Assessing the burden of antibiotics and other pharmaceuticals in the water cycle from anthropogenic and animal farms sources

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Farmaci nell'ambiente – Fonti di Immissione

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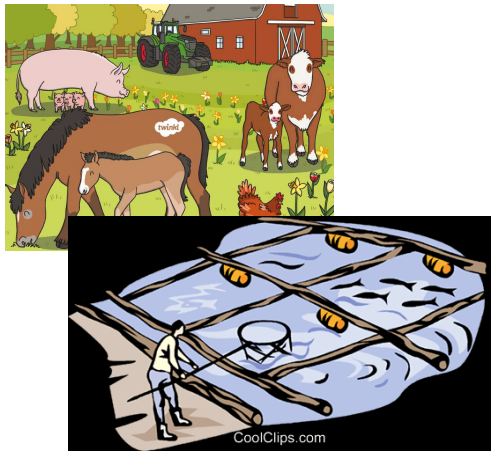
Pharmaceuticals are **ubiquitous contaminants** in the environment

Human Use

Wastewater Treatment Plants Effluents

Direct discharge of wastewater

Veterinary Use



Animal farms and acquaculture

Industrial discharge

Local contamination

Active compounds in complex **mixtures**

Pharmaceuticals in the environment

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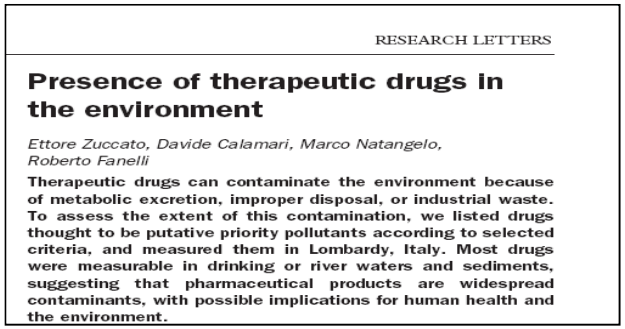


RESEARCH LETTERS

Presence of therapeutic drugs in the environment

Ettore Zuccato, Davide Calamari, Marco Natangelo, Roberto Fanelli

Therapeutic drugs can contaminate the environment because of metabolic excretion, improper disposal, or industrial waste. To assess the extent of this contamination, we listed drugs thought to be putative priority pollutants according to selected criteria, and measured them in Lombardy, Italy. Most drugs were measurable in drinking or river waters and sediments, suggesting that pharmaceutical products are widespread contaminants, with possible implications for human health and the environment.

The Lancet, 2000, 355, 1789-1790

First Monitoring of pharmaceuticals in surface and tap water in Italy

Mass balance of pharmaceuticals in surface water in Italy

Strategic Survey of Therapeutic Drugs in the Rivers Po and Lambro in Northern Italy

DAVIDE CALAMARI,*,† ETTORE ZUCCATO,‡ SARA CASTIGLIONI,†,‡ RENZO BAGNATI,‡ AND ROBERTO FANELLI‡

Department of Structural and Functional Biology, University of Insubria, Via J.H. Dunant 3, 21100 Varese, Italy, and Department of Environmental Health Sciences, Mario Negri Institute for Pharmacological Research, via Eritrea 62, 20157 Milan, Italy

Environmental Science and Technology, 2003, 37, 1241-1248

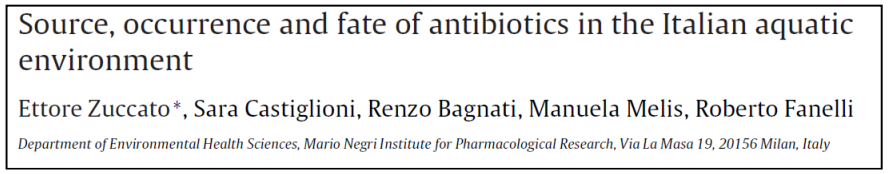
Removal of Pharmaceuticals in Sewage Treatment Plants in Italy

SARA CASTIGLIONI,†,‡ RENZO BAGNATI,‡ ROBERTO FANELLI,‡ FRANCESCO POMATI,† DAVIDE CALAMARI,† AND ETTORE ZUCCATO*,‡

Department of Biotechnology and Molecular Sciences, University of Insubria, Via J.H. Dunant 3, 21100 Varese, Italy, and Department of Environmental Health Sciences, Mario Negri Institute for Pharmacological Research, via Eritrea 62, 20157 Milan, Italy

Environmental Science and Technology, 2006, 407, 357-363

Monitoring fate and removal of pharmaceuticals and antibiotics



Source, occurrence and fate of antibiotics in the Italian aquatic environment

Ettore Zuccato*, Sara Castiglioni, Renzo Bagnati, Manuela Melis, Roberto Fanelli

Department of Environmental Health Sciences, Mario Negri Institute for Pharmacological Research, Via La Masa 19, 20156 Milan, Italy

Journal of Hazardous Materials, 2010, 179, 1042-1048

Water Research 131 (2018) 287–298

Contents lists available at ScienceDirect

Water Research

journal homepage: www.elsevier.com/locate/watres

Mass balance of emerging contaminants in the water cycle of a highly urbanized and industrialized area of Italy

Sara Castiglioni [a, *], Enrico Davoli [a], Francesco Riva [a], Marinella Palmiotto [a], Paolo Camporini [a], Angela Manenti [b], Ettore Zuccato [a]

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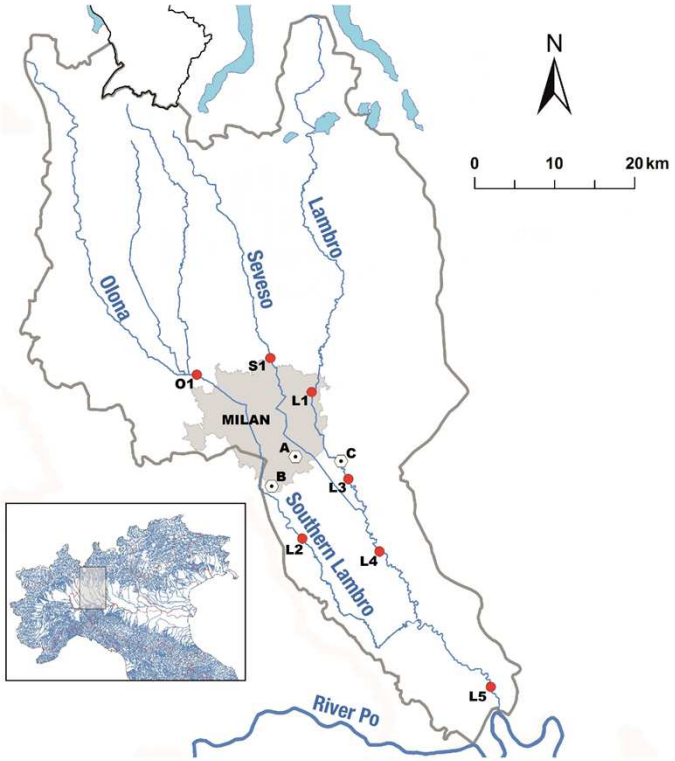
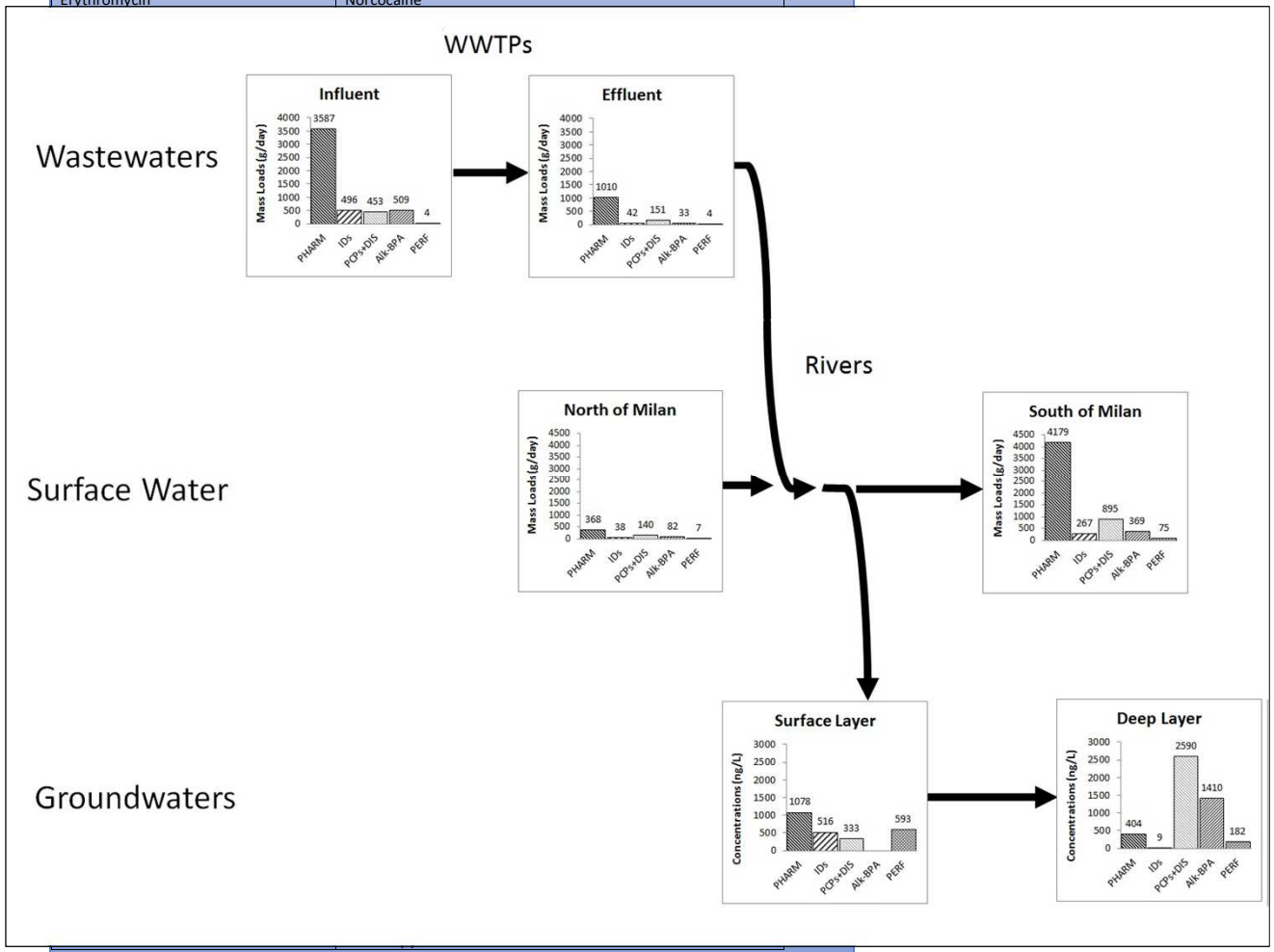
[b] Metropolitana Milanese S.p.A., Area Acquedotto, Via Giuseppe Meda 44, 20141 Milan, Italy



fondazione cariplo

Emerging Contaminants Investigated – MARIO NEGRI	
PHARMACEUTICALS	**ILLICIT DRUGS**
Antibiotics	***Cocaine and metabolites***
Amoxicillin	Benzoylecgonine
Ciprofloxacin	Norbenzoylecgonine
Clarithromycin	Cocaine
Erythromycin	Norcocaine



Antibiotics in Surface Water (Lambro, Seveso, Olona)

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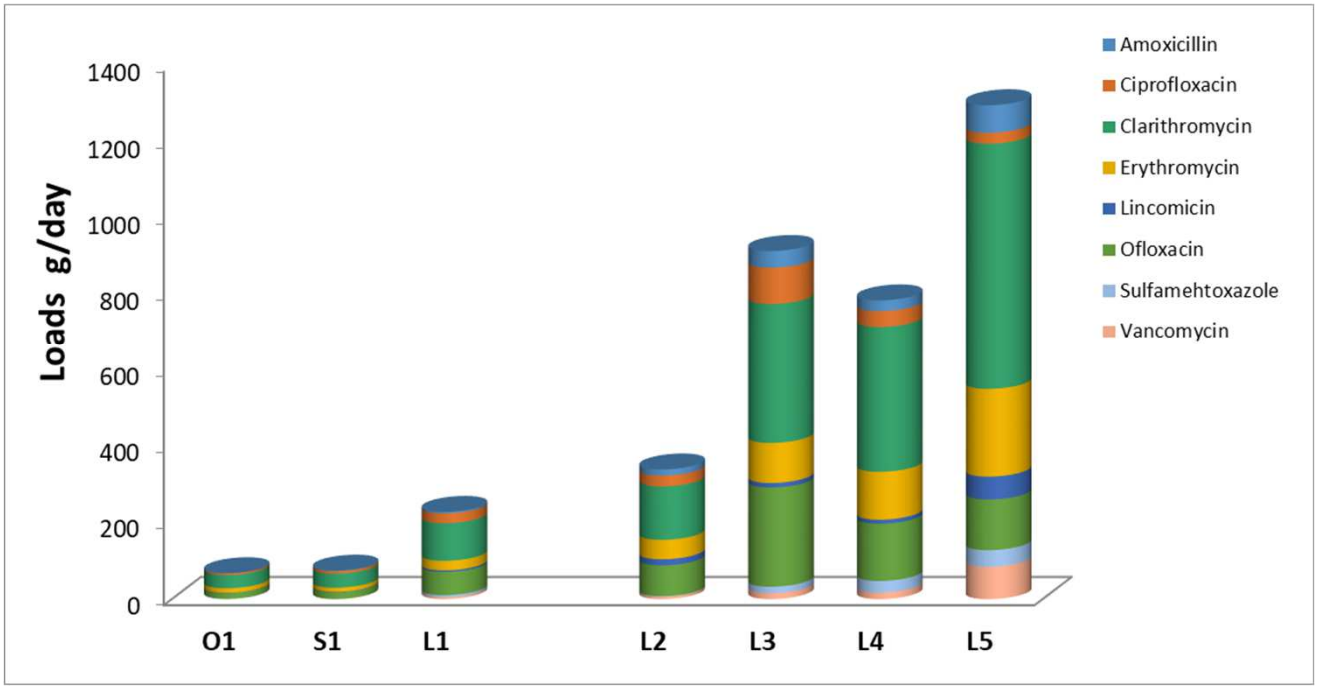

In: Gli antibiotici spiegati bene – Silvio Garattini- Edizioni LSWR, 2020

Assessing antibiotics burden in surface water

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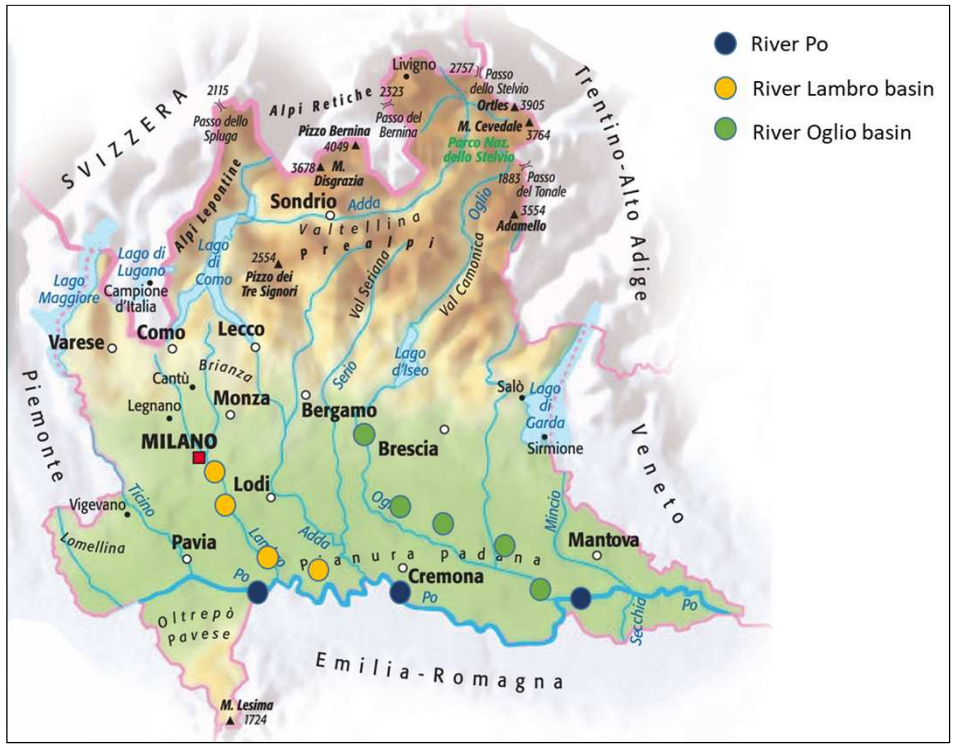
Fondazione Lombardia per l'Ambiente

Supported by Regione Lombardia

Monitoring the **presence of antibiotics for human and veterinary use** and other pharmaceuticals in surface water in the North of Italy

Study area



Sampling period

Three sampling campaigns

1. Autumn – winter 2020- 2021
2. Spring 2021
3. Summer 2021

Assessing antibiotics burden in surface water

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Selected Analytes

Antibiotics were selected among the most used in veterinary medicine (with some for human use)

Other pharmaceuticals were selected among the most used in human medicine

Antibiotics		Other Pharmaceuticals
Sulfonamides	***Fluoroquinolones***	***CNS drugs***
sulfamethoxazole	ciprofloxacin	diazepam
sulfadiazina	flumequine	demethyl-diazepam
sulfadimetossina	levofloxacin	*carbamazepine*
Penicillins	***Amphenicols***	***Diuretics***
amoxicillin	florfenicol	furosemide
ampicillin	thiamphenicol	hydrochlorothiazide
benzylpenicillin	***Diaminopiridine***	***Bronchodilators***
Macrolides	trimetoprim	salbutamol
spiramycin	***Tetraciclines***	***Anti-inflammatories***
tylosin	doxycycline	ibuprofen
tilmicosin	chlortetracycline	naproxene
oleandomicin	oxytetracycline	ketoprofen
erythromycin	***Anthelmintics***	diclofenac
Lincosamides	ivermectine	
lincomycin	levamisol	

Method of analysis for pharmaceuticals

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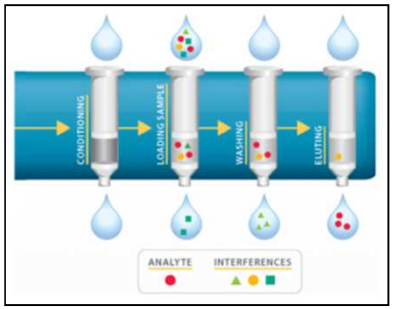
Sample preparation

Filtration on 1.6 and 0.45 µm filters

Sample extraction

Cartridges Oasis MCX ed HLB (60 mg)
Two different protocols



Sample analysis

HPLC- MS/MS
(API 5500 QqQ)

- Multiple reaction Monitoring (MRM)
- Two/three most abundant fragmentation products of the protonated pseudo-molecular ions
- Positive and negative ionization mode

Pharmaceuticals in surface water – Overall Results

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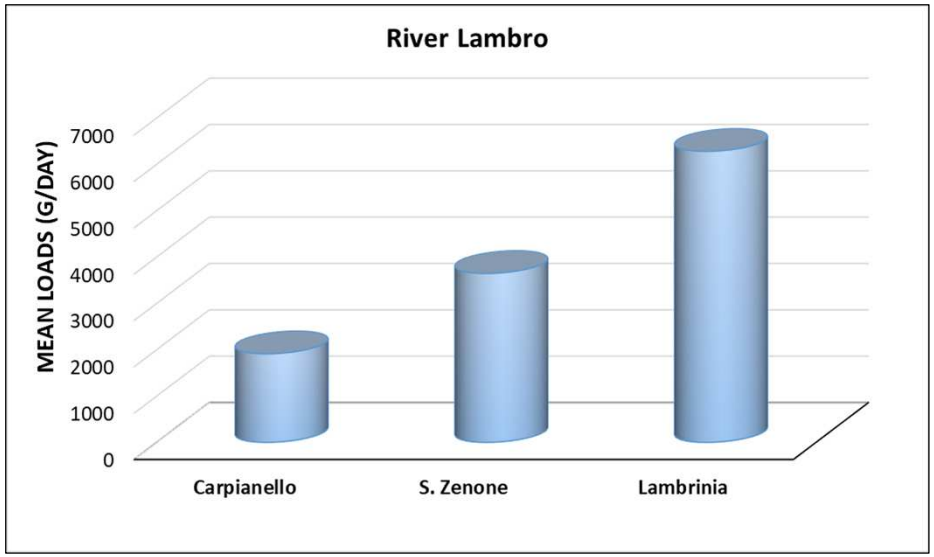
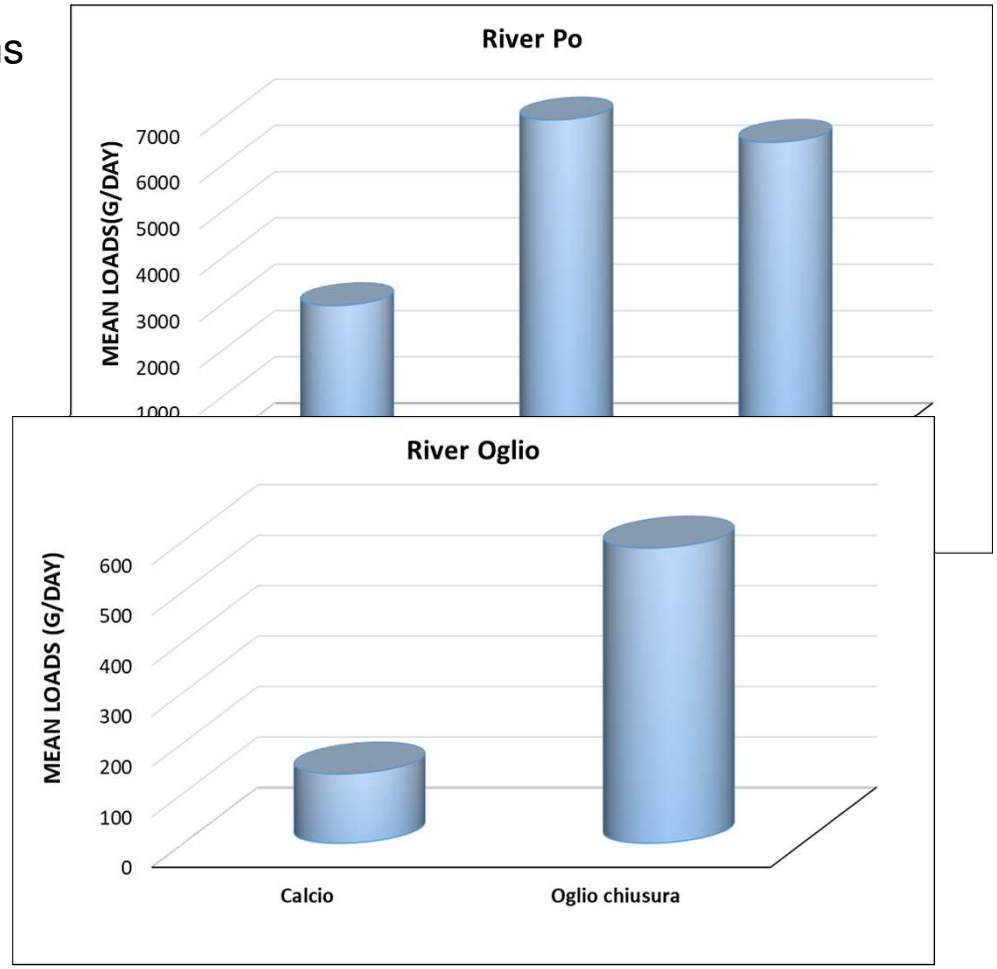
Mean Mass Loads (g/day) from three analytical campaigns





