Environmental risk assessment of pharmas in Finland - Watch List monitoring, SYKE Policy Brief and EPIC-project recommendations

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Nordic WFD conference, Vaasa 21.-23.5.2019

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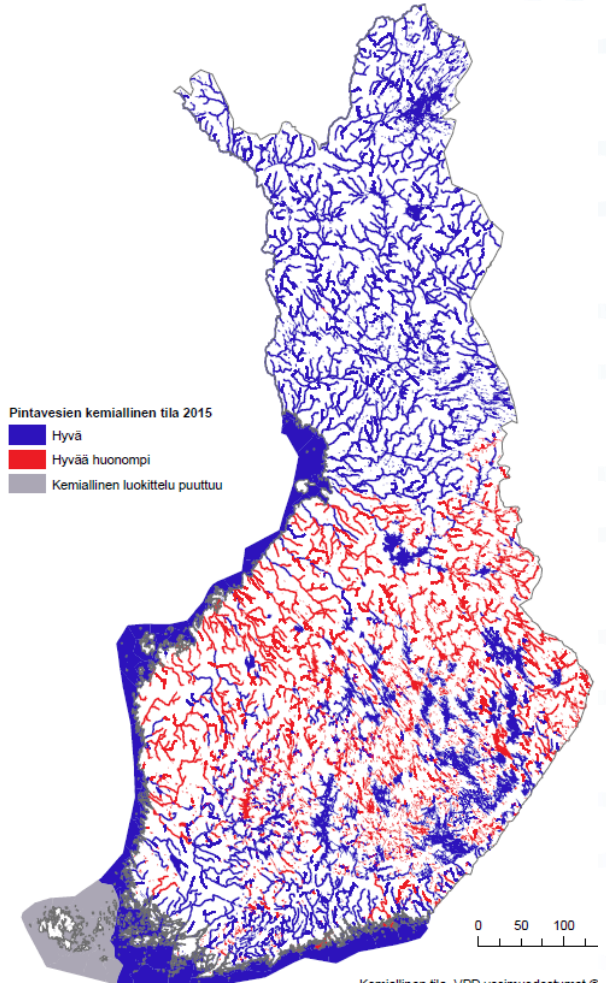
Chemical status of surface waters

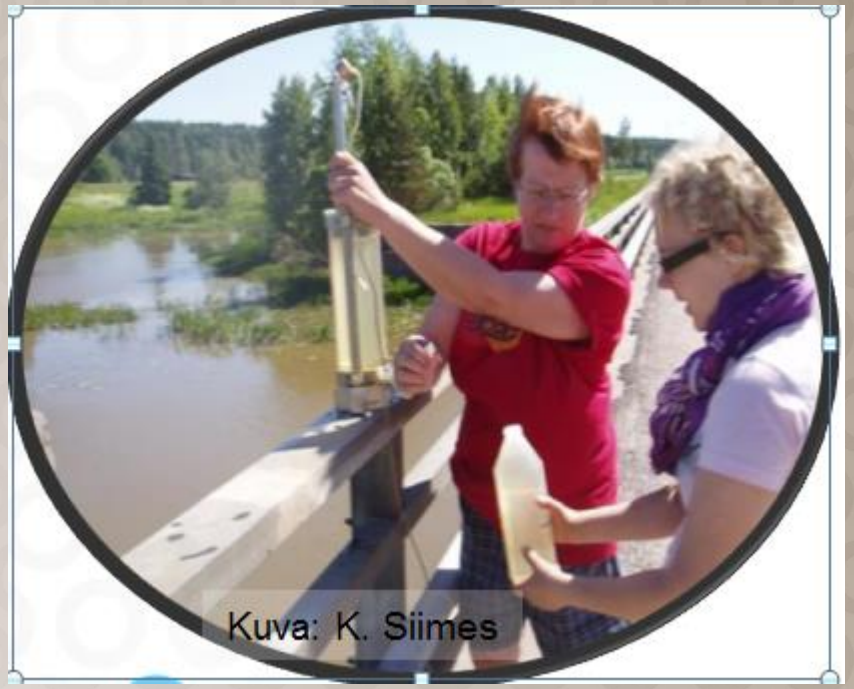
2nd classification period

- >45 substances on list
- 6875 sites
  - > 35000 evaluations
  - Measured data, expert evaluations or modelled (Hg)
- Causing problems
  - Mainly Hg
  - Metals (Cd, Ni)
  - TBT



