Risk assessment of anthropogenic substances in water in the Netherlands

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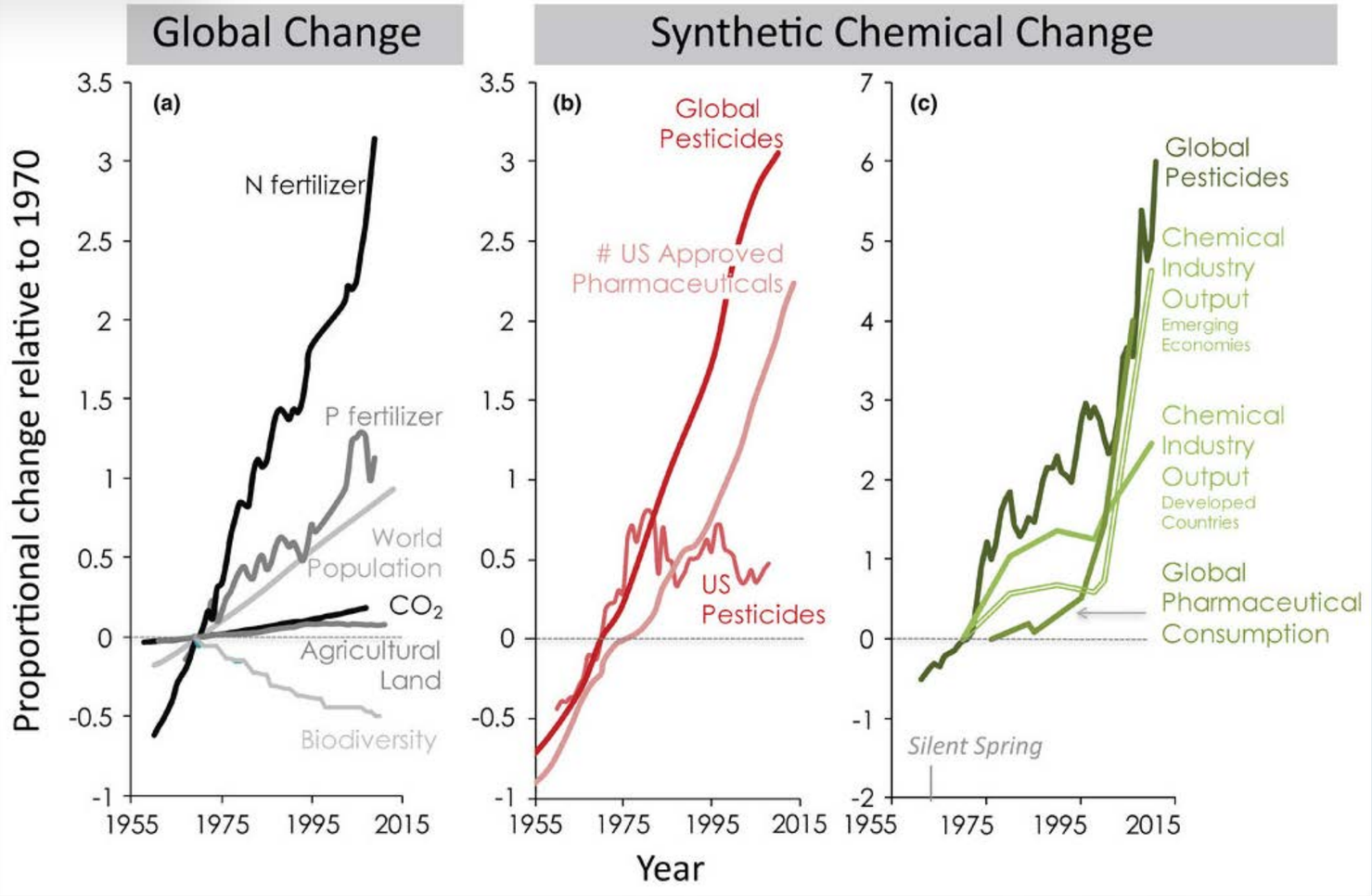
Sources Dutch drinking water

Global increase chemical production ⟶ increase chemicals found in water

Netherlands sources for water production

1. Groundwater (60%)
2. Surface Water (40%)



Types chemical substances

-Pharmaceuticals (emission: 140 ton p/y to surface water*)

