International Pharmaceutical Federation

Green and sustainable pharmacy practice – Guidance for practitioners

6 July 2020

Facilitator

Gonçalo Sousa Pinto,

Lead for Practice Development and Transformation

FIP

fip International Pharmaceutical Federation | ADVANCING PHARMACY WORLDWIDE

Announcements

Webinar house rules

1. This webinar is being recorded and live-streamed via Facebook.
2. The recording will be available on our website www.fip.org.
3. You may ask questions using the questions box.
4. You are welcome to provide feedback to webinars@fip.org.
5. We invite you to become a member of FIP at

   www.fip.org/membership_registration

Introduction

Programme of today's webinar

Overview

1. Introduction - Gonçalo Sousa Pinto – 5 min
2. Jaakko Teppo will provide a theoretical introduction (25 min) about how APIs make their way to the environment and which kinds of molecules are the most problematic and why – highlighting the case of antimicrobial resistance (AMR).
3. Eeva Teräsalmi will then discuss the classification of APIs and present different solution models from across production and distribution chain (25 min).
4. Panel discussion and questions from the audience – 30 min
5. Wrap-up and take-home messages – 5 min

Learning objectives

After this webinar the participants should:

1. Understand the mechanisms of how active pharmaceutical ingredients (APIs) end in the environment
2. Understand what kind of problems APIs cause for the environment
3. Get ideas and models of how pharmacists can prevent these problems

International Pharmaceutical Federation

Green and sustainable pharmacy practice
Guidance for practitioners
Part I

Jaakko Teppo

PhD (Pharm)

Jaakko Teppo

Researcher and member of the Generation Green working group

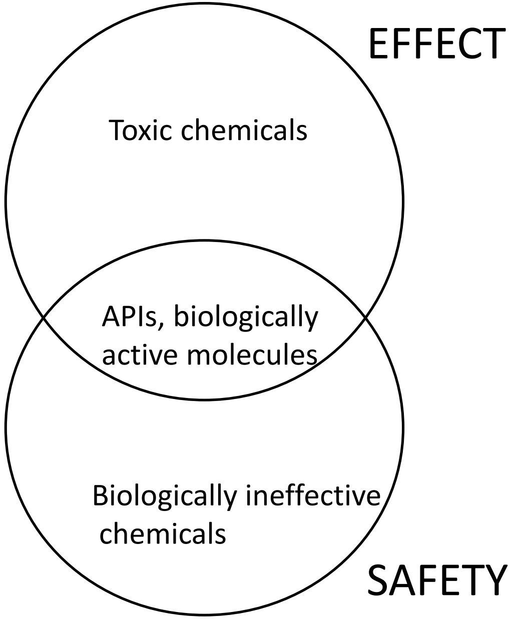
University of Helsinki, Division of Pharmaceutical Chemistry and Technology

fip International Pharmaceutical Federation | ADVANCING PHARMACY WORLDWIDE

PART 1

- Active pharmaceutical ingredients (APIs) and their properties
- Flow of APIs in the nature
- Residuals in the environment
- Metabolic processes of APIs
- Wastewater management (not discussed during the presentation)
- Where are APIs found
- Effects in nature (some examples presented, others for self-learning)
- Ecotoxicity measures

Active pharmaceutical ingredients (APIs)



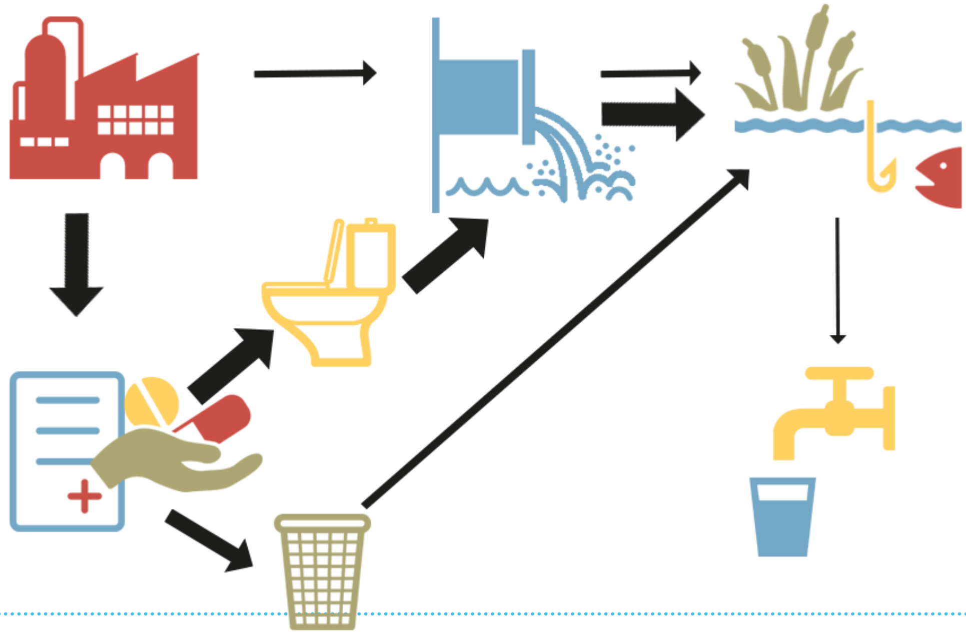
- Type of exposure, chronic/acute
- Biotransformation
  - Degradation in the nature (sun)
  - Interactions
- Interactions between molecules
- Concentration in the food chain
- ~ 3000 molecules + other ingredients
- Analytical sensitivity

APIs in the environment – flow

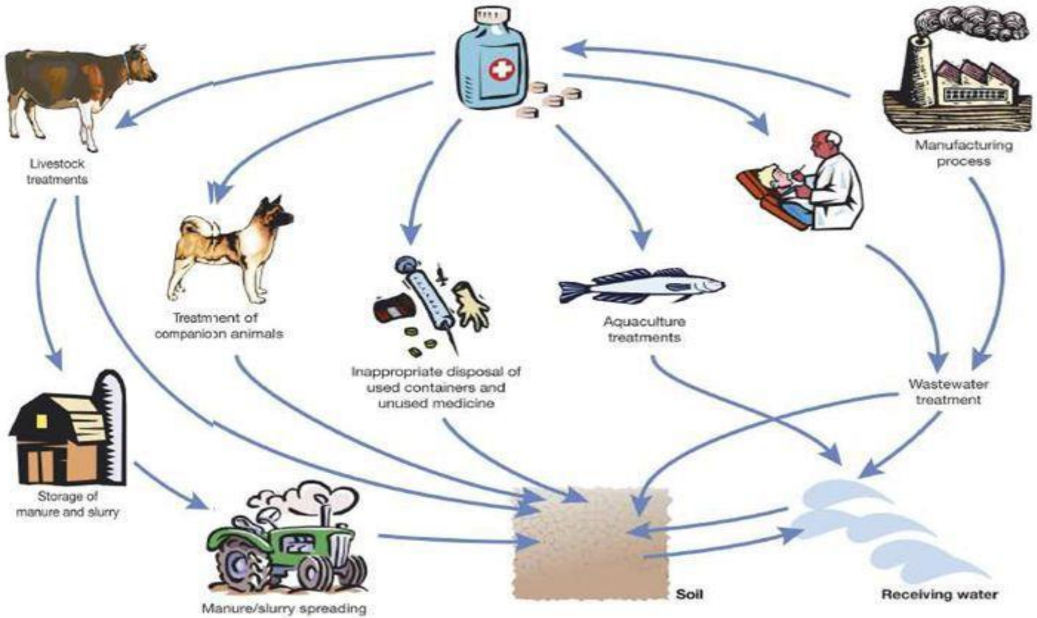
Figure 1: Main emission pathways of human and veterinary pharmaceuticals entering the environment.

https://www.umweltbundesamt.de/sites/default/files/medien/378/publikationen/pharmaceuticals_in_the_environment_0.pdf

APIs in the environment -flow



APIs in the environment, flow



Environ Health Perspect 2012, 1221-1229

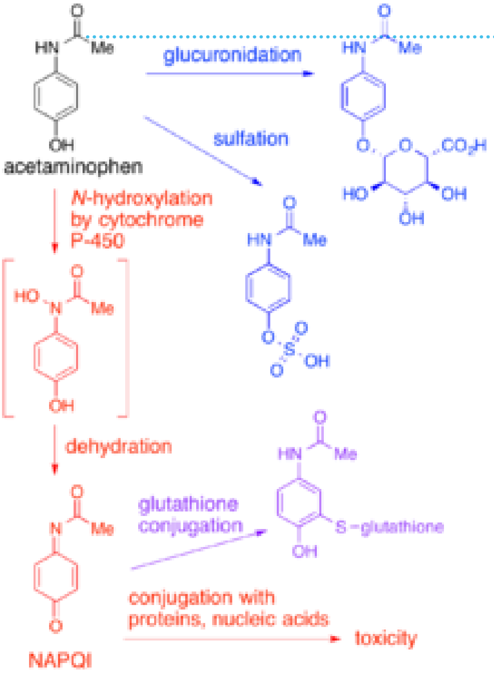
RESIDUALS IN THE ENVIRONMENT

- Biologically active transformation products of APIs
- Biologically active transformation products of additives

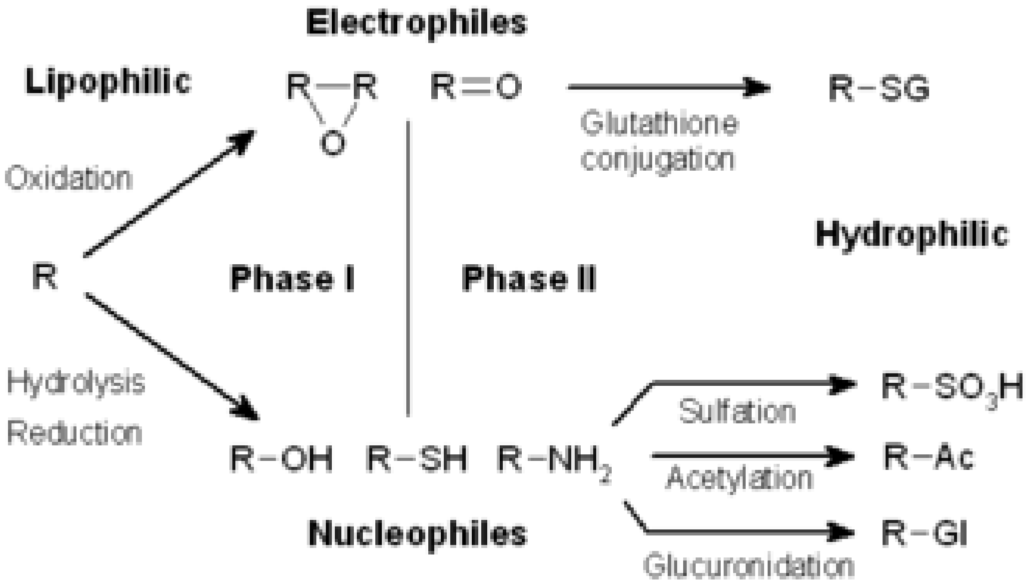
Problematic APIs:

- Antibiotics
- Analgesics
- Lipid-lowering drugs
- Betablockers
- Sytostatics
- Hormones
- Lipophilic, stable molecules
- Molecules which can accumulate in food chains

Metabolism of APIs – what happens in the body

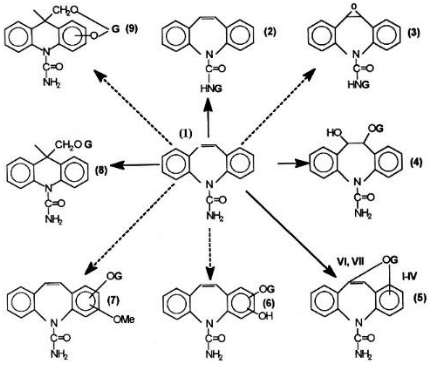


https://upload.wikimedia.org/wikipedia/commons/thumb/7/79/Acetaminophen_metabolism.png/220px-Acetaminophen_metabolism.png

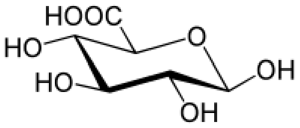


https://upload.wikimedia.org/wikipedia/commons/thumb/9/97/Xenobiotic_metabolism.png/350px-Xenobiotic_metabolism.png

Biotransformation has effects in analytical work, are you measuring API or metabolites?



Drug Metab Dispos 1997, 275-280



https://upload.wikimedia.org/wikipedia/commons/thumb/6/6c/Beta_D-Glucuronic_acid.svg/200px-Beta_D-Glucuronic_acid.svg.png

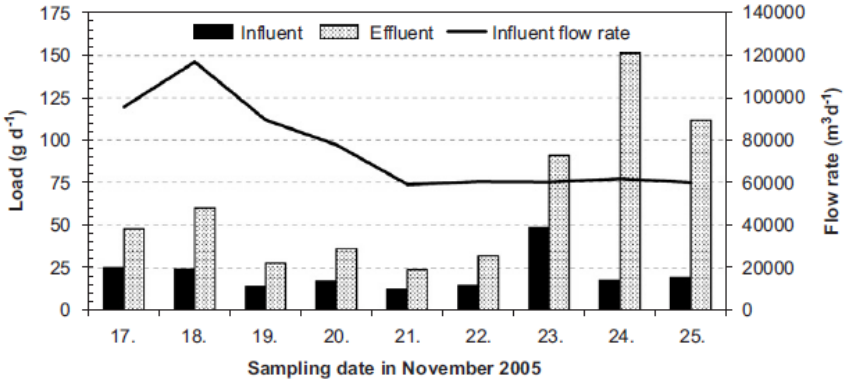
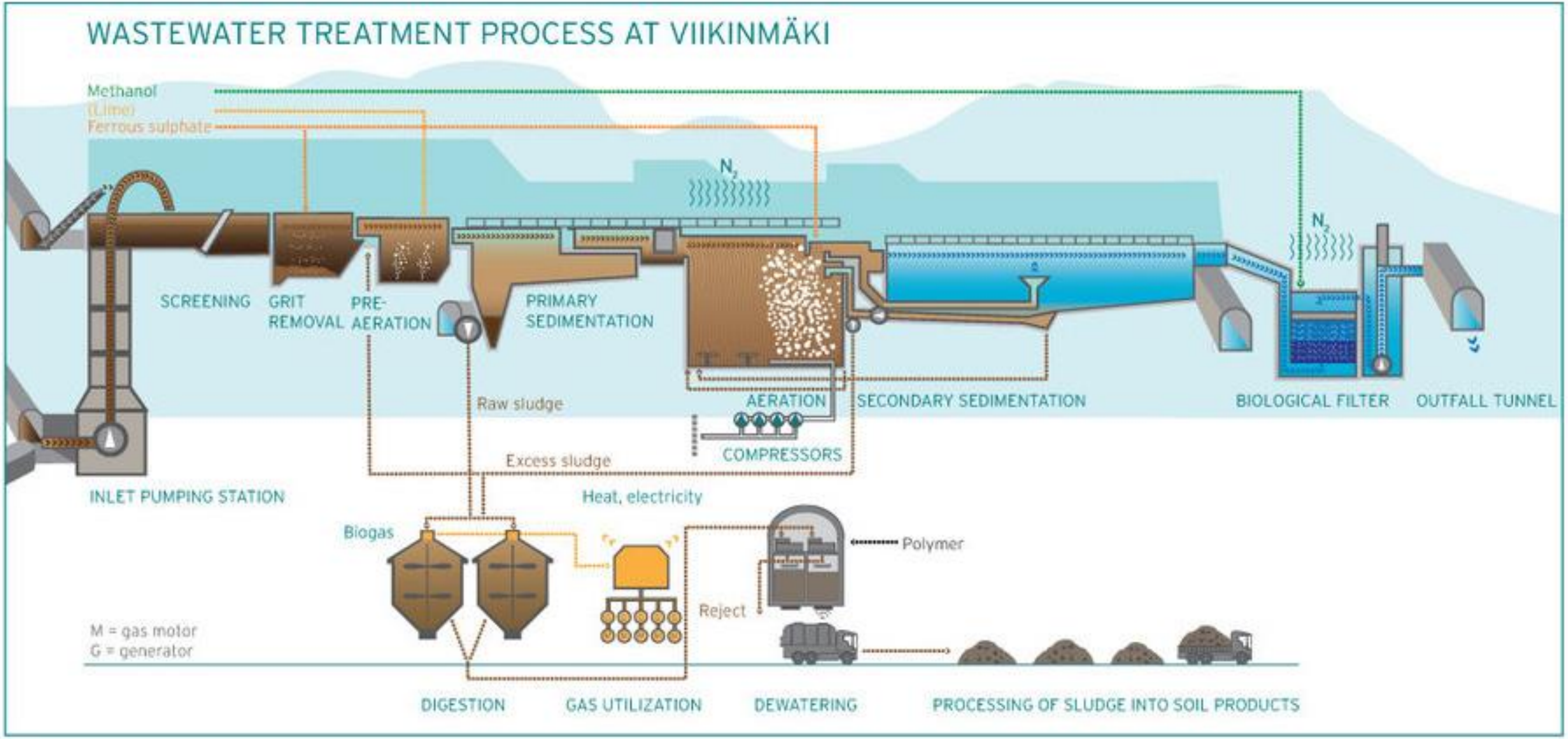


Fig. 4 – The fluctuation of carbamazepine load in the influent and effluent of STP K along with the influent flow rate.

Water Res 2007, 1001-1012

Wastewater management



fip International Pharmaceutical Federation | PHARMACY WORLDWIDE

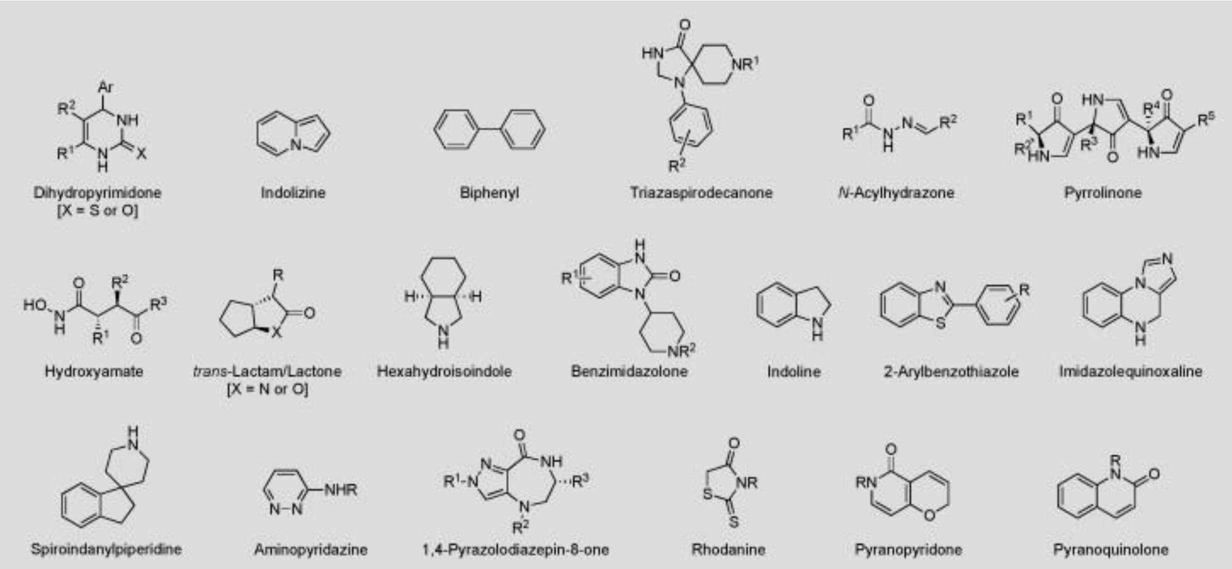
https://www.hsy.fi/en/experts/water-services/wastewater-treatment-plants/viikinmaki/PublishingImages/Viikinmaki_process.jpg

What happens to APIs when treated in waste water plant

- Mechanisms
  - Adhesion to the sludge
  - Biotransformation or biodegradation
- Oxidation, nitrification, etc.
  - Sometimes some byproducts
- Not all APIs react in the same way – huge differences
  - Calculation of speed and effectiveness of the process
  - Metabolites should be considered

Why is it difficult to remove all APIs from the waste water?

Huge chemical variability between APIs



ELSEVIER
Current Opinion in Chemical Biology
Volume 14, Issue 3, June 2010, Pages 347-361

Privileged scaffolds for library design and drug discovery

Matthew E Welsch [1], Scott A Snyder [1], Brent R Stockwell [1, 2]

Where are APIs detected

Number of pharmaceuticals detected in surface water, groundwater, tap water, and/or drinking water

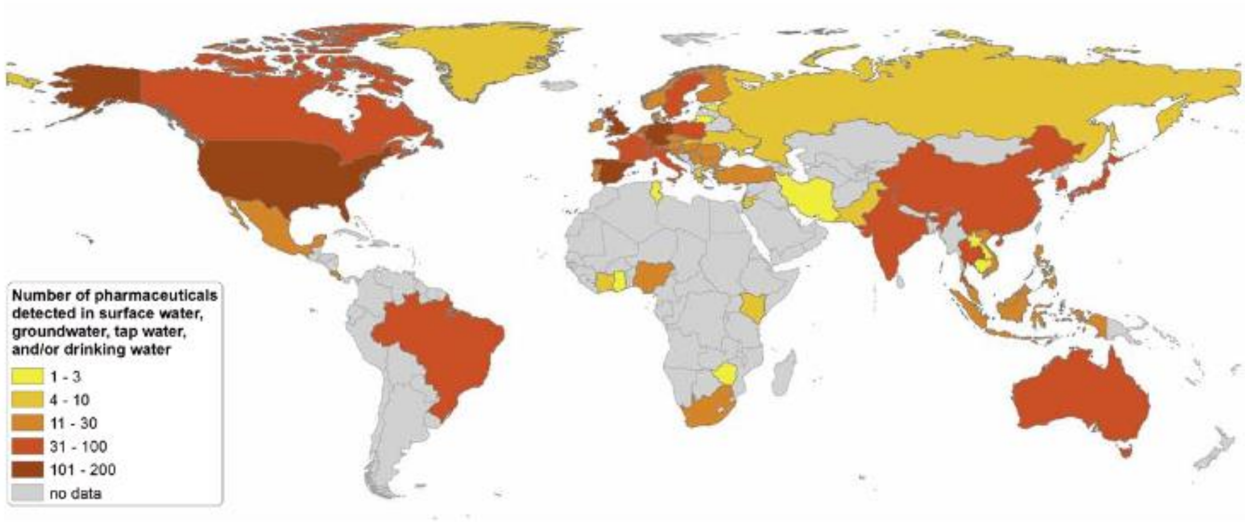


Figure 3: Global occurrence of pharmaceuticals: Pharmaceuticals have been found in the environment in all UN regional groups (IWW 2014).

https://www.umweltbundesamt.de/sites/default/files/medien/378/publikationen/pharmaceuticals_in_the_environment_0.pdf

International Pharmaceutical Federation

ADVANCING PHARMACY WORLDWIDE

Pharmaceutical	Therapy Group	Number of countries worldwide in which pharmaceuticals have been found in the aquatic environment
Diclofenac	Analgesics	50
Carbamazepine	Antiepileptic drugs	48
Ibuprofen	Analgesics	47
Sulfamethoxazole	Antibiotics	47
Naproxen	Analgesics	45
Estrone	Estrogens	35
17-β-Estradiol	Estrogens	34
17-α-Ethinylestradiol	Estrogens	31
Trimethoprim	Antibiotics	29
Paracetamol	Analgesics	29
Clofibric acid	Lipid-lowering drugs	23
Ciprofloxacin	Antibiotics	20
Ofloxacin	Antibiotics	16
Estriol	Estrogens	15
Norfloxacin	Antibiotics	15
Acetylsalicylic acid	Analgesics	15

Table 1: Several globally marketed pharmaceuticals have been found in the aquatic environment of all UN regional groups (IWW 2014).

https://www.umweltbundesamt.de/sites/default/files/medien/378/publikationen/pharmaceuticals_in_the_environment_0.pdf

What happens to the APIs in the environment?

Occurrence patterns of pharmaceutical residues in wastewater, surface water and groundwater of Nairobi and Kisumu city, Kenya

K.O. K'oreje [a, b, c], L. Vergeynst [a], D. Ombaka [a, b], P. De Wispelaere [a], M. Okoth [c], H. Van Langenhove [a], K. Demeestere [a, *]

Chemosphere 2016, 238-244

Adsorption of sulfonamides on lake sediments

Zhenxing ZHONG[1,2], Jian XU[1,3], Yuan ZHANG (✉)[1,3], Lei LI[1,3], Changsheng GUO[1,3], Yan HE[1,3], Wenhong FAN[4], Beiping ZHANG[2]

Front Environ Sci Eng 2013, 518-525

Uptake of pharmaceuticals, hormones and parabens into vegetables grown in soil fertilized with municipal biosolids

Lyne Sabourin [a], Peter Duenk [b], Shelly Bonte-Gelok [c], Michael Payne [d], David R. Lapen [e], Edward Topp [a,*]

Sci Environ Technol 2012, 233-236

BIOAVAILABILITY OF PHARMACEUTICALS IN WATERS CLOSE TO WASTEWATER TREATMENT PLANTS: USE OF FISH BILE FOR EXPOSURE ASSESSMENT

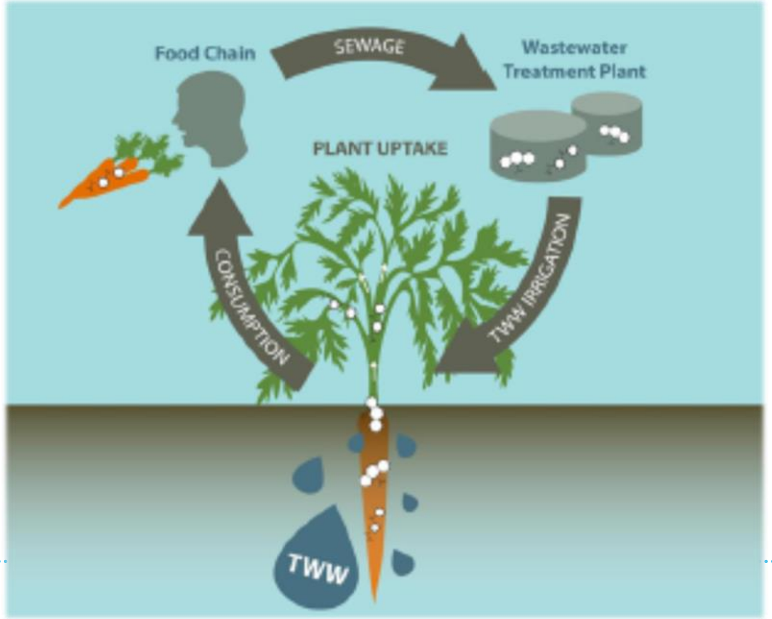
MARJA LAHTI,*† JENNY-MARIA BROZINSKI,‡ HELMUT SEGNER,§ LEIF KRONBERG,‡ and AIMO OIKARI†
†Division of Environmental Science and Technology, Department of Biological and Environmental Science, University of Jyväskylä, Jyväskylä, Finland
‡Laboratory of Organic Chemistry, Åbo Akademi University, Turku, Finland
§Center for Fish and Wildlife Health, University of Bern, Bern, Switzerland

Environ Toxicol Chem 2012, 1831-1837

Environmental Science & Technology
Article
pubs.acs.org/est

Irrigation of Root Vegetables with Treated Wastewater: Evaluating Uptake of Pharmaceuticals and the Associated Human Health Risks

Tomer Malchi,[†,‡] Yehoshua Maor,[‡] Galit Tadmor,[†,‡] Moshe Shenker,[†] and Benny Chefetz*[,†,‡]



Environ Sci Technol 2014, 9325-9333

A pharmacognostic example

Angewandte Communications

Natural Products

DOI: 10.1002/anie.201305697

Occurrence of the Synthetic Analgesic Tramadol in an African Medicinal Plant**

Ahcène Boumendjel, Germain Sotoing Taïwe, Elisabeth Ngo Bum, Tanguy Chabrol, Chantal Beney, Valérie Sinniger, Romain Haudecoeur, Laurence Marcourt, Soura Challal, Emerson Ferreira Queiroz, Florence Souard, Marc Le Borgne, Thierry Lomberget, Antoine Depaulis, Catherine Lavaud, Richard Robins, Jean-Luc Wolfender, Bruno Bonaz, and Michel De Waard**

Angew Chem Int Ed 2013, 11780-11784

Angewandte International Edition Chemie

VIP **Anthropogenic Contamination** *Very Important Paper*

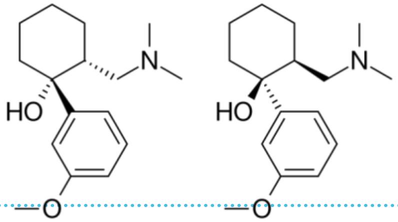
DOI: 10.1002/anie.201406639

Tramadol—A True Natural Product?**

*Souvik Kusari, Simplice Joel N. Tatsimo, Sebastian Zühlke, Ferdinand M. Talontsi, Simeon Fogue Kouam, and Michael Spiteller**

Angew Chem Int Ed 2014, 12073-12076

https://commons.wikimedia.org/wiki/File:Nauclea_latifolia_.jpg



(1*R*,2*R*)-tramadol (1*S*,2*S*)-tramadol

https://upload.wikimedia.org/wikipedia/commons/thumb/7/74/Tramadol_as_a_racemic_mixture.svg/270px-Tramadol_as_a_racemic_mixture.svg.png

APIs effects in the environment

Main problem is the biological activity of API

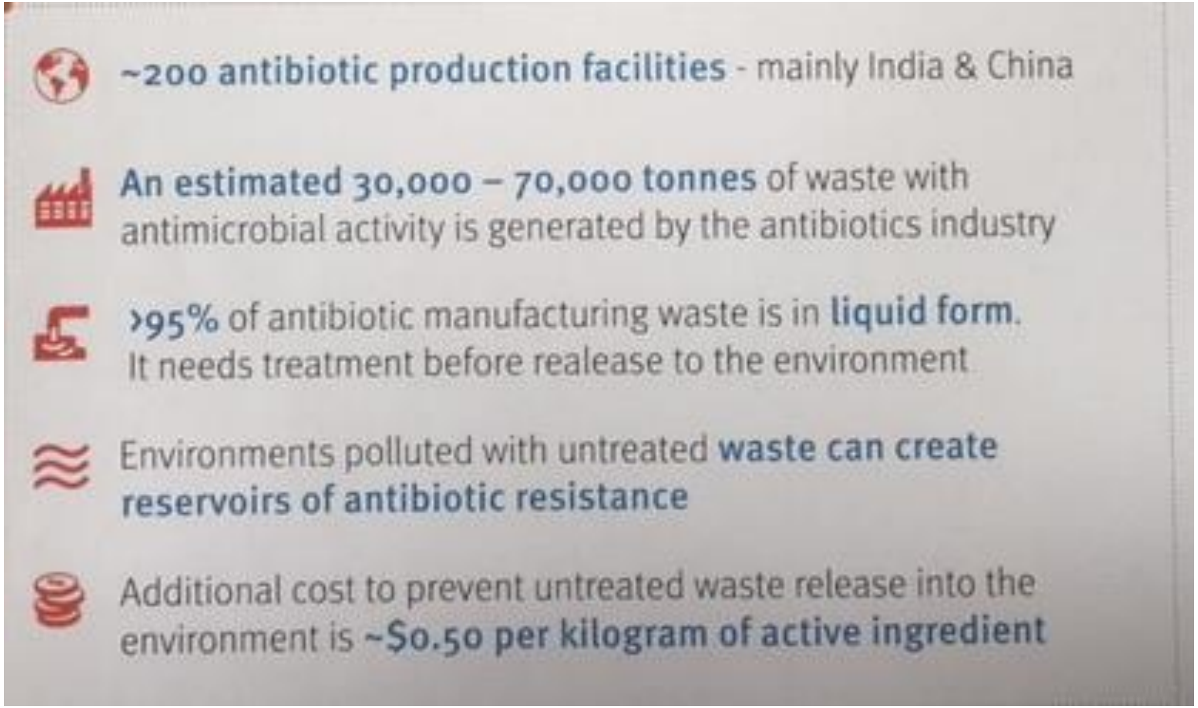
				
Pharmaceutical	Diclofenac	17α-Ethinylestradiol	Diclofenac	Sulfonamide
Therapeutic group	Analgesics	Synthetic estrogen	Analgesics	Antibiotic
Non-target organism	Vulture (Gyps bengalensis)	Fathead minnow (Pimephales promelas)	Rainbow trout (Oncorhynchus mykiss)	Maize (Zea mays) Willow (Salix fragilis)
Effects	Population collapse due to renal failure	Population collapse due to feminization of male fish	Strong reactions of liver, kidney, and gills	Adverse effects on root growth. Death of maize at high conc.
Study type	Wildlife	Whole-lake experiment	Laboratory	Greenhouse
Reference	Oakes et al. 2004	Kidd et al. 2007	Triebskorn et al. 2007	Michelini et al. 2012

				
Pharmaceutical	Fluoxetine	Oxazepam	Ivermectin	Enrofloxacin, Ciprofloxacin
Therapeutic group	Antidepressant	Anxiolytics	Veterinary parasiticide	Antibiotics
Non-target organism	Leopard Frog (Rana pipiens)	European perch (Perca fluviatilis)	Dung fly and beetle	Cyanobacterium (Anabaena flosaquae) Duckweed (Lemna minor)
Effects	Delayed tadpole development	Altered behaviour and feeding rate	Mortality of eggs and larvae	Growth inhibition
Study type	Laboratory	Laboratory	Laboratory and field	Laboratory
Reference	Foster et al. 2010	Brodin et al. 2013	Liebig et al. 2010	Ebert et al. 2011

Table 2: Some selected examples of adverse effects of pharmaceuticals on non-target organisms in laboratory, field, and environmental observations.

https://www.umweltbundesamt.de/sites/default/files/medien/378/publikationen/pharmaceuticals_in_the_environment_0.pdf

Antimicrobial resistance (AMR)



~200 antibiotic production facilities - mainly India & China

An estimated 30,000 – 70,000 tonnes of waste with antimicrobial activity is generated by the antibiotics industry

>95% of antibiotic manufacturing waste is in **liquid form**. It needs treatment before realease to the environment

Environments polluted with untreated **waste can create reservoirs of antibiotic resistance**

Additional cost to prevent untreated waste release into the environment is **~$0.50 per kilogram of active ingredient**

Pharmaceutical Pollution: A hidden cause of AMR

The way that antimicrobials are produced, the by-products which result, and particularly the impact of effluent from factories on AMR, is an issue which has too often been neglected in discussions about AMR

There is growing evidence of API manufacturers that do not adequately treat waste products, with the result that high concentrations of antibiotic active ingredients are disposed into the local environment creating 'reservoirs' of antibiotic resistant bacteria.

(AMR Review, May 2016)

Outsourcing the problem?

FINANCIAL TIMES

MENU SEARCH

HOME WORLD US COMPANIES MARKETS OPINION WORK & CAREERS LIFE & ARTS

India + Add to myFT

Pharmaceutical pollution in India is bitter pill for Nordea

Concern over environmental damage caused by outsourcing of drug manufacturing

BUT:

Dissemination of Multidrug-Resistant Bacteria into the Arctic

Maria Sjölund,*[1] Jonas Bonnedahl,† Jorge Hernandez,‡ Stina Bengtsson,* Gunilla Cederbrant,* Jarone Pinhassi,‡ Gunnar Kahlmeter,*§ and Björn Olsen‡§

Emerg Infect Dis 2008, 70-72

Intersex fish

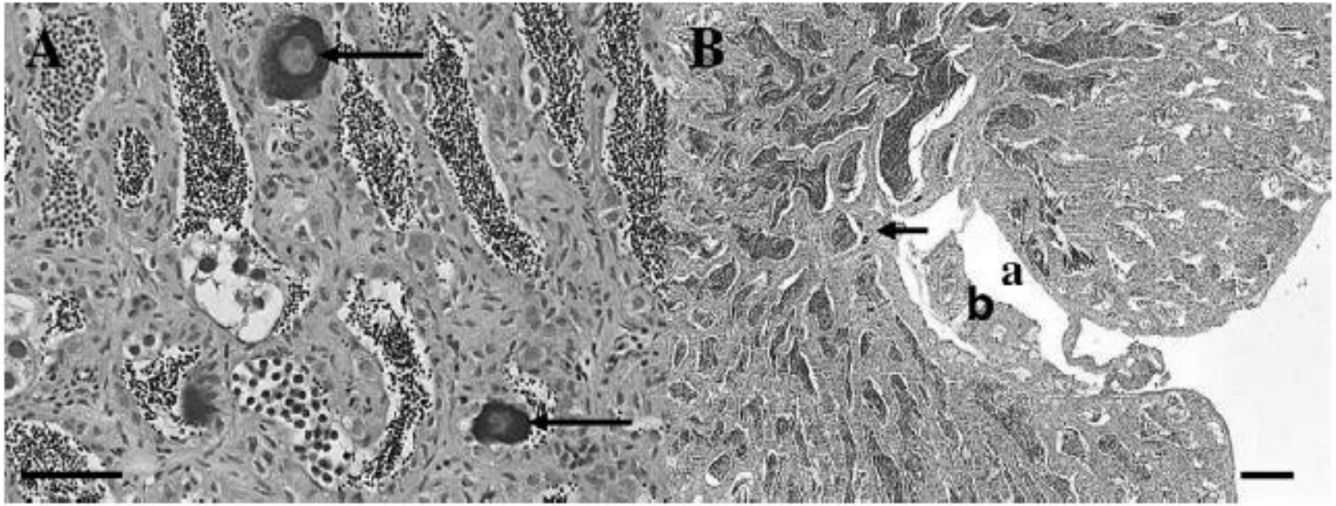


FIGURE 2.—Microscopic appearance of testicular oocytes in smallmouth bass. (A) Oocytes observed within testes of male smallmouth bass were primarily previtellogenic, chromatin nucleolus stage (arrow). Bar = 50 µm. (B) Immature oocytes (arrows) are most often observed around the central area (a) in close proximity to blood vessels and nerves (b). Bar = 100 µm. H&E stain used.

J Aquat Anim Health 2007, 242-253

Effects near the wastewater management units

Roach
(Rutilus rutilus)