Pharmaceuticals in surface water – Seasonal variability

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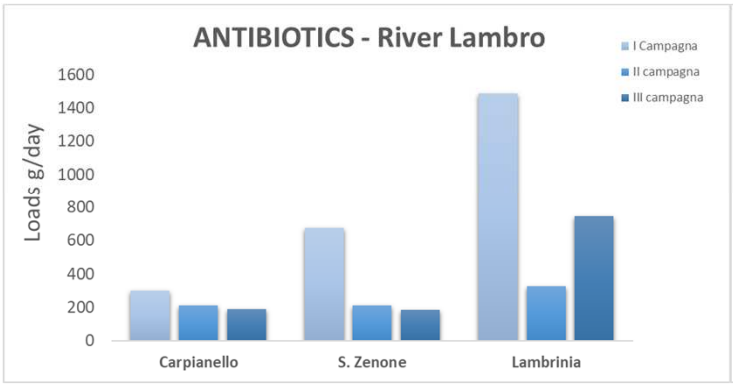
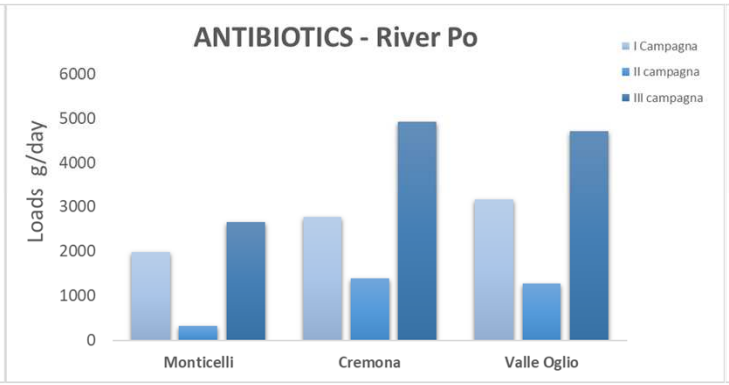
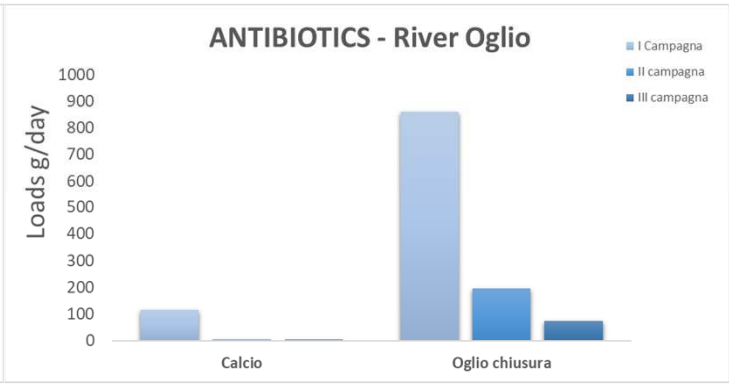
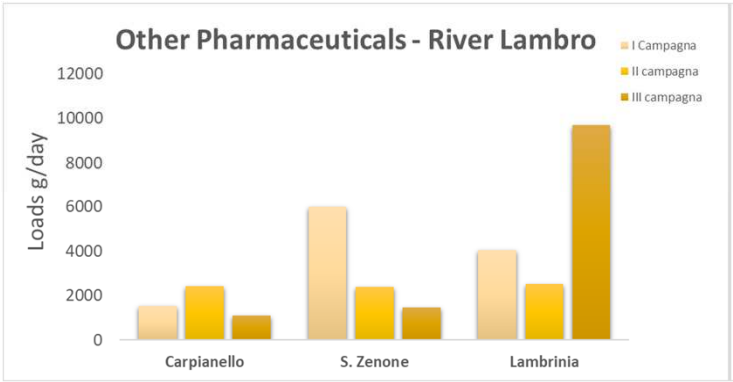
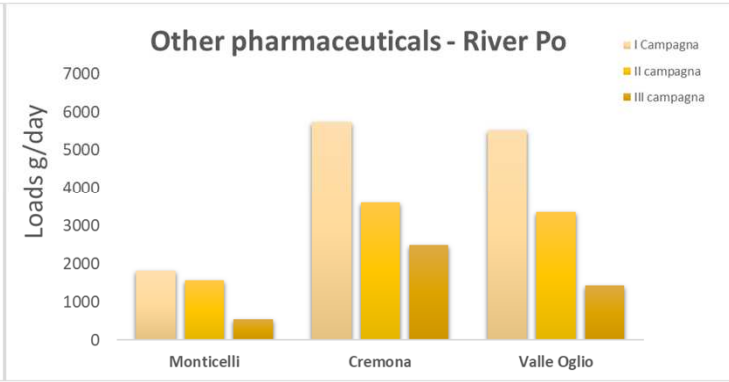
First campaign: autumn – winter; second campaign: spring; third campaign: summer

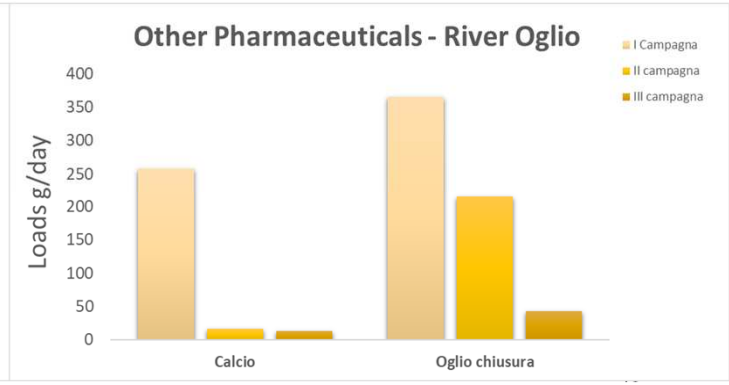












Conclusions and future investigations

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Increasing burden of pharmaceuticals along the investigated rivers

Quantitative Assessment of **most abundant substances** along the rivers

Local contamination of specific substances in some sampling sites

Identification of **potential sources of contamination** for specific substances

THANKS FOR ATTENTION !!

Istituto Mario Negri

Sara Castiglioni
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