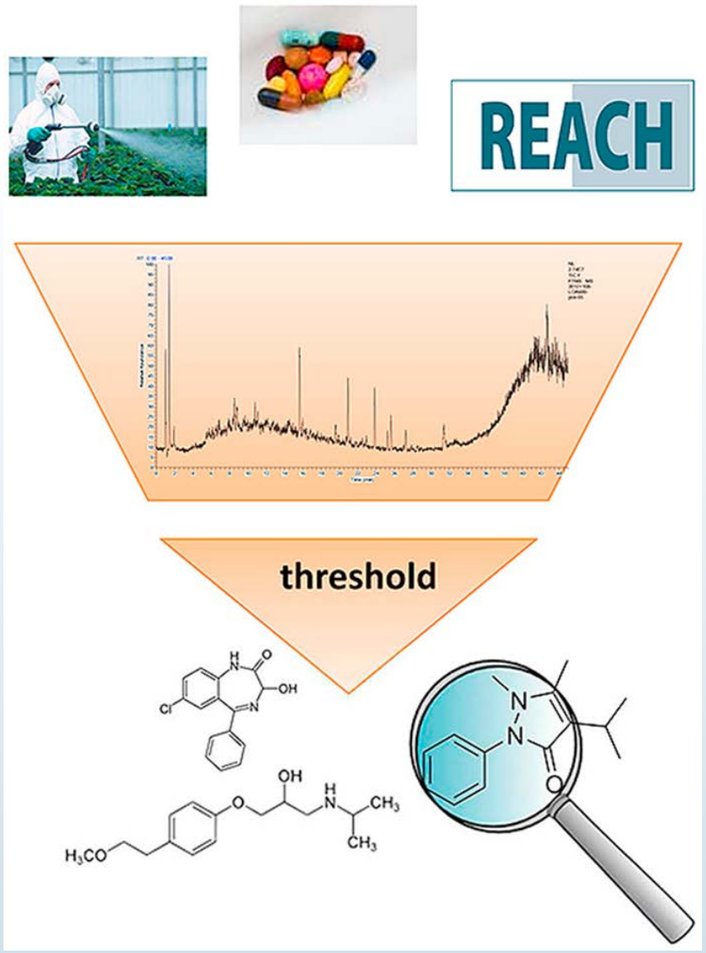
- Antibiotics

-Pesticides (17 ton p/y to water*)

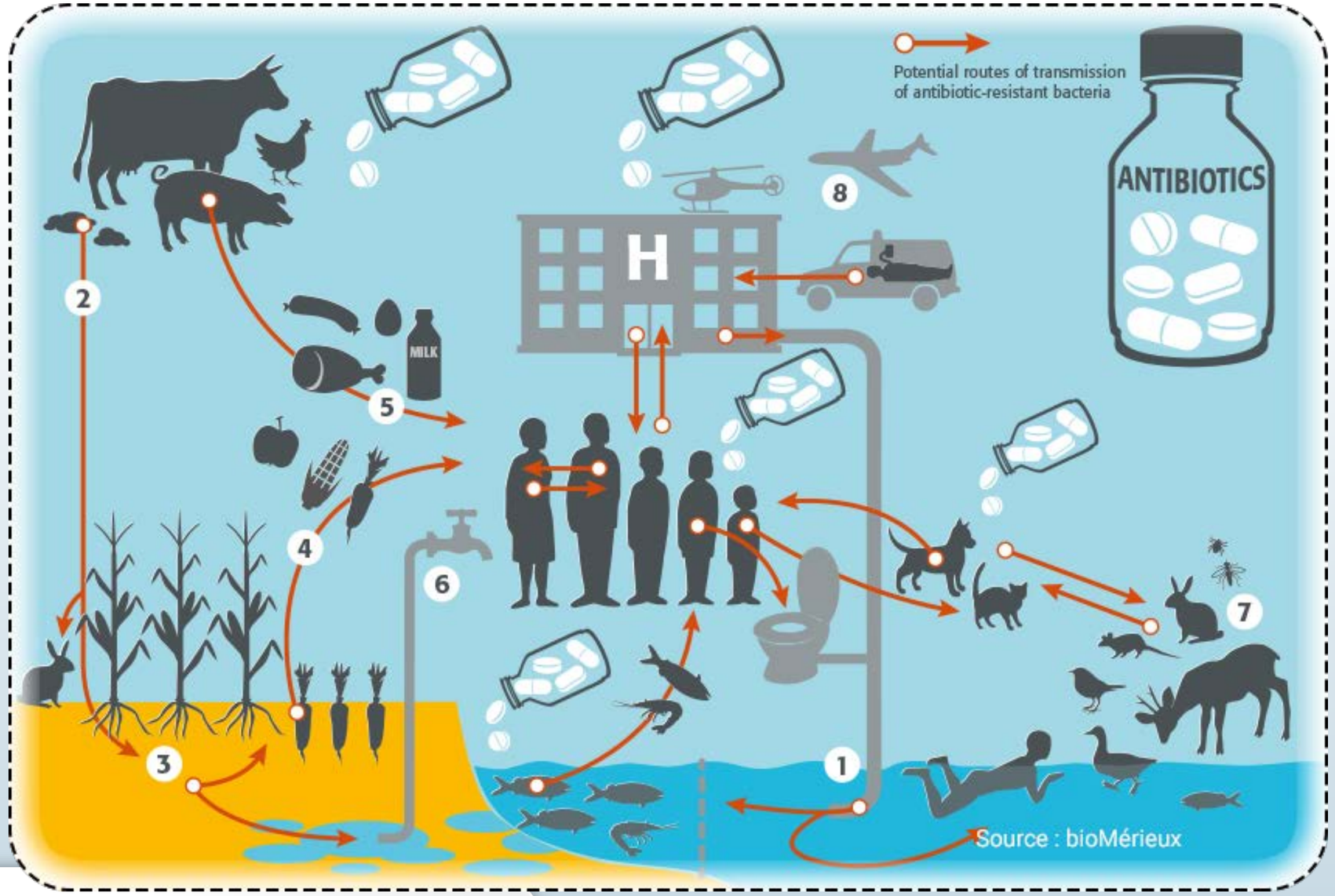
-Industrial chemicals (1600 ton p/y to water*)

-Other: microplastics (in Netherlands not measured in drinking water, but in surface water)

*Data 2018

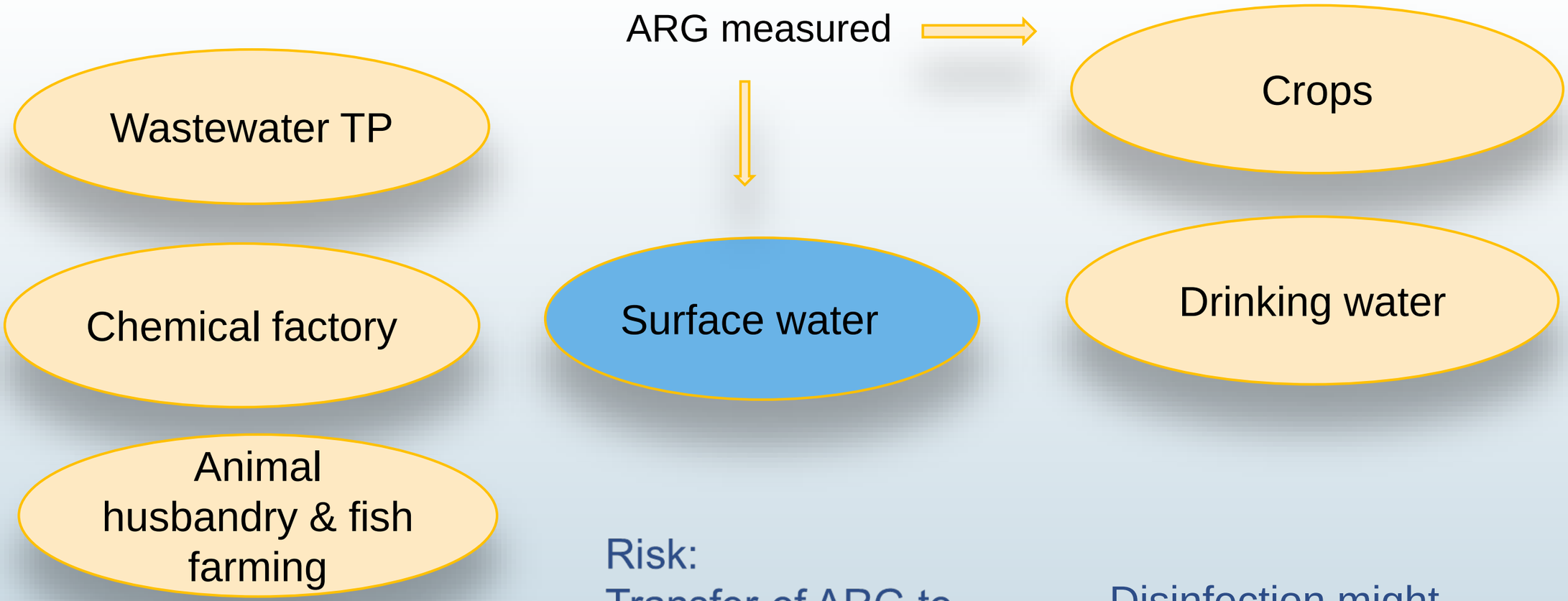


Anthropogenic substances in water



Increasing relevance due to
reuse of treated wastewater

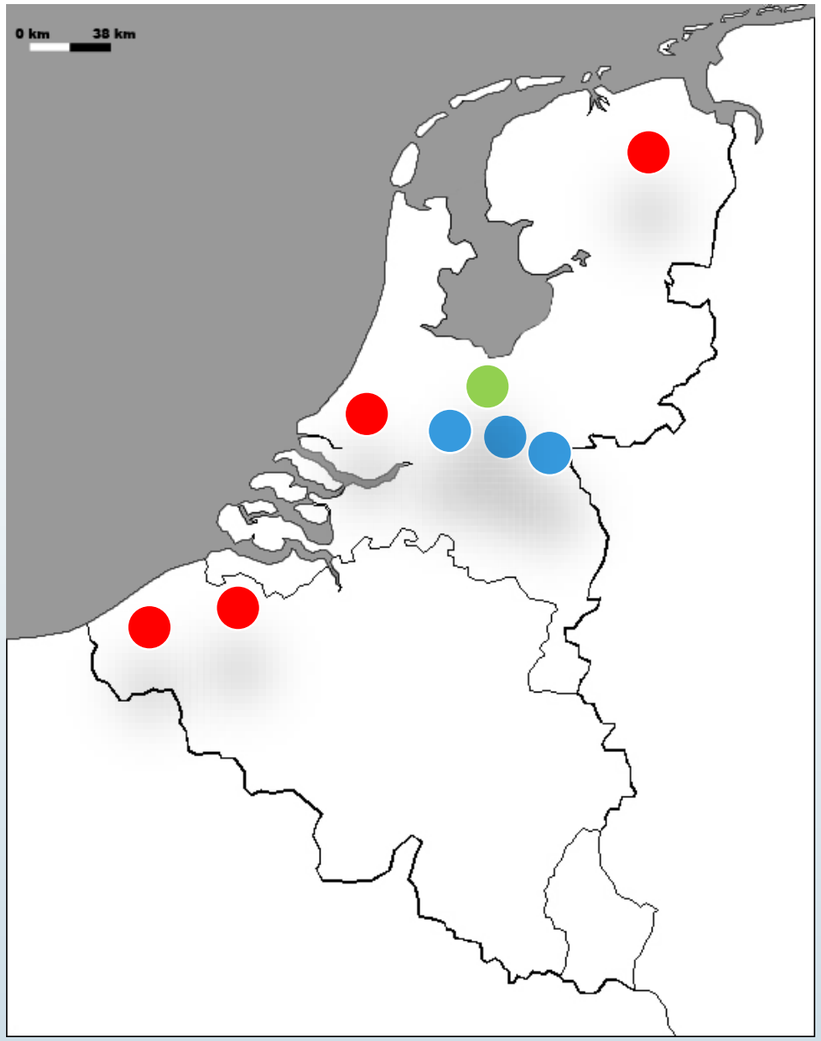
Antibiotics (A), Antibiotic Resistant Bacteria (ARB), Antibiotic Resistance Genes (ARG)



Risk:
Transfer of ARG to environmental bacteria

Disinfection might promote ARG levels

Monitoring Antibiotic Resistance Genes in water



- Drinking water production Surface water
- Drinking water production Ground water
- River Lek before and after ww treatment plant

Isolate DNA & detect the genes using Q-PCR

<u>5 sets of ARG (15 genes total)</u>

- ESBL Extended Spectrum B lactamase prod. bacteria
- MRSA Methicilline Resistant Staphylococcus Aureus
- VRE Vancomycin Resistant Enterococcus
- Sulfonamide resistance genes
- Tetracycline resistance genes

1. Large routine monitoring programs

Who:

A. Directorate-General for Public Works and Water Management

B. 10 drinking water companies (REWAB database)

Where:

A. Where large rivers enter The Netherlands

B. Intakepoints for drinking water (≤800 chemicals)

2. Risk based monitoring

- Screening and prioritizing CEC's (contaminants of emerging concern)
- Non routine measurements (KWR Watercycle Research)

Three types monitoring:

- measuring known substances (target screening)
- measuring unknown substances (non-target screening)
- Effect based monitoring

KWR can measure in water:

