



PILLS Final Conference Plenum Presentations

Pharmaceutical consumption and emission in hospitals

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on behalf of the project partners



Contents

- Selection of substances (pharmaceuticals) for monitoring
- Expected and measured concentrations
- Analytical methods
- Contribution of hospitals to load in sewers
- Observations on contribution by nursing/residential hospitals
- Conclusions

Selection of substances

Relevant for NW Europe

(focus on aqueous phase)

Hospital specific

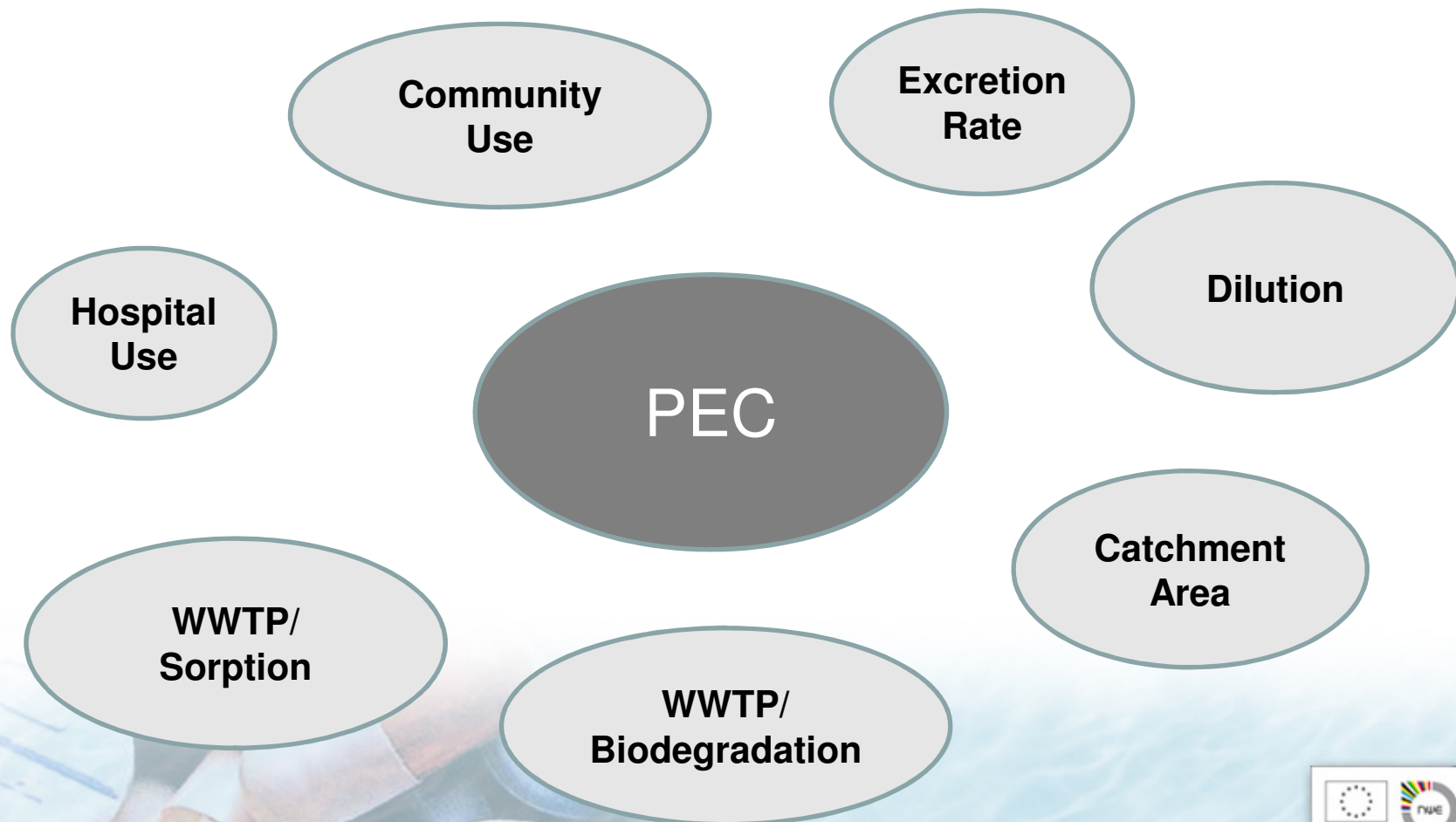
(and representation of relevant treatment groups)

expected / found
in relatively high
concentration

high toxicity
MEC/PNEC
PEC/PNEC

not removed in
conventional
WWTP

PEC identification: availability and variability of data



Selected substances

Treatment group	Substance (detail for selection in report)
Analgesics and anti-inflammatories	<ul style="list-style-type: none"> •Diclofenac •Naproxen
Anticonvulsants / tranquillisers	<ul style="list-style-type: none"> •Carbamazepine
Betablockers / Antihypertensives	<ul style="list-style-type: none"> •Atenolol
Lipid regulators	<ul style="list-style-type: none"> •Bezafibrate
Anaesthetics	<ul style="list-style-type: none"> •Lidocaine



Selected substances – contd.

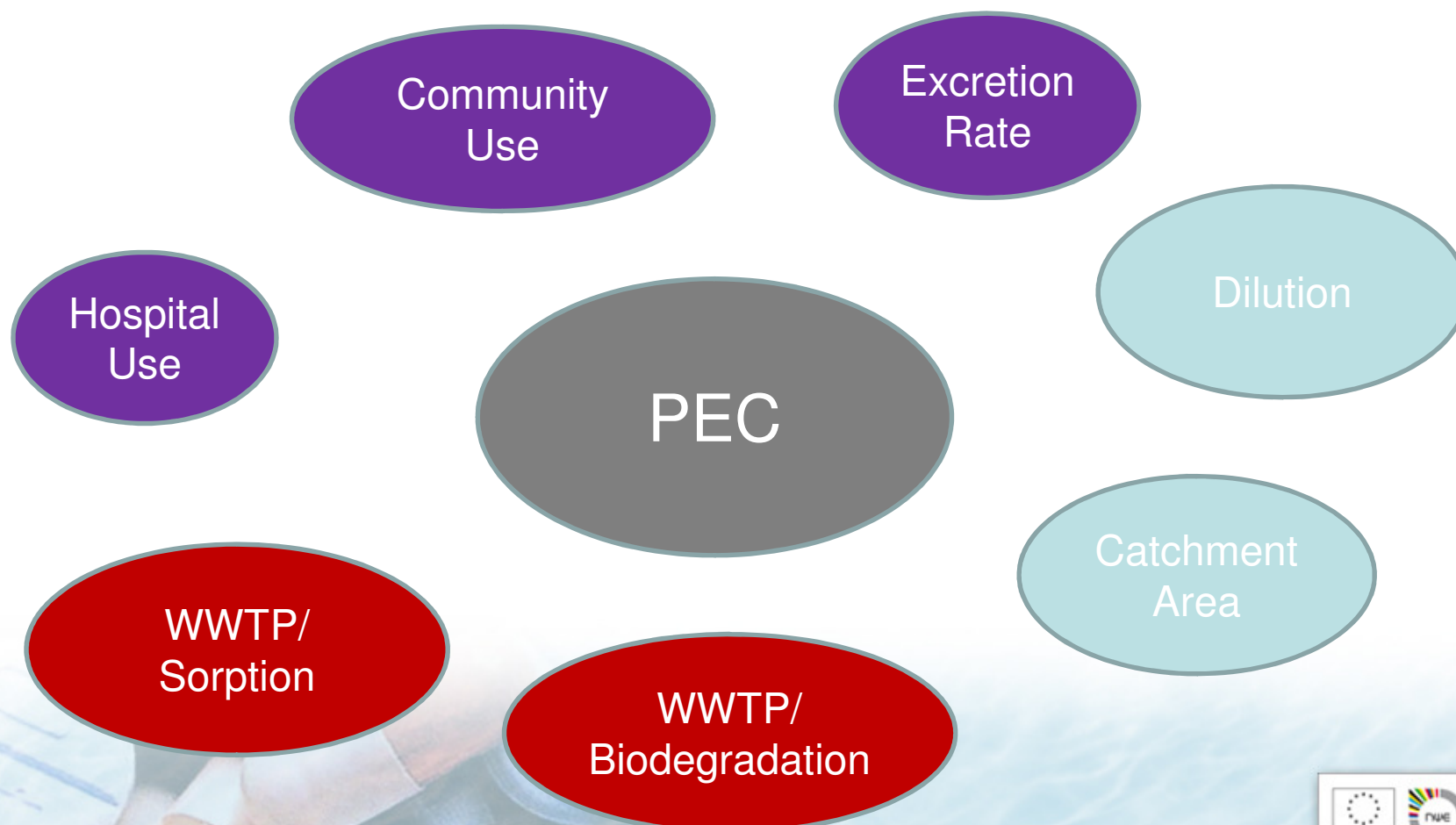
Treatment group	Substance (detail for selection in report)
Antibacterials	<ul style="list-style-type: none"> •Amoxicillin (penicillin) •Ciprofloxacin (fluoroquinolone) •Clarithromycin (macrolide) •Erythromycin (macrolide) •Acetyl-/ Sulfamethoxazole (sulfonamide)
X-Ray Contrast media	<ul style="list-style-type: none"> •Diatrizoate •Iopamidol •Iopromide
Cytostatics	<ul style="list-style-type: none"> •Cyclophosphamide •Ifosfamide



Analytical methods

- Sampling: flow proportional but not always continuous
- Sample preparation:
 - Filtration, typically 0.1-0.2 μm
 - Clean up, SPE and pH correction
 - Further clean up by SLE by some partners
- Analysis:
 - LC-MS-MS (majority) or GC-MS-MS
 - Isotopically labelled internal standards for quality assurance

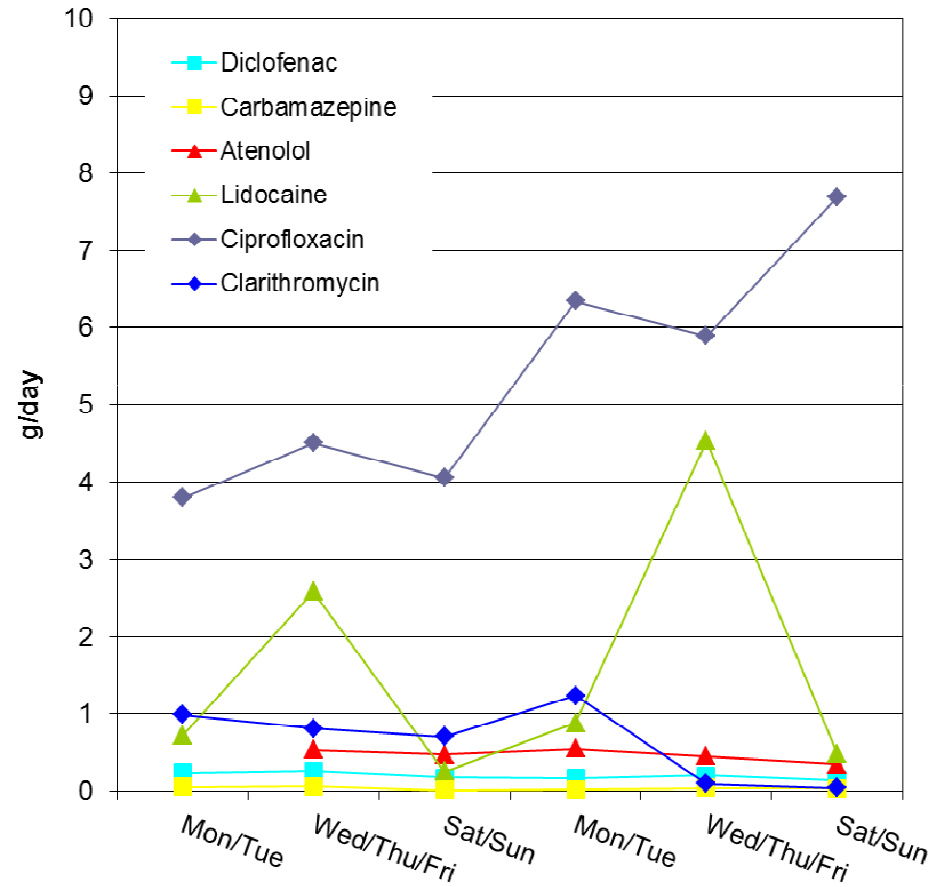
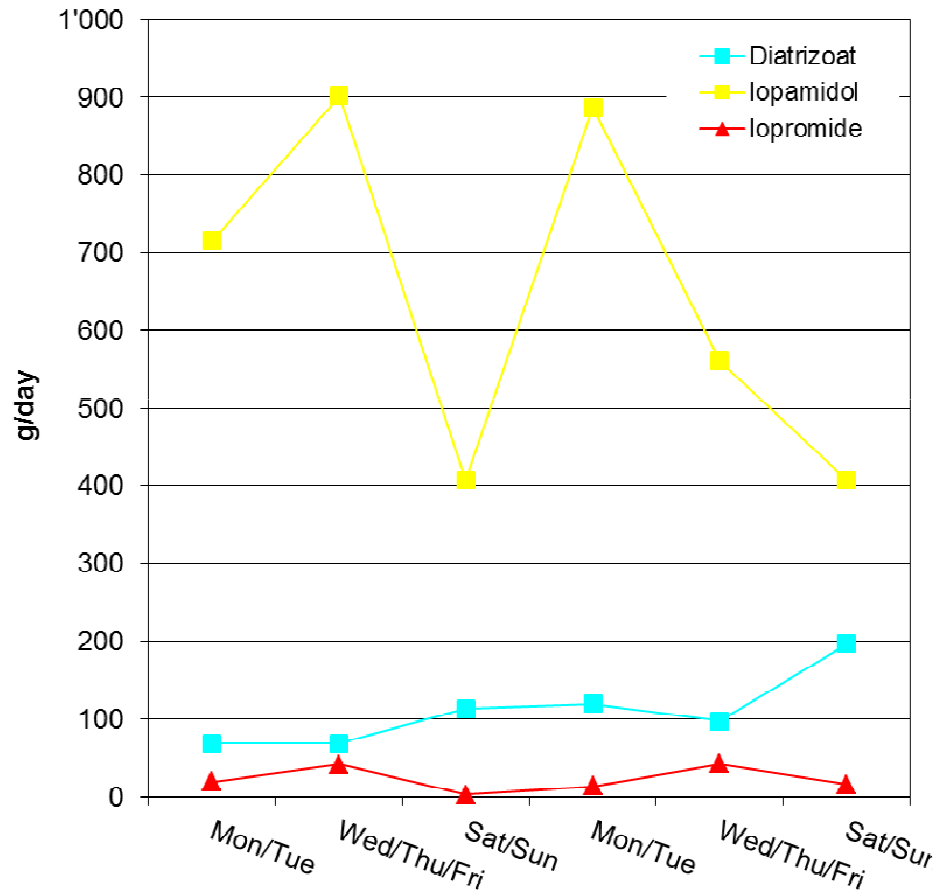
PEC identification: availability and variability of data



Pharmaceutical variation in raw water



Swiss measurements June 15-28 (24h composite samples)



Sampling example: Switzerland



Expected and measured concentrations: Switzerland & Germany

Fig. 2-1 CH: Measured load based on 2/3-day composite samples over 5 weeks (n=15)

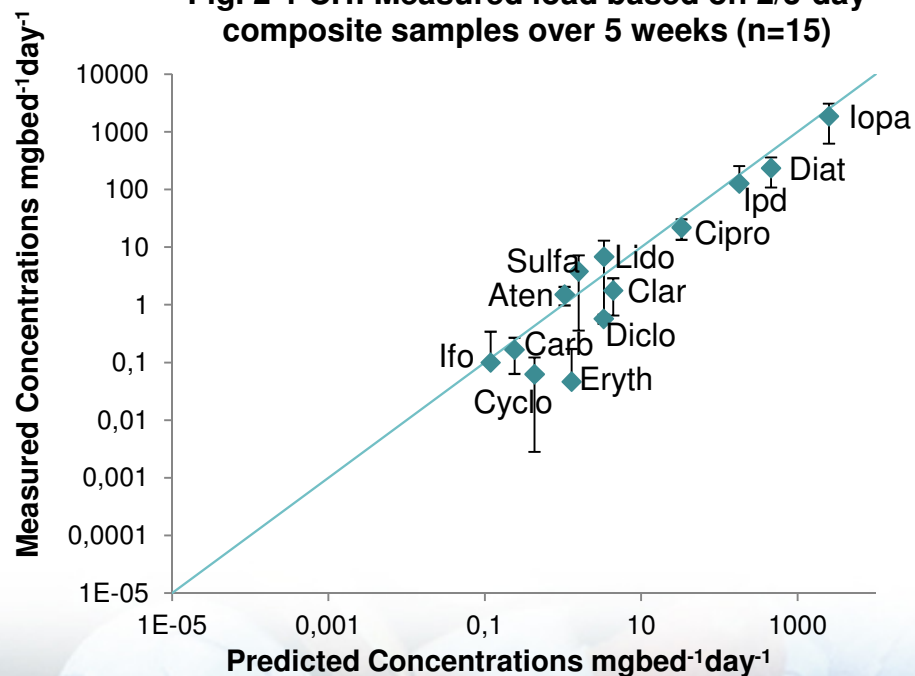
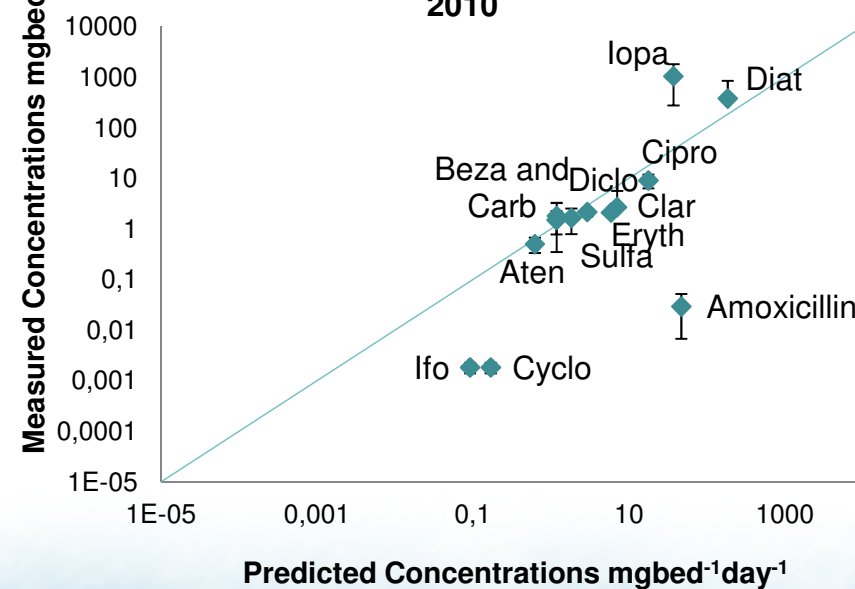
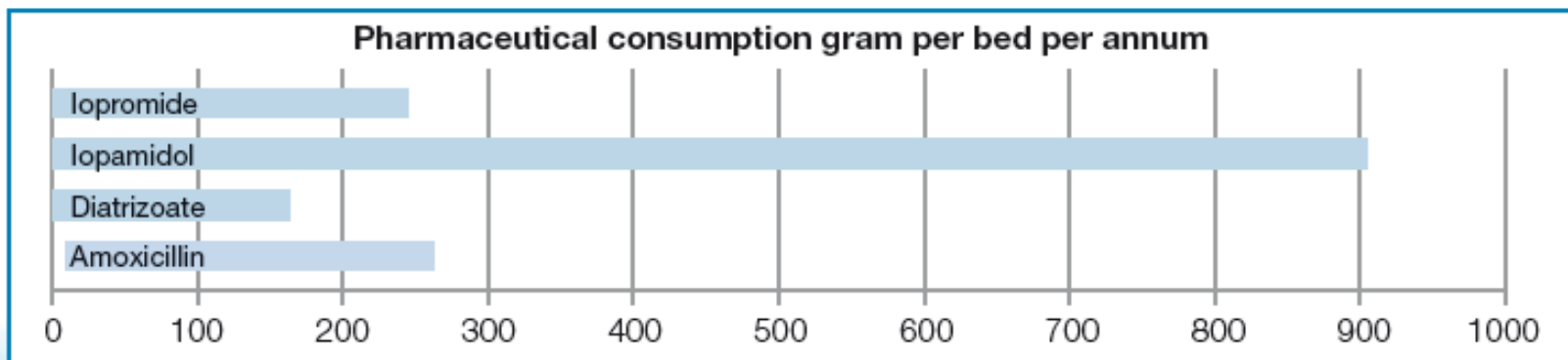
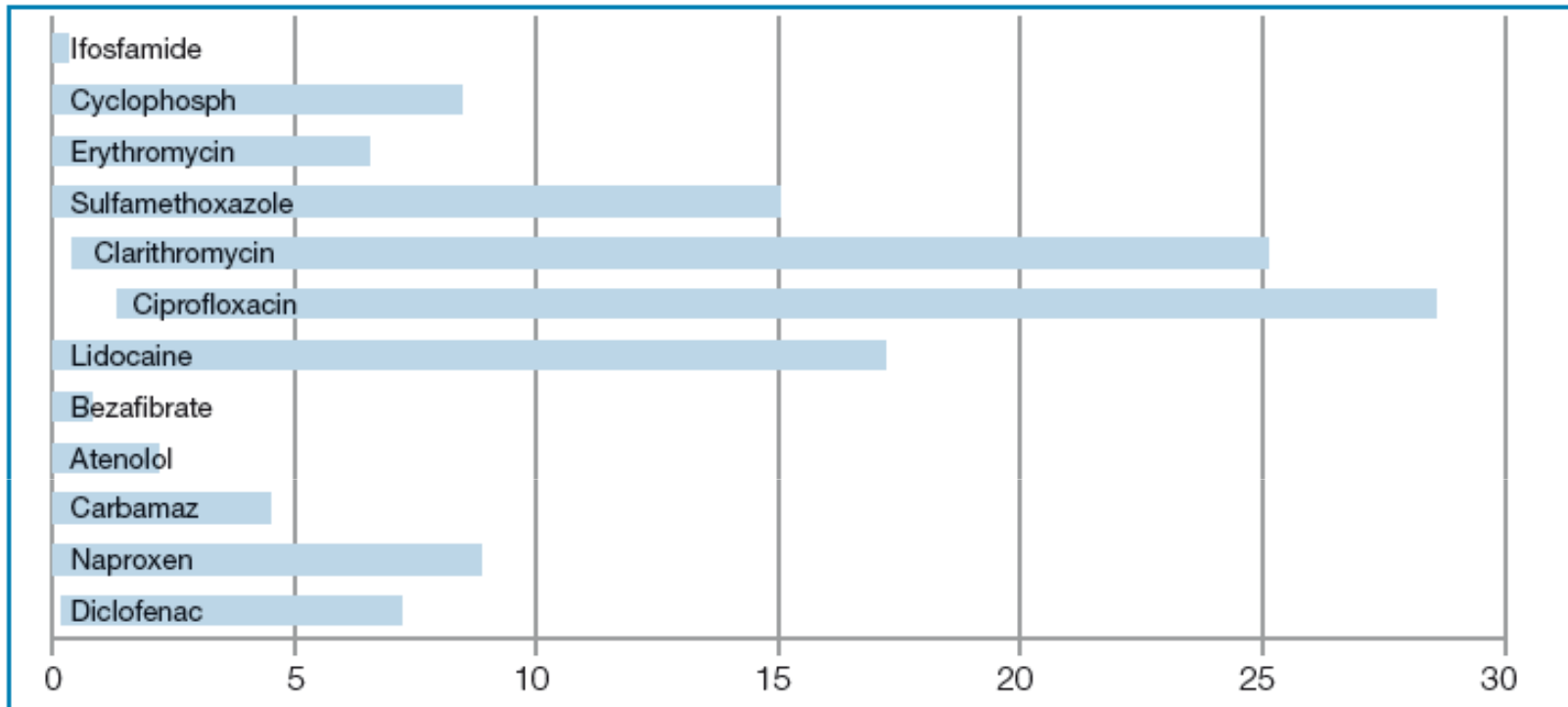


Fig. 2-2 GE: Measured load based on 24h composite samples (n=7)
Predicted load based on consumption data for 2010



Pharmaceutical consumption [gbed⁻¹a⁻¹]



Hospital contribution to load in sewer [%]



Compound	GE	CH	LU	UK Galashiels	Literature
Diclofenac	2.9	0.7	5.5	<i>n.d.</i>	
Naproxen	1.2	n.a.	11.2	5.3	
Carbamazepine	4.4	0.8	21.4	10.1	
Atenolol	1.0	1.7	1.9	6.1	
Bezafibrate	2.1	0.2	n.a.	8	
Lidocaine	n.a.	56	61.2	<LOQ	
Amoxicillin	1.0	n.a.	n.a.	42	
Ciprofloxacin	11.8	40	154.6	74.8	
Clarithromycin	59.1	12	18.2	36	
Sulfamethoxazole	4.7	16	53	<LOQ	<25
Acetyl-sulfamethoxazole	6.1	11	12.9	<LOQ	
Erythromycin	82.4	<1.2	64.3	8.1	
Diatrizoate (Amidotrizoate)	67.8	95	n.a.	<LOQ	
Iopamidol	77.8	112*	n.a.	100	~50
Iopromide	0.1**	40	n.a.	100	
Cyclophosphamide	< LOQ	<LOQ	12.7	<LOQ	
Ifosfamide	< LOQ	<LOQ	n.a.	100	high

Contribution by nursing/ residential hospitals

- Wide range of definitions, from sheltered housing to long term care for geriatrics, or high dependency psychological illness patients
- Resultant wide range of potential contributions:
 - Continence pads for elderly => very little contribution
 - Specific psychoactive drugs in high concentration => high load
 - On balance, less relevant contribution expected
- Little specific contribution was identified
- Monitored by only one partner => no general results

Conclusions

- Good match between selected substances and other studies;
- A good mass balance requires significant measurement investment and extensive knowledge of prescriptions as well as patient behaviour;
- Hospitals are a localised “hot-spot” for pharmaceutical release,
 - Contributing ~20% of sewer load;
 - Contributions are broadly in range of literature values;
 - But significant variation between locations and individual substances;
- Certain pharmaceuticals (X-ray, cytostatics, some antibacterials) have higher contribution and may have potential for elimination at source;
- Geriatric hospitals showed lower than expected load (continence pads).