http://www.luontoportti.com/suomi/images/14241.jpg

Environ Sci Technol 1998, 2498-2506

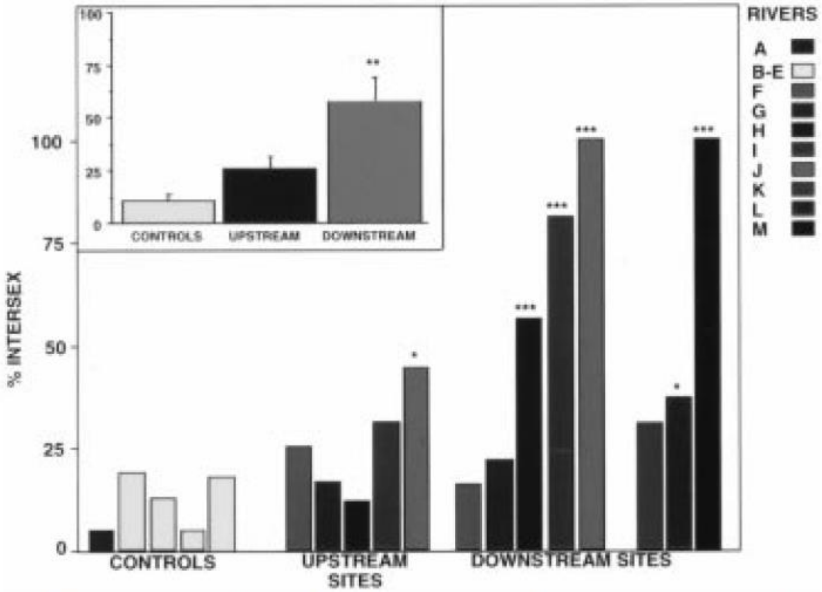
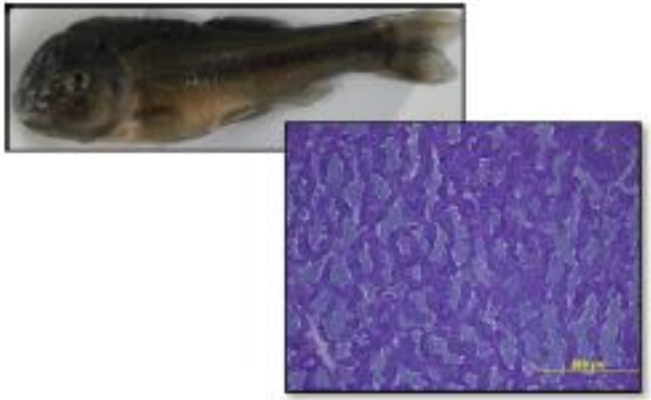
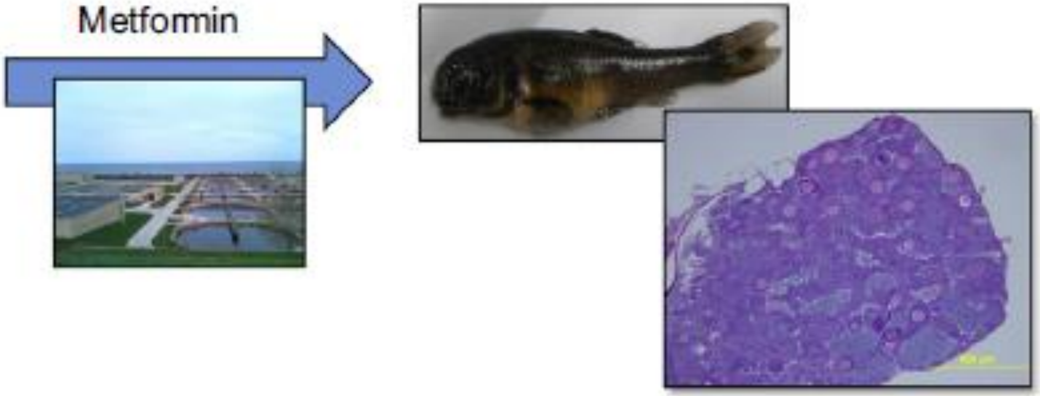
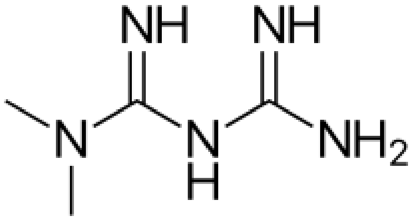


FIGURE 2. Incidence of intersexuality in samples of male roach from various rivers. The proportion of intersex roach (containing oocytes in their testes and/or with female reproductive ducts) in rivers (F–M), lakes or canals (B–E) in England and southern Ireland and in a laboratory control population (A). Sites B–E received no sewage treatment work (STW) effluent, whereas rivers F–M received varying amounts of STW effluent from more than one STW. Rivers F–J were sampled both upstream and downstream of major STWs (the two sites on these rivers were several kilometers apart and separated by one or more physical barriers). The inset diagram illustrates the general trends in the data when results from control, upstream, and downstream sites were pooled. The asterisks denote significance from the field control sites (B–E) at the following significance levels: *, $p = 0.05$; **, $p = 0.01$; ***, $p = 0.001$.

Not only due to contraceptives







https://upload.wikimedia.org/wikipedia/commons/thumb/4/46/Metformin.svg/220px-Metformin.svg.png

Chemosphere 2015, 38-45

Mussels suffering

Physiological effects of diclofenac, ibuprofen and propranolol on Baltic Sea blue mussels

Hanna Ericson[a,*], Gunnar Thorsén[b], Linda Kumblad[a]

Aquat Toxicol 2010, 223-231

http://images.csmonitor.com/csm/2013/07/mussel.jpg?alias=standard_600x400

Oxazepam effecting fish behavior

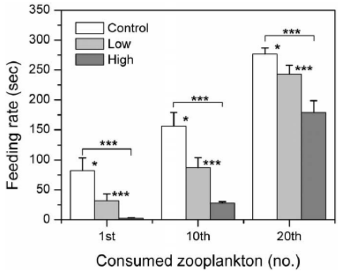


Fig. 2. Feeding rate of perch after oxazepam treatments. Feeding rate is expressed as the latency to capture the first zooplankton, the 10th zooplankton, and the 20th zooplankton. Error bars represent ±1 SE (n = 25 in all treatments); statistically significant differences between the control and treatments are indicated (*$P < 0.05$ or ***$P < 0.001$).

Science 2013, 814-815

European perch
(Perca fluviatilis)

http://www.luontoportti.com/suomi/images/14044.jpg

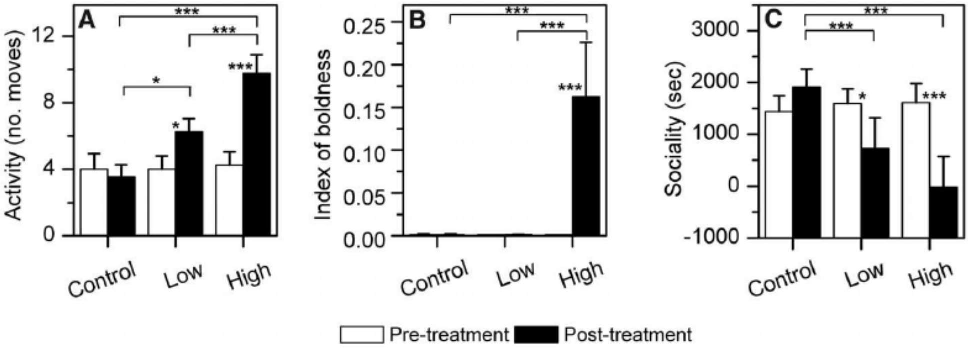
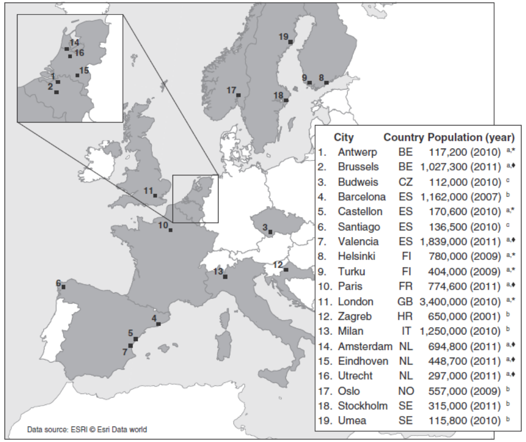


Fig. 1. Fish behavioral response to two concentrations (low: 1.8 μg liter^{-1}; high: 910 μg liter^{-1}) of dissolved oxazepam compared to control treatment (0 μg liter^{-1}). (**A**) Activity, measured as number of swimming bouts (>2.5 cm) during 10 min. (**B**) Boldness, measured as the inverse of latency to enter a novel area during the total trial time (900 s). (**C**) Sociality, measured as the cumulative time (in seconds) spent close to a group of conspecifics. Error bars represent ±1 SE (n = 25 in all treatments); statistically significant differences between the pre- and posttreatments are indicated (*$P < 0.05$ or ***$P < 0.001$).

Usage of illicit drugs



Sci Total Environ 2012, 432-439

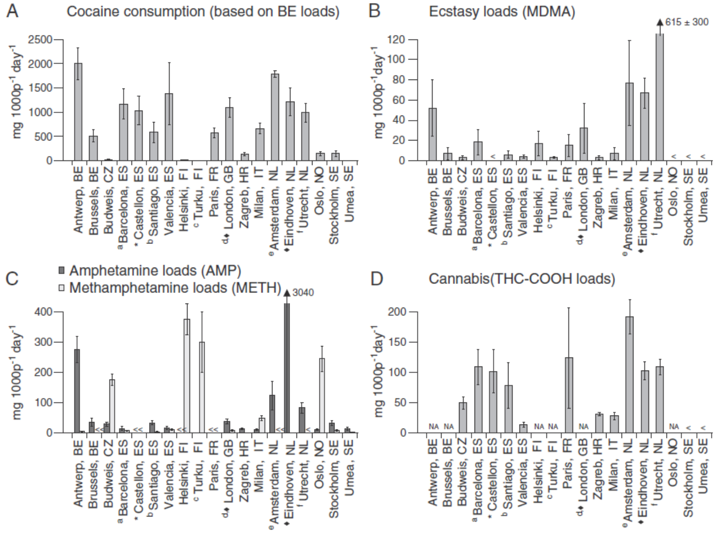


Fig. 2. Average estimates of cocaine (COC) consumption (back-calculated from benzoylecgonine (BE) loads, the main metabolite of COC) and population-normalized loads of amphetamine (AMP), methamphetamine (METH) in 19 selected European cities and cannabis (THC-COOH, all in mg/1000 inhabitants/day) in 13 of them between the 9th and 15th March 2011 (mean ± SD from all sampling days, n = 7). [a]Sampling one week later (16th–22th March 2011). [b]n = 6, sample of Monday 14th March missing. [c]n = 6, sample of Sunday 13th March missing. [d]n = 6, sample of Saturday 12th March missing. [e]n = 6, sample of Monday 14th and Tuesday 15th March missing. [f]Sampling started one day later (10th–16th March 2011). [*]Sampling uncertainty estimated to be larger than variation of interlaboratory comparison of chemical analysis. [♦]Exfiltration of sewerage larger than 20%. [NA]Not analyzed. [<]All measured concentrations were below the limit of quantification.

