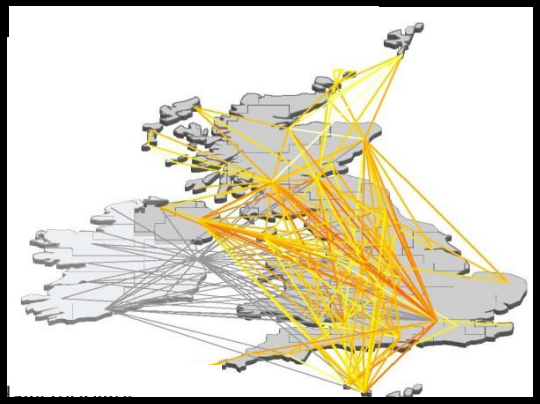


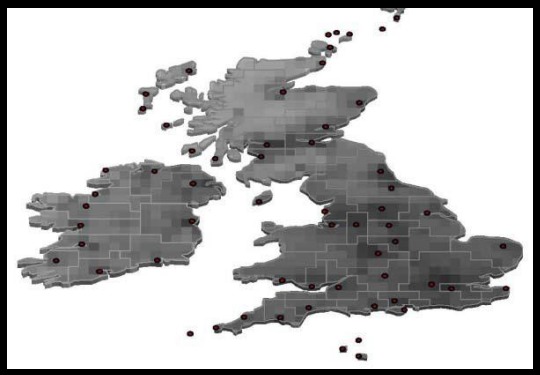
Impact Assessment

?

?

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

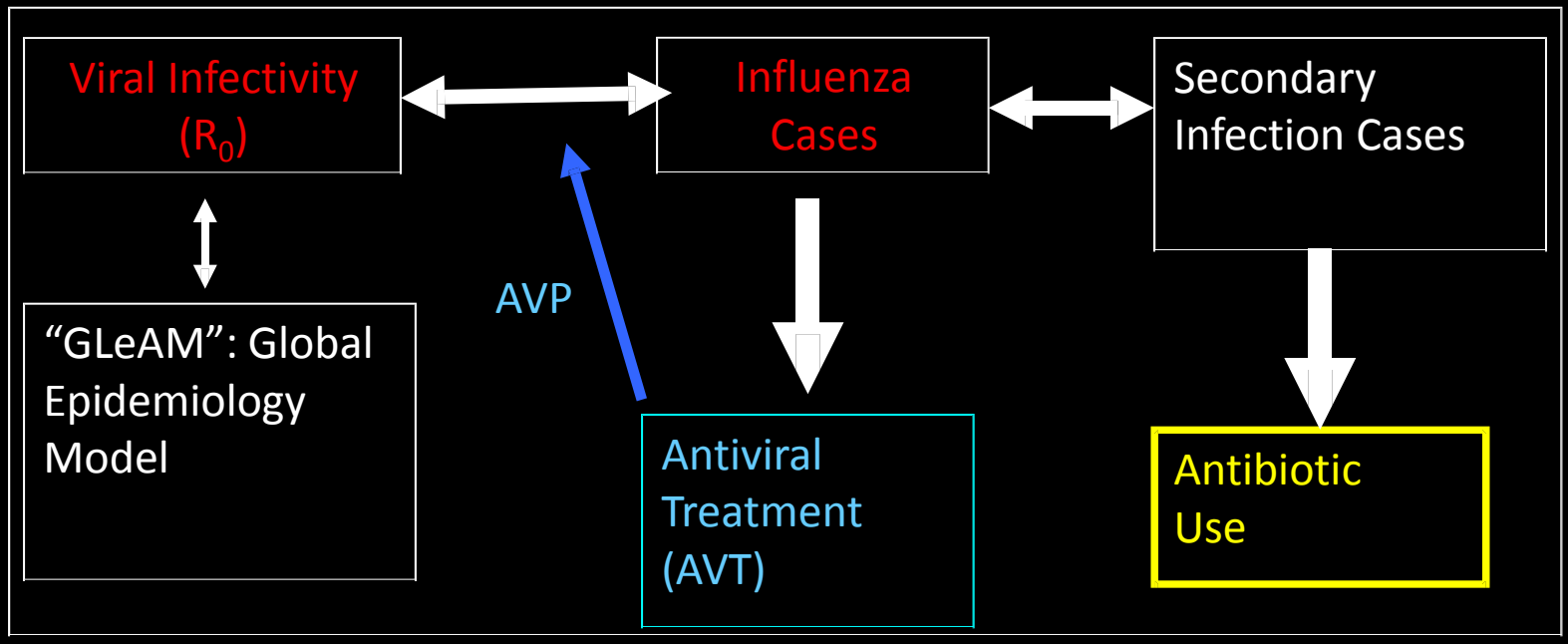
commuting mobility layer
- ☐ daily commuting data
- ☐ >30 countries in 5 continents
- ☐ universal law of mobility

demographic layer
- ☐ cells ¼° x ¼°
- ☐ tessellation around transportation hubs

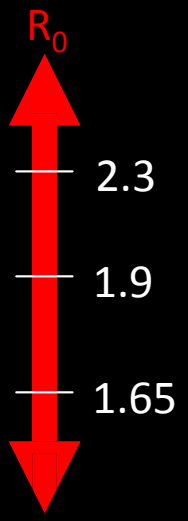
www.epiwork.eu

Balcan et al. PNAS (2009)

Pharmaceutical Use Model During an Influenza Pandemic



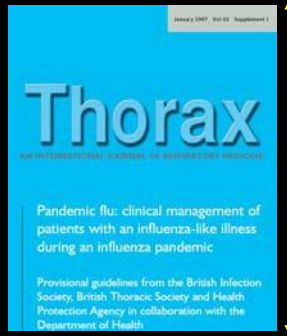
R_0 = number of secondary cases of influenza produced by 1 infected individual

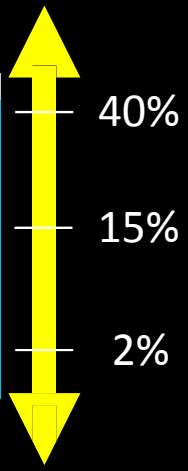


AVT/AVP

- No prophylaxis
- Early stage Prophylaxis
  - 2w
  - 4w
- Treatment 30% cases

Secondary Infection Rate



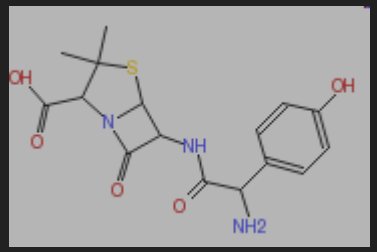


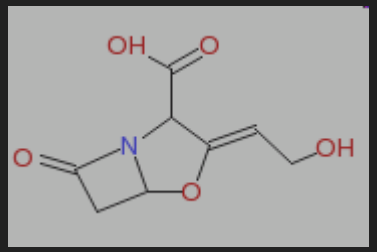
54% reduction in pneumonia with antiviral treatment

Kaiser (2003) Arch Intern Med; Nicholson (2000) Lancet; Treanor (2000) JAMA; Whitley (2000) Pediatr Infect Dis J

β-lactam Cephalosporin

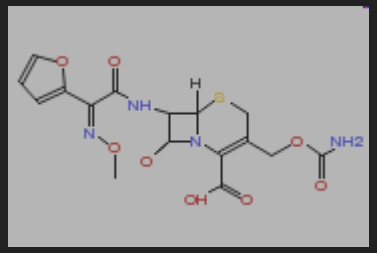
Amoxicillin

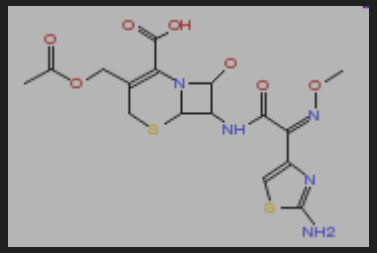




Clavulanic acid

Cefuroxime

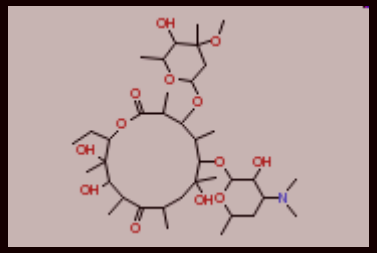


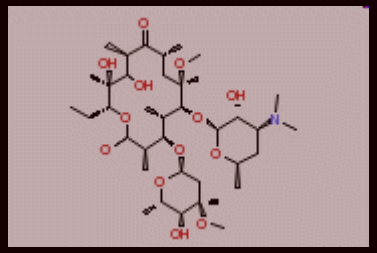


Cefotaxime

Macrolide

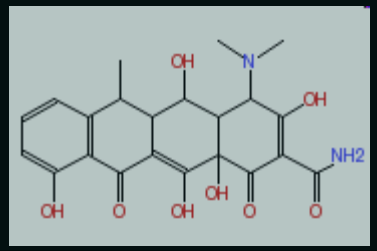
Erythromycin





Clarithromycin

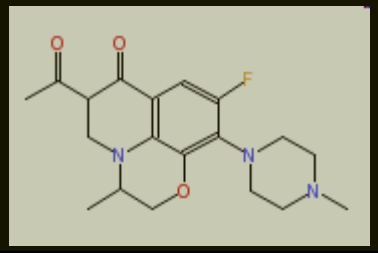
Tetracycline

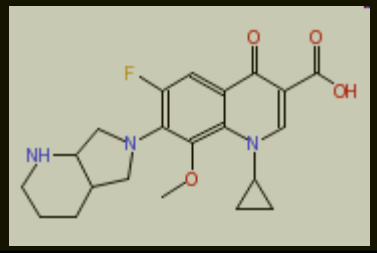


Doxycycline

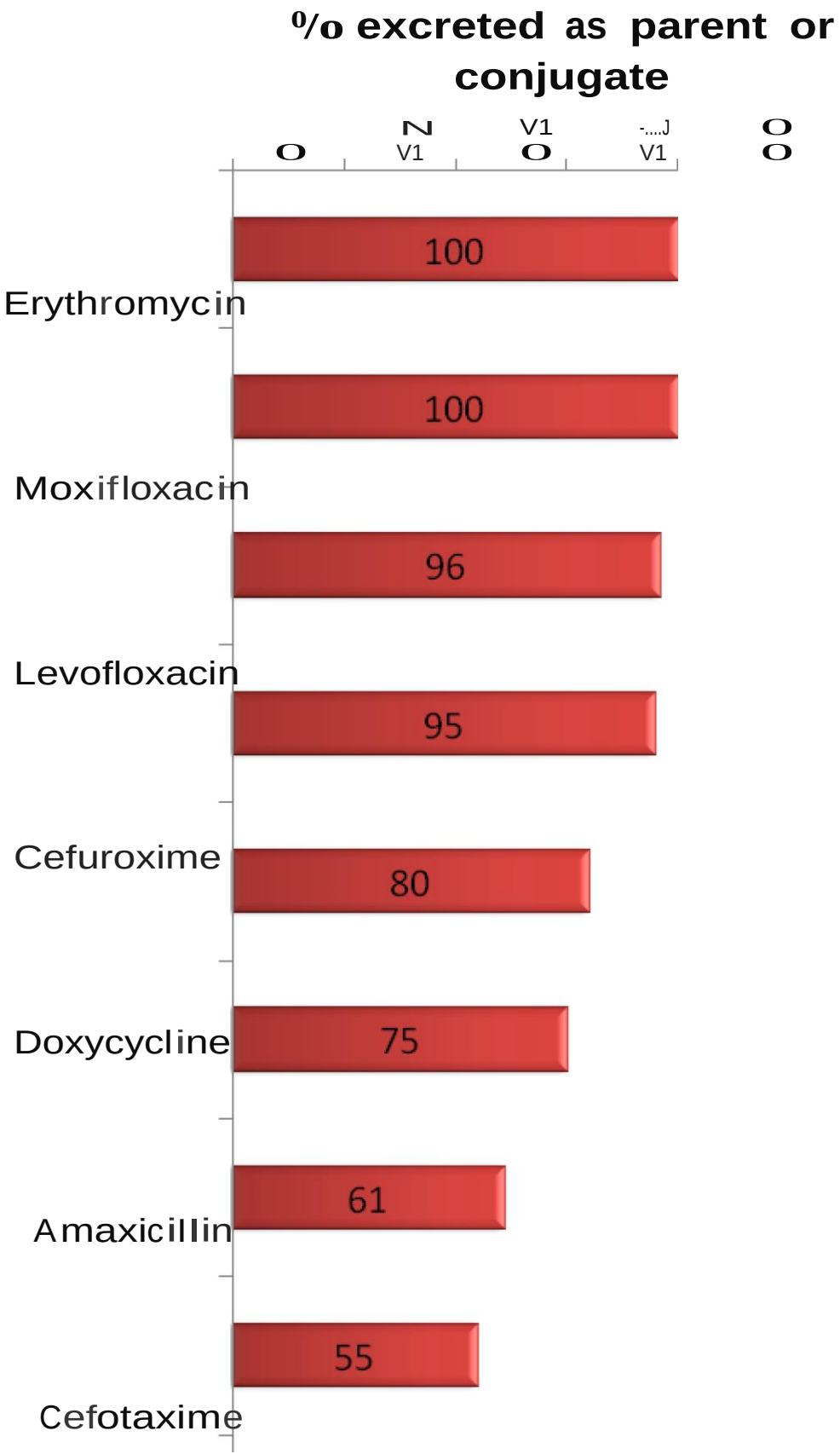
Quinolone

Levofloxacin



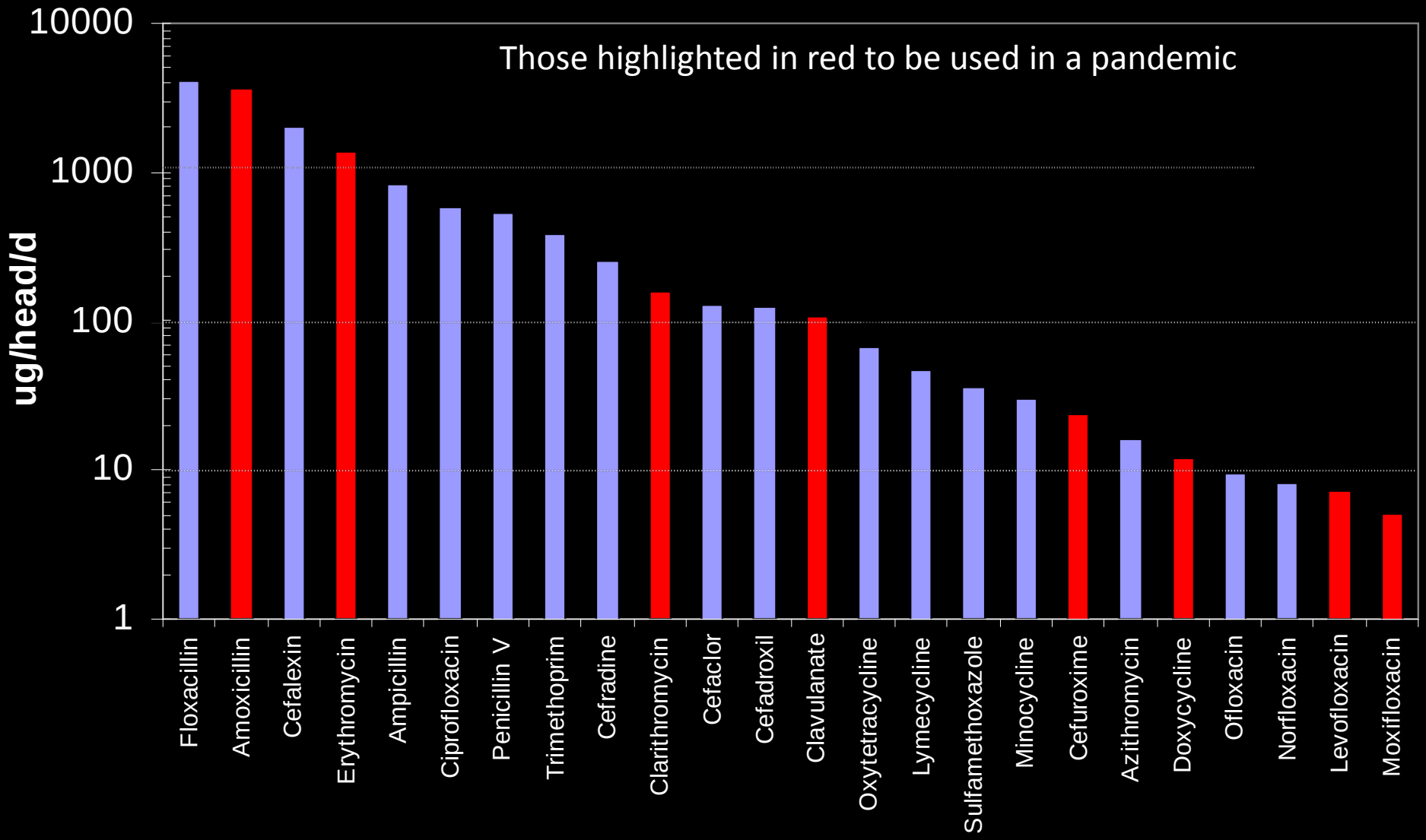


Moxifloxacin


%o excreted as parent or conjugate
100
Erythromycin
100
Moxifloxacin
96
Levofloxacin
95
Cefuroxime
80
Doxycycline
75
Amaxicillin
61
Cefotaxime
55

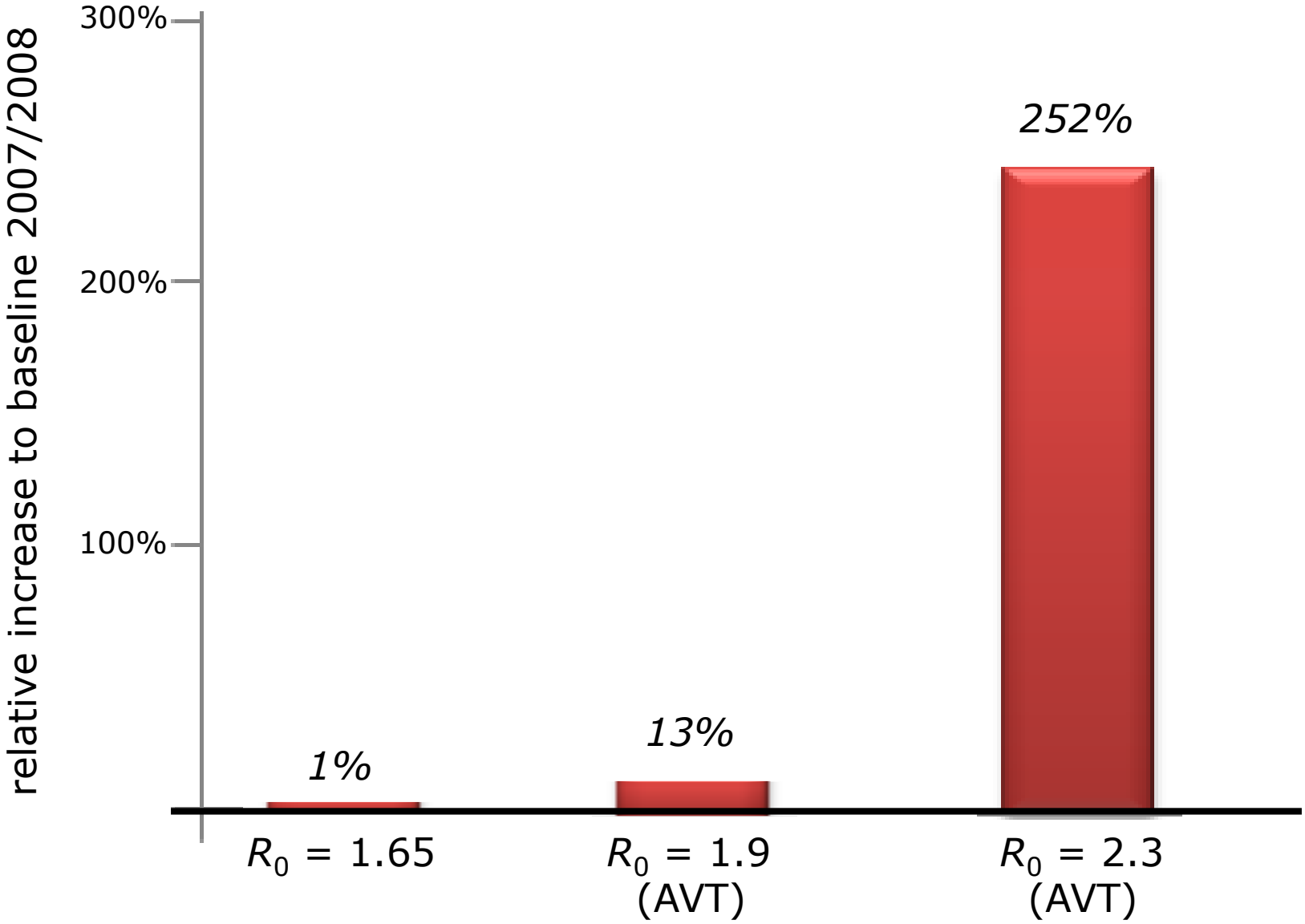
Baseline Antibiotic Use

(excreted in England)

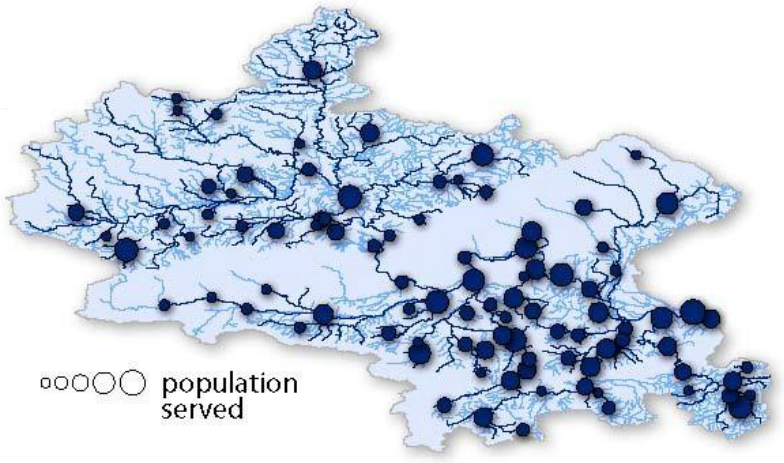


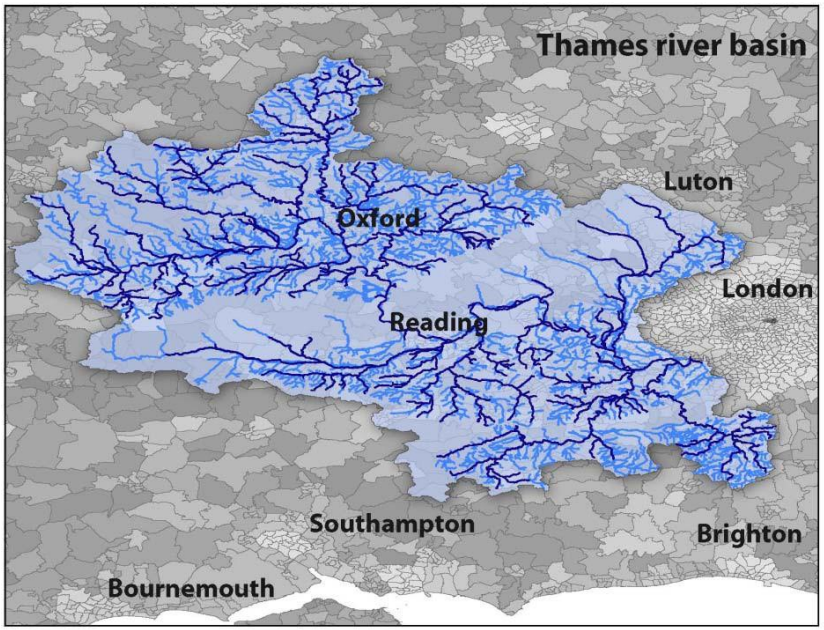
NHS BSA (2008) http://www.nhsbsa.nhs.uk/PrescriptionServices/Documents/NPC_Antibiotics_July_2008.ppt

results: antibiotics in WWTPs



LF2000-WQX works





Determining Impact

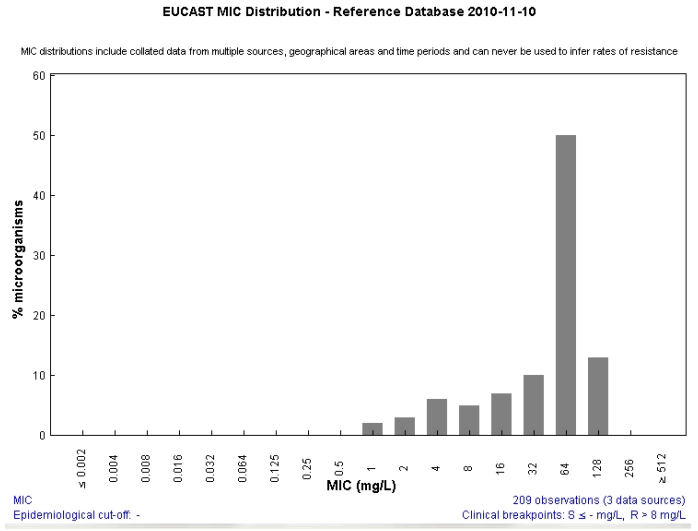
Tamiflu	→	No acute toxicity Inhibition of microbial biofilms
Antibiotics	→	Microbial growth inhibition (WWTP & rivers)

toxicity (0-100%)

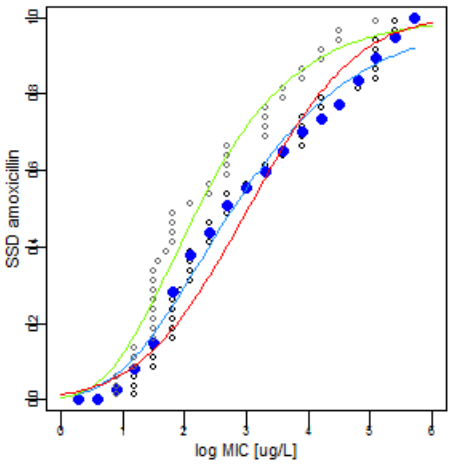
'Potentially affected fraction' of sewage or river microbial species

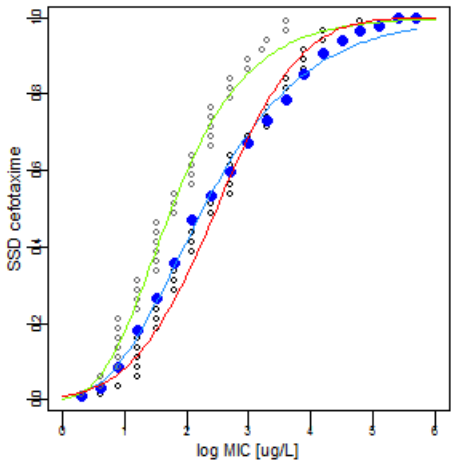
EUCAST EUROPEAN COMMITTEE ON ANTIMICROBIAL SUSCEPTIBILITY TESTING

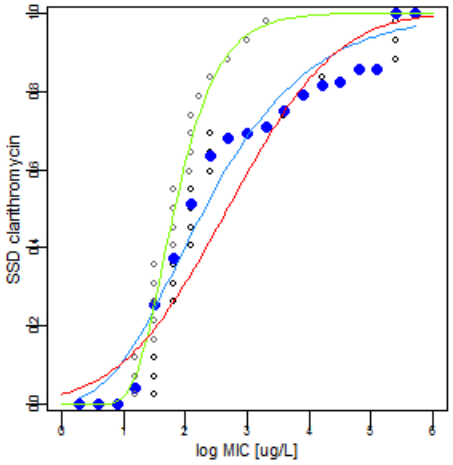
European Society of Clinical Microbiology and Infectious Diseases

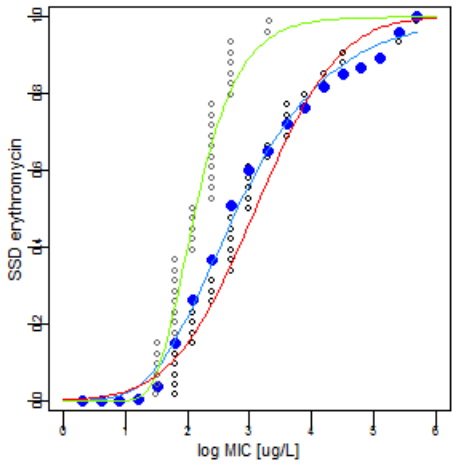


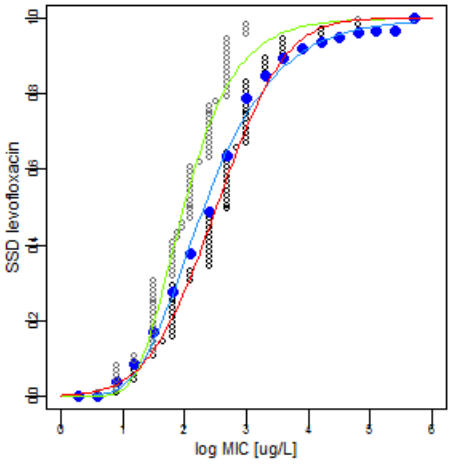
Ecotoxicity: Species sensitivity distributions based on Minimum Inhibitory Concentrations

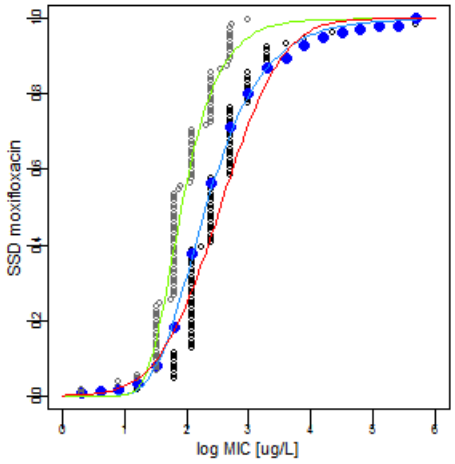


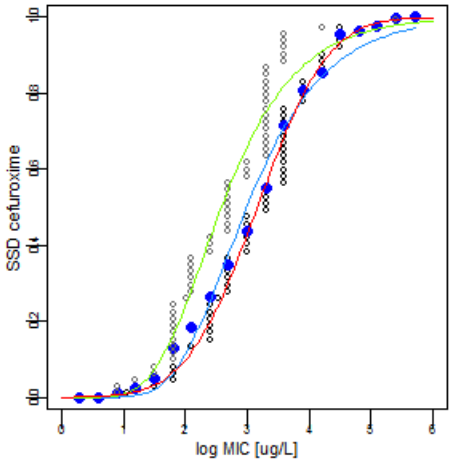


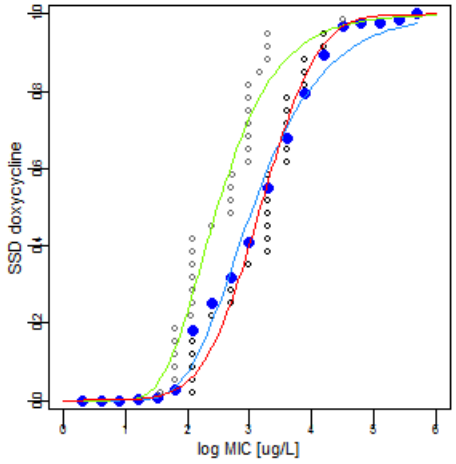




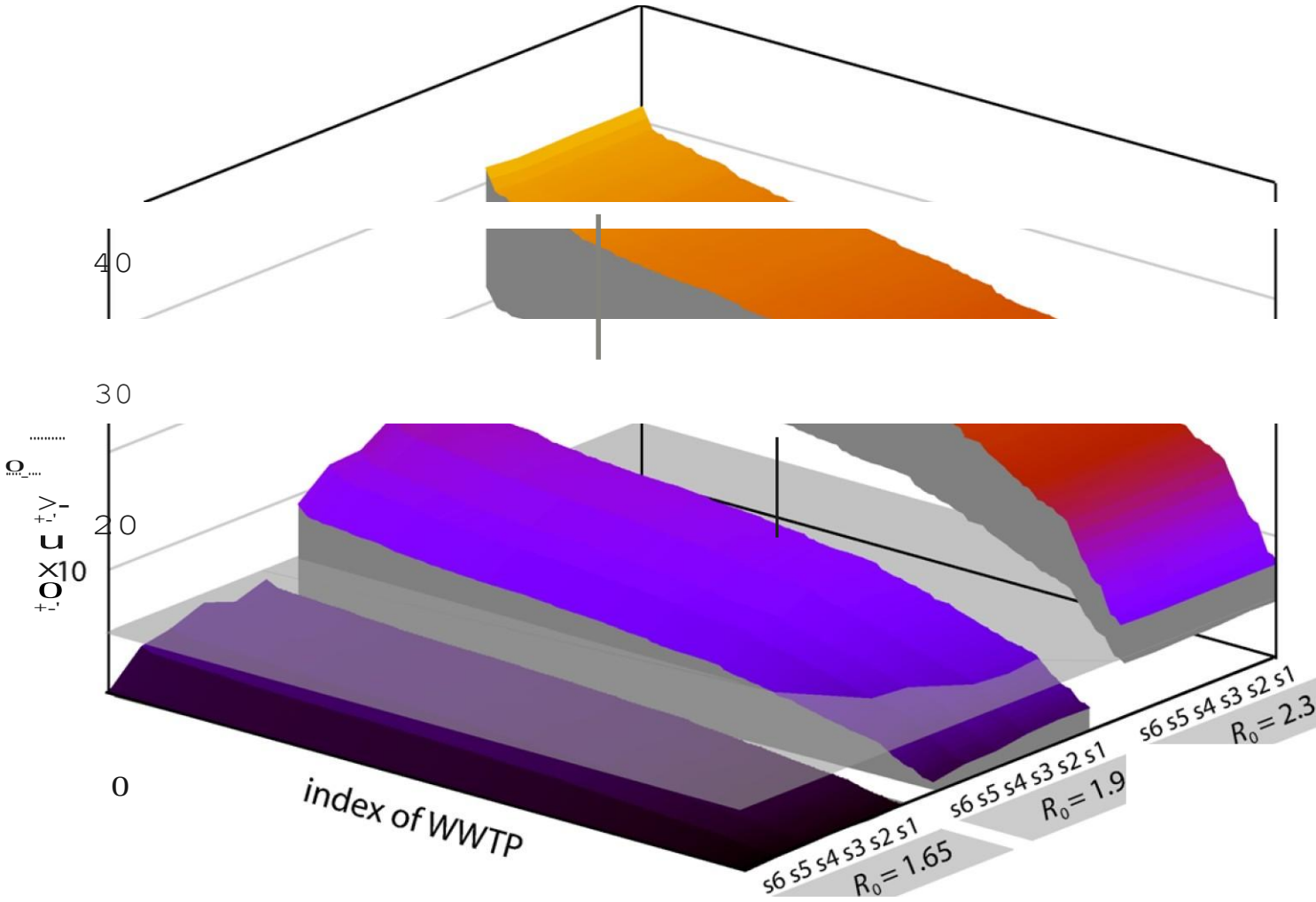






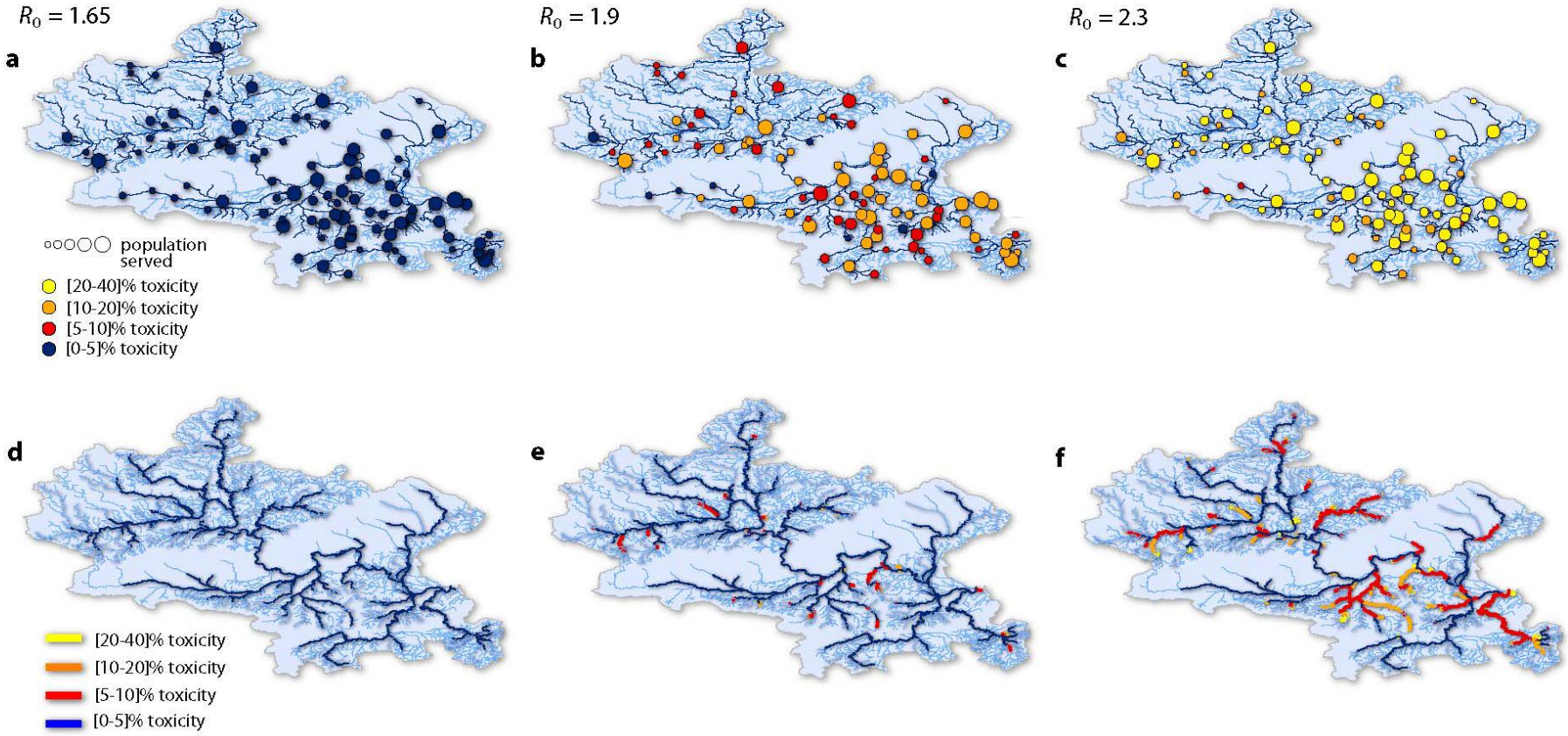


results: toxicity in WWTPs



Spatial distribution of toxicity in WWTPs & Rivers

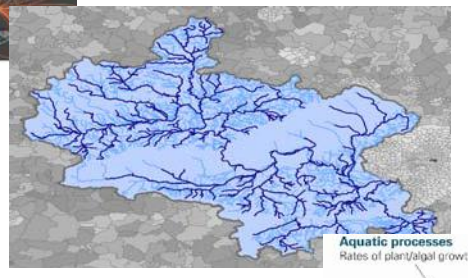
% of sewage plants >5% PAF	≤ 85	≤100

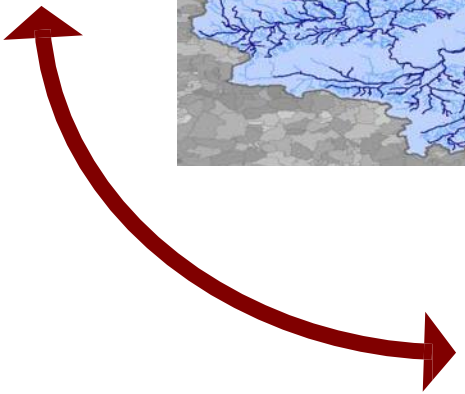


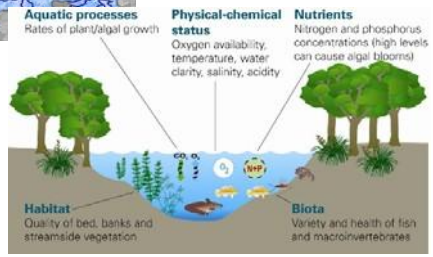
% of Thames River length >5% PAF	≤ 10	≤ 40

General Conclusions

Impact







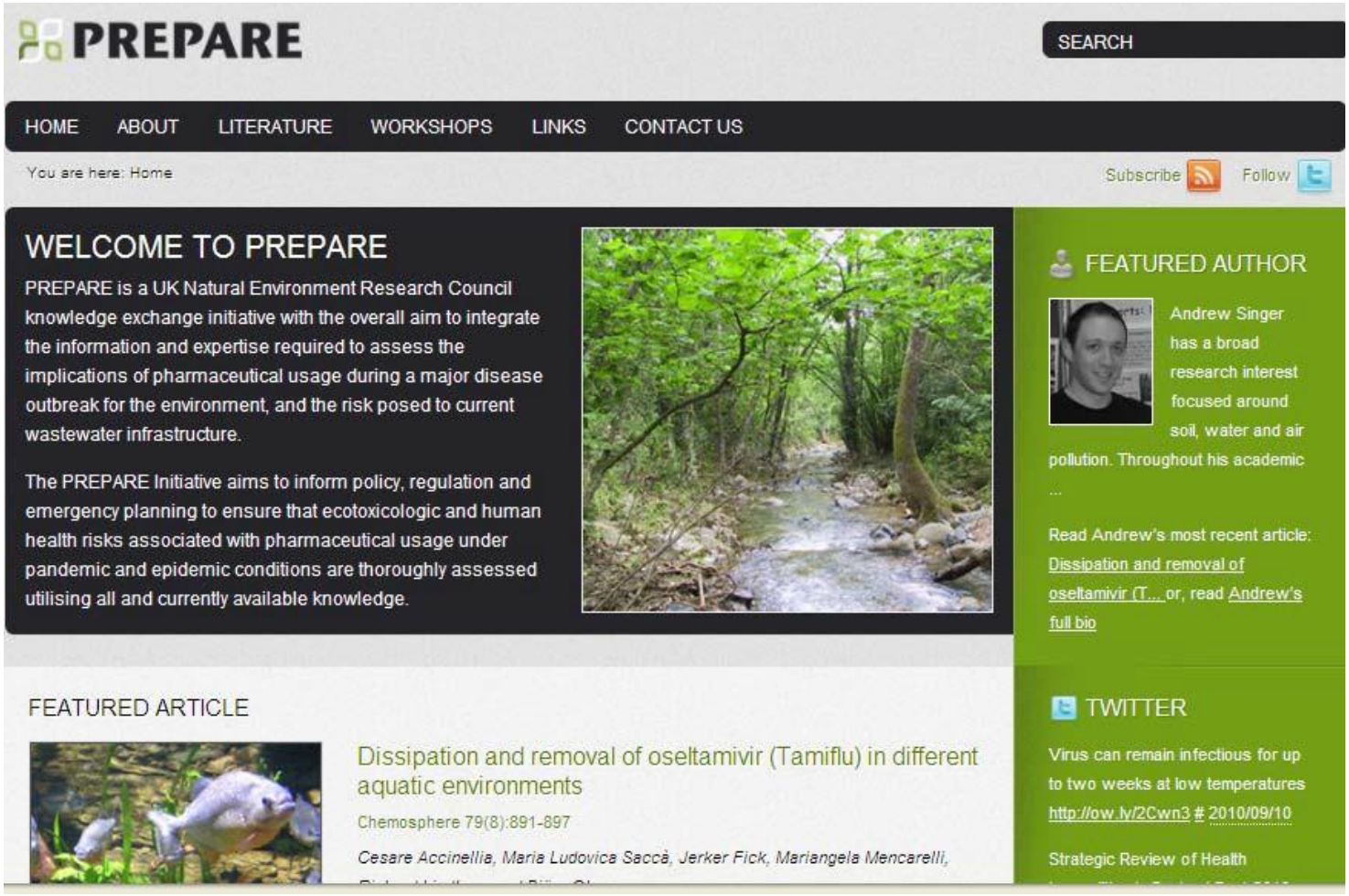
antiviral and antibiotics resistance

Solutions ?

VACCINATION!!

Priority Research

Pandemic usage of Pharmaceuticals



Thanks to Collaborators...and you!

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