Watch List monitoring

(based partly on presentation of Katri Siimes)



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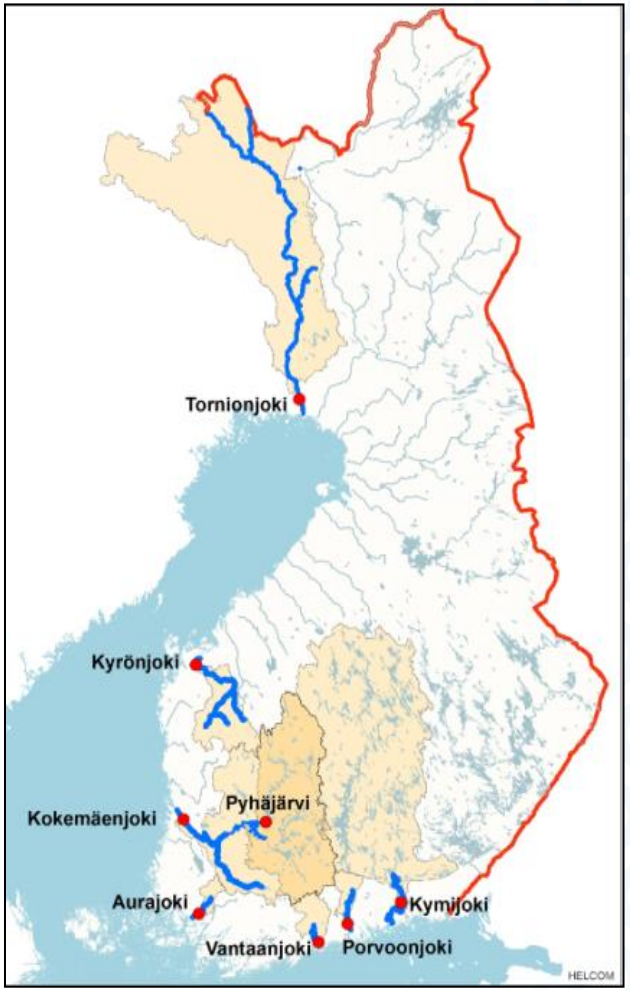
Watch List monitoring

- A minimum number of sites for FI set by the EU = 9
- 8 river sites, 1 lake
- App. once a year sampling/analyzing
- 4 sites had exceedences



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Monitoring results 2015-2018

WL 2015-2018	Pain_killer	Hormones			Macrolidiantibiotics			Neonicotinoids					(UV-prot.)
Summary (FIN)	Diclofenac	EE2	E1	E2	Azithromyc	Erythromyc	Clarithrom	Clothianidin	Thiamethoxa	Thiacloprid	Imida	Aceta	EHMC
Kymijoki	<LoQ - 3	<LoQ	<LoQ - 0,2	<LoQ	<LoQ - 1	<LoQ	<LoQ - 1	<LoQ	<LoQ	<LoQ	<LoQ	<LoQ	<LoQ
Porvoonjoki	**23 - 204**	<LoQ	0,4 - 0,9	<LoQ	<LoQ - 1	<LoQ - 2	2 - 11	<LoQ - 1	<LoQ - 1	<LoQ	<LoQ	<LoQ	<LoQ - 40
Vantaanjoki	**17 - 100**	<LoQ - **0,76**	0,2 - 1,8	<LoQ	<LoQ - 1	<LoQ - 3	1 - 26	<LoQ - 21	1 - 5,5	<LoQ - 1	<LoQ	<LoQ	<LoQ
Aurajoki	<LoQ - **10**	<LoQ	<LoQ - 0,2	<LoQ	<LoQ	<LoQ	<LoQ	<LoQ - 20	<LoQ - 14	<LoQ	<LoQ	<LoQ	<LoQ
Kokemäenjoki	<LoQ - **83**	<LoQ - **0,18**	<LoQ - 0,2	<LoQ	<LoQ	<LoQ	<LoQ	<LoQ	<LoQ	<LoQ	<LoQ	<LoQ	<LoQ
Kyrönjoki	**6 - 30 (ELY: 95!)**	<LoQ - **0,72**	<LoQ - 1,6	<LoQ	<LoQ	<LoQ	<LoQ - 1	<LoQ - 2	<LoQ	<LoQ	<LoQ	<LoQ	<LoQ
Tornionjoki	<LoQ	<LoQ	<LoQ - 0,2	<LoQ	<LoQ	<LoQ	<LoQ - 1	<LoQ	<LoQ - 2	<LoQ - 2	<LoQ	<LoQ	<LoQ
Pyhäjärvi	**7 - 33**	<LoQ - **0,06**	<LoQ - 1,2	<LoQ	<LoQ - **7**	<LoQ	<LoQ - 6	<LoQ	<LoQ	<LoQ	<LoQ	<LoQ	<LoQ
Päijännetunneli	<LoQ	<LoQ	<LoQ	<LoQ	<LoQ	<LoQ	<LoQ	<LoQ	<LoQ	<LoQ	<LoQ	<LoQ	<LoQ
Required LoQ	10	0,035	sum 0,4 ng/l		sum 19 ng/l			sum 8,3 ng/l					6000
PNEC (Loos et al. 2018)	100->50	**0,035**	3,6	**0,4**	**19**	200	120	130	42	50	**8,3**	500	**6000**

- No problems with the detection limits
- Diclofenac and EE2!
- Temporal variation observed (EE2)

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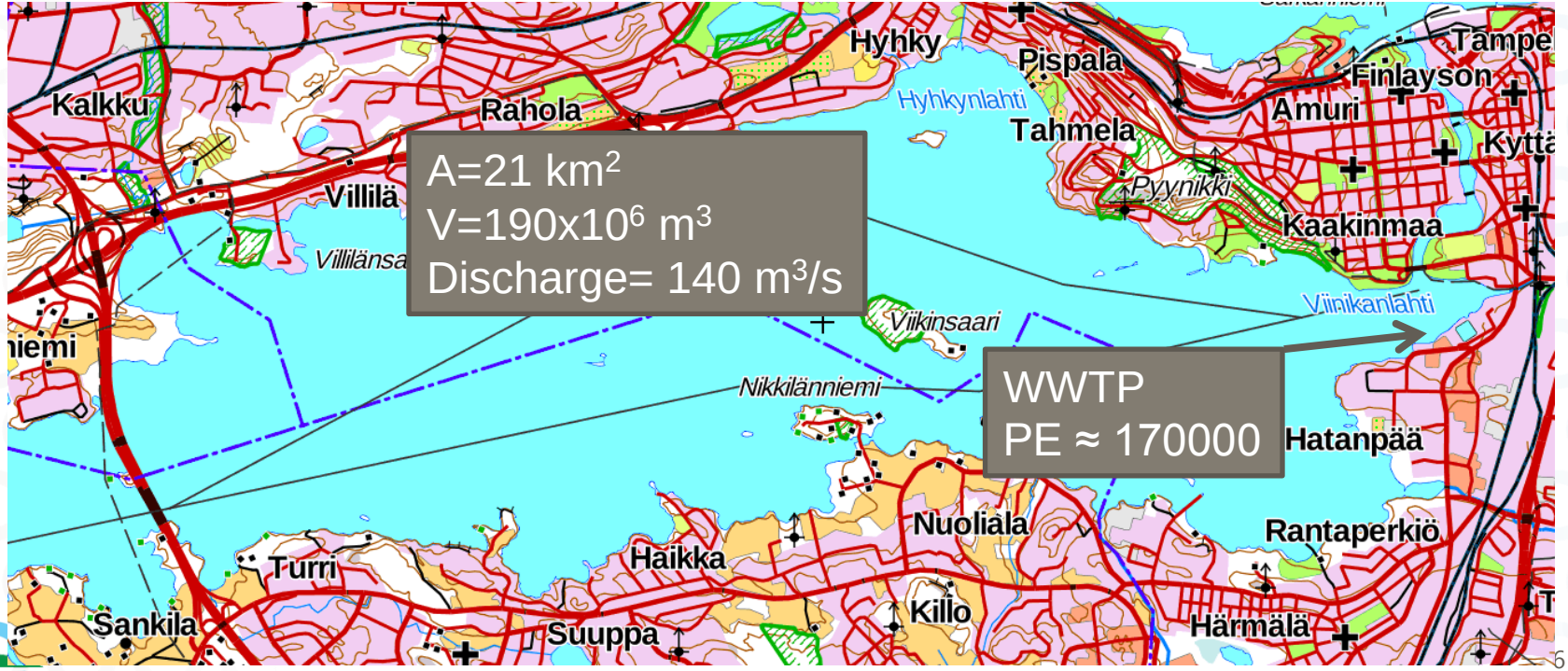
An example and future needs for monitoring and risk assessment of pharmas (1)