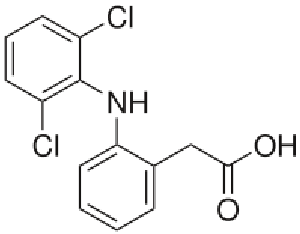
Diclofenac and Indian vultures

PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B

rstb.royalsocietypublishing.org

Avian scavengers and the threat from veterinary pharmaceuticals

Richard J. Cuthbert[1,2], Mark A. Taggart[3], Vibhu Prakash[4], Soumya S. Chakraborty[4], Parag Deori[4], Toby Galligan[1], Mandar Kulkarni[4], Sachin Ranade[4], Mohini Saini[5], Anil Kumar Sharma[5], Rohan Shringarpure[4] and Rhys E. Green[1,6]



https://upload.wikimedia.org/wikipedia/commons/thumb/0/00/Diclofenac.svg/200px-Diclofenac.svg.png

https://en.wikipedia.org/wiki/Indian_vulture_crisis#/media/File:Gyps_bengalensis_PLoS.png

How to measure the ecotoxicity

- USA 1980s part of the dossier
- EU 1996 ”Guideline on the environmental risk assesment of medicinal products for human use”, updated 2012, EU-dossier
- REACH in Europe for chemicals – not for APIs
- Environmental Classification of Pharmaceuticals at www.fass.se – Guidance for pharmaceutical companies, Sweden and Norway

How is the evaluation done

1. APIs

PNEC (predicted no-effect concentration)

PEC (predicted environmental concentration)

If the relation >1, => risk. If >10, a big risk

If the relation is <1, small risk to environment, very small <0,1

Real risk is also based on the national usage figure

2. Products

No existing system

Green and sustainable pharmacy practice
Guidance for practitioners
Part II

Eeva Teräsalmi

MS in pharm, pharmacy owner, FIP vicepresident

Speaker

Ms Eeva Teräsalmi

FIP Vice President (Finland)

Global problem - global solutions

- UN: Environment program since 1972

UNEP

- UN: Sustainable development goals
  Proposition to add AMR –indicator

UN and WHO: Green procurement in health care sector

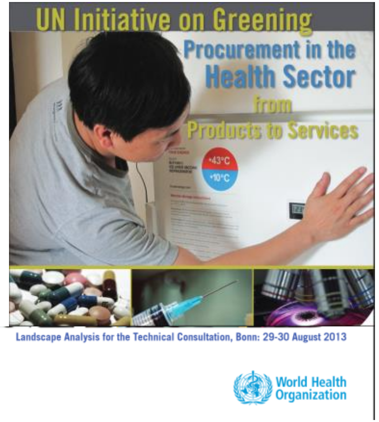
Interagency Task Team on Sustainable Procurement in the Health Sector including United Nations Development Programme (UNDP), United Nations Population Fund (UNFPA), United Nations Environment Programme (UNEP), United Nations Office for Project Services (UNOPS), United Nations Children's Fund (UNICEF) and World Health Organization (WHO).

Medicines:

During man-made and natural catastrophs – drug donations and disposal

Stockholm County Council Environmental Classification of Pharmaceuticals: The Stockholm County Council introduced environmental classification of pharmaceuticals and described their environmental hazards and risks. This is helpful in substituting more environmentally friendly components during production. This environmental classification and EU legislation on medical products provide guidelines for manufacturers to follow Good Manufacturing Practices and environmental standards. http://www.janusinfo.se/, www.fass.se

The Viennese Database for Disinfectants (WIDES Database) is a user-friendly database established by the City of Vienna Climate Protection Programme, ÖkoKauf Wien, to assist hospitals and other health care settings to assess effectiveness, safety and environmental factors when procuring disinfectants. http://www.wien.gv.at/english/environment/protection/oekokauf/disinfectants/7.



CLASSIFICATION SYSTEMS

- Based on APIs risk to environment x consumption

- Environmental Classification of Pharmaceuticals at www.fass.se – Guidance for pharmaceutical companies, Sweden and Norway

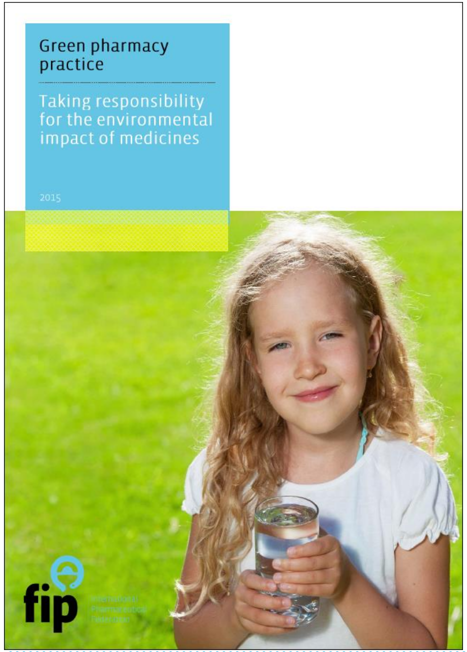
- Classification is needed if we want to
  - inform customers
  - influence purchasing processes and tenders
  - create a mark for packages/eco-friendly medicine
  - change the pricing mechanisms
- Should be based on the whole life-cycle of one product – these systems do not exist

- FDA, EU- environmental risk analysis only for new molecules, there are about 2000 APIs in the market which are unclassified

EU: Strategic Approach to Pharmaceuticals in the Environment 2019

- For both human- and veterinary medicins from production to waste
- Raise awareness and promote prudent use!
- Improve training and risk assessment
- Gathering monitoring data
- "Green design"
- Reduce emissions from manufacturing
- Reduce waste
- Improve wastewater treatment
- AMR- European One Health Action

Green Pharmacy Practice
Taking responsibility for the environmental impact of medicines

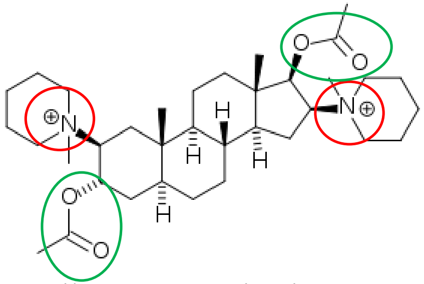


- FIP/WHO: Guidelines on Good Pharmacy Practice 2009
- FIP: Statement on Green Pharmacy Practice and reference document 2015, statement on policy 2016

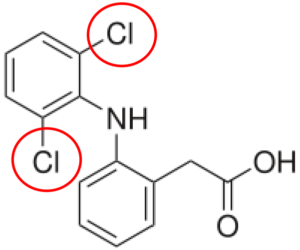
WHAT PHARMACISTS CAN DO?