SYKE Lake Pyhäjärvi/Tampere city: EE2 exceedences

An example and future needs for monitoring and risk assessment of pharmas (2)

- A survey of pikeperch populations of region
- Lake Pyhäjärvi had high percentage of ”raw” individuals in old year classes (> 6 y)
- A connection to WWTP effluents?

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An example and future needs for monitoring and risk assessment of pharmas (3)

- Watch List monitoring should be more frequent and covering more sites
  - Effect of season (winter)
  - Include other pharmas of suspected environmental effects
- Readily moved to priority substance list
- Risks of endocrine disrupters should be evaluated using effect based methods
  - E.g. ISO 19040 tests (estrogen receptors in yeast and human cell lines)
  - EBMs should be part of the chemical status assessment
- Application of other EBMs (neurotoxicity, cytotoxicity etc.)
- Survey of antimicrobial resistance (effluents/recipients)

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SYKE Policy Brief
17.5.2019

Environmental drug load can be reduced

SYKE

www.syke.fi/policybriefs/en
https://helda.helsinki.fi/handle/10138/301744

Fate of selected pharmaceuticals

	Paracetamol Analgesic, one of Finland's most common pharma-ceutical substances	Furosemide Diuretic, used in the treatment of high blood pressure, among other things	Diclofenac Anti-inflammatory medicine, used in analgesic gels, for example.	Tetracycline Antibiotic, also used in veterinary medicine
Amount used	200 000 kg/year	2 900 kg/year	2 500 kg/year	1 100 kg/year
In wastewater to WWTP [A]	10 000 kg/year	2 300 kg/year	1 500 kg/year	660 kg/year
From WWTP [A] to waterbodies	**100** kg/year	**2 300** kg/year	**1 400** kg/year	**99** kg/year
Removal in the activated sludge process [B, C]	99%	0%	10–20% [D]	85% [E]
In influent wastewater [C]	100 µg/l	2 µg/l	1,5 µg/l	1,5 µg/l
In effluent wastewater [C]	Not detected	2 µg/l	1 µg/l	0,1 µg/l
In the environment [C]	Water: **0,02** µg/l	Water: **0,1** µg/l	Water: **0,07** µg/l	Soil: **110** µg/kg Avg.

SOURCES: SYKE & FIMEA[5]

Annual estimates of use of pharmaceutical substances are based on sales figures for 2015-2017. Annual pharmaceutical loads have been estimated computationally. | A) Wastewater treatment plant | B) The activated sludge process is the treatment method that is usually used at wastewater treatment plants in Finland | C) Indicative results from Finnish surveys | D) Elimination of diclofenac fluctuates considerably | E) Most of the elimination of tetracycline involves the substance binding on the sludge. The load that reaches the treatment plant does not disappear. It continues its journey in the sludge processing chain.

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Source: SYKE Policy Brief

Policy Brief recommendations

- Improving the WWTP treatment
  - New technologies
  - Estimated costs 15 cents/m^3 (membr. filtration + oxidation)
- Use of less environmentally harmful drugs
  - Environmental classification system needed in FI
- Reduction of the drug waste
  - Package size, return instructions; consumer awareness
- Monitoring and setting limit values for emissions
  - Industry, hospitals, WWTPs

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EFFICIENT TREATMENT OF PHARMACEUTICAL RESIDUE AT SOURCE - EPIC -project

(based on presentations of Taina Nysten and project members)

http://www.syke.fi/projects/epic

Financed by Business Finland

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EPIC work packages

- WP1 Emissions and risk identification
- WP2 pilot-scale testing of WWTP technologies
- WP3 Cost-effectiveness of WWTP solutions
- WP4 Policy recommendations
- WP5 Coordination

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EPIC recommendations – Policy tools

- Environmental permits
  - WWTPs should be aware of burden and potential env. risks
  - Bioassays tests for effluent
  - Limit/threshold values for specific pharmas
  - Management of waste (WWTP deals, collection, less haz. chems)
- Developing environmental classification of pharmaceuticals in Finland
  - To make choices in health care based on environmental aspects
  - Large stakeholder involvement needed; political issue
  - International (Nordic) collaboration?

Thank you!

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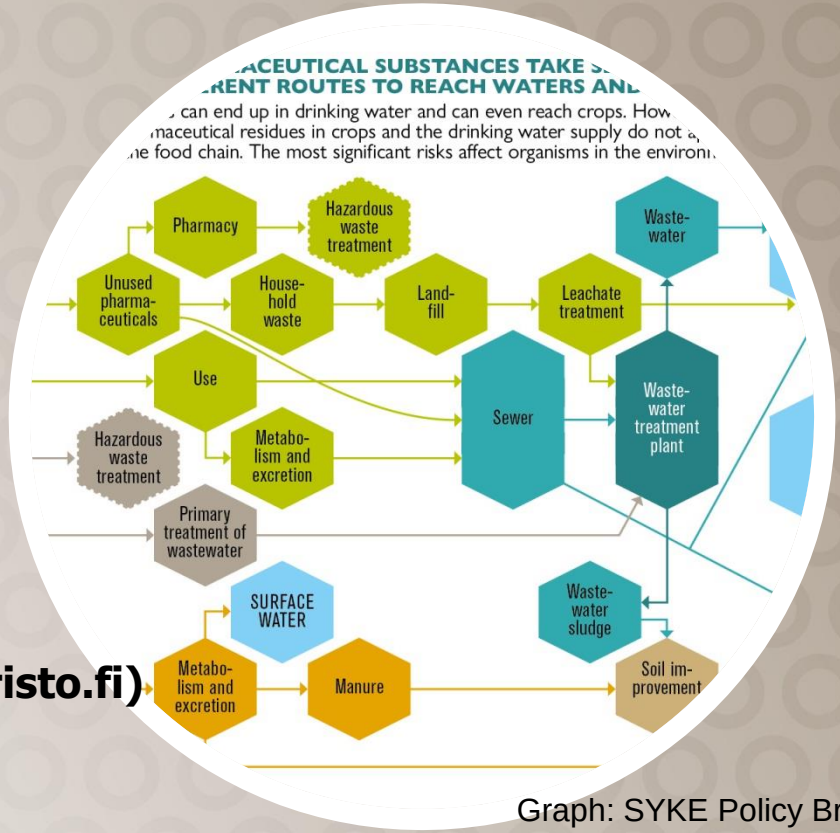

Graph: SYKE Policy Brief