- Drug development and research: Green chemistry –principles
- Industry: small emissions and effective processes, classification of medicines
  role of GMP?
- Wholesalers: effective logistics and procurement processes
- Hospital pharmacies: Drug committee work and procurement, education and collection of waste at point, risk management of own actions
- Open care pharmacy: Adherence to the medical therapies, information to customers, medical waste, risk management of own actions
- Regulation: classification of medicines, drug prices, GMP etc
- Education: Future pharmacists should be aware of the problem and of the solutions

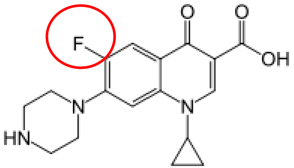
Benign by design – green chemistry and green formulations



https://en.wikipedia.org/wiki/Pancuronium_bromide#/media/File:Pancuronium.svg



https://upload.wikimedia.org/wikipedia/commons/thumb/0/00/Diclofenac.svg/200px-Diclofenac.svg.png

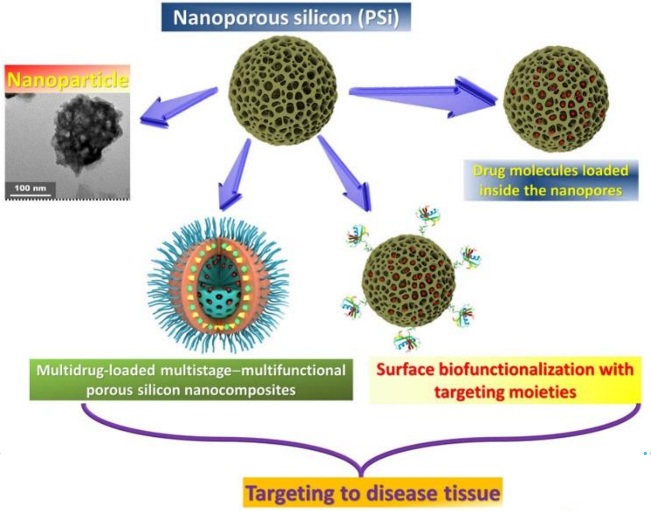


https://upload.wikimedia.org/wikipedia/commons/thumb/7/7d/Ciprofloxacin.svg/200px-Ciprofloxacin.svg.png

Re-Designing of Existing Pharmaceuticals for Environmental Biodegradability: A Tiered Approach with β-Blocker Propranolol as an Example

Tushar Rastogi, Christoph Leder, and Klaus Kümmerer*

Environ Sci Technol 2015, 11756-11763



http://www.3iregeneration.com/images/3iNano_Overall_Idea_1024.jpg

RATIONAL MEDICINE USAGE

- Rational prescribing and usage are main factors to prevent the problem!!!
- Drug waste management is expensive. The amount of drug waste should be minimized.
- Consumers should be informed about the impacts of medical wastage.
- In Finland the cost of medical waste is ~100 million euros/year!

NOW YOU CAN MAKE DIFFERENCE!

Nyt voit vaikuttaa!

Hoitosi onnistumiseen:

For successful treament

Lääkekustannuksiisi:

On your own costs

Ympäristön kuormittumiseen:

To the environmental load

DRUG WASTE

- Legislative actions about waste management are necessary
- Classification of medical waste as hazardous waste
- Incineration (>930 ^{0}C) is the only way to dispose medical waste safely
- Take up-programs should be organised (based on national legislation)
- In many countries pharmacies are running take-back programs
- In hospitals treatment on the spot -work

Effective wastewater management
Treatment at the source

Medical Wastewater Treatment In COVID Times

By Zhenzhen Xu 17 April, 2020

Coronavirus can be found in faeces/urine so medical wastewater must be treated properly. CWR's Xu expands on China's efforts in Wuhan & beyond

http://www.syke.fi/en-US/Rese arch__Development/Research_and_development_projects/Projects/Efficient_Treatment_of_Pharmaceutical_Residue_at_Source_EPIC

RISK ANALYSIS

Table shows that the most important issues for a community pharmacy are to improve medication compliance so that all medicines dispensed are actually used by the consumer. Also participating in the medical waste collection programmes is essential.

It is important to be able to measure the success of different actions taken. One can measure the amount of waste collected, the amount of electricity used, the consumption of paper etc.

Table 1 Example of a risk analysis in a community pharmacy

RISK ANALYSIS IN A COMMUNITY PHARMACY					
ACTIVITY	ISSUE	EFFECT ON ENVIRONMENT	IMPORTANCE OF RISK	WHAT WE CAN DO	INDICATORS
Paper usage	Garbage: paper and cardboard, confidential material	Adds to unnecessary landfill	++	Collection of waste, recycling	Monitor paper usage, follow up of the amount of confidential material
Premises	Electricity, water, heating	Effect on waste water and climate	+	Modern technology (less consumption of energy), closing all machines for night, effective cleaning, central heating and cooling with optimal temperatures	Monitor electricity bills, change of equipment
Storage	Optimisation of storage	Unused medicines are a cost for disposal processes	+	Effective storage management	Amount and value of expired products
Equipment	Batteries and fluorescent lights	Used batteries and fluorescent lights are a cost for disposal processes	+	Collect and take to proper discharge place	Exchange intervals of fluorescent lights
Cleaning	Towels for single use	Unnecessary landfill	+	If possible, usage of multi-use towels	Follow-up of towel usage
Eating	Packaging materials, biowaste	Unnecessary landfill and impact to atmosphere	++	Sorting and recycling	
Logistics	Logistical problems	Traffic emissions	+	Suppliers use same transport system	
Customers	Packaging materials	Unnecessary landfill	+	Customer information, ask if plastic pack is needed, we do have linen bags	Frequency of plastic bag orders
Customers, return of unused and expired medicines	Medical waste	Environmental problems if not discharged properly	+++	Support of adherence, rational use of small packages, information to customers, recycling information	The amount of returned medicines per year
Physicians, prescribing habits	Environmental risks	Toxic effects on the environment	+	Information to other health care providers. National guidelines on prescription	Actions taken

PHARMACEUTICAL EDUCATION

It is of importance that the future pharmacists should be aware of sustainable solutions and practice. These topics should be included and integrated on all pharmacy curriculums.

More information:
Sivén M et al: Generation Green –
A holistis approach to implementation of green principles and practices in education programmes in pharmaceutical and medical sciences at the University of Helsinki.
Sustain chem Pharm 16:100262, 2020

Generation Green

Any questions?

Please use the Q&A tool

Wrap up & Conclusions

Episode 22

Key considerations for developing COVID-19 treatments: Learning from the past and planning for the future

In partnership with: BPS Pharmacy Practice Research Special Interest Group

RESPONDING TO THE PANDEMIC TOGETHER

FIP COVID-19 Online Programme

Moderator

Victoria Garcia Cardenas
Senior Lecturer
University of Technology Sydney (Australia)

Speaker

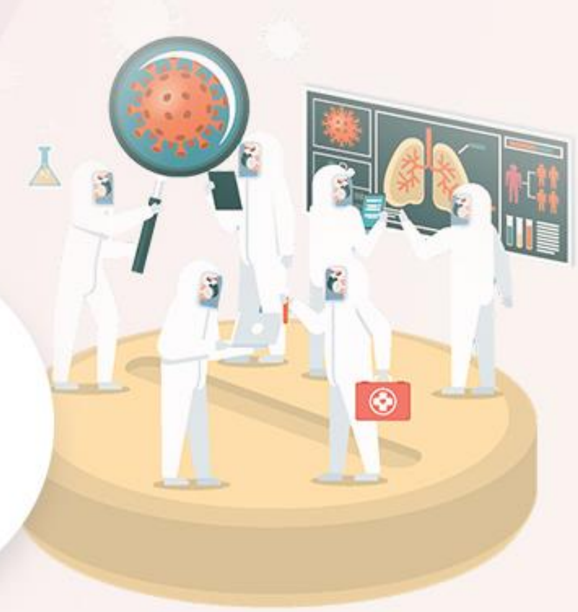
Syed Shahzad Hasan
Senior Research Fellow/ Senior Lecturer
University of Huddersfield (UK)

Speaker

Dalia Dawoud
Associate Editor, Research in Social and Administrative Pharmacy (UK)

Date
7 July

Time
15:00 CEST



SEASON 1

The FIP CEO Interviews...

fip ADVANCING PHARMACY WORLDWIDE

7 July, 12:00 CEST

Carmen Peña

Catherine Duggan

Chief Executive Officer, International Pharmaceutical Federation (FIP)
The Netherlands

Carmen Peña

Immediate Past President, FIP
Doctor in Pharmacy, Complutense University of Madrid
Spain

Thank you for attending!

Please provide feedback through the survey you will see at the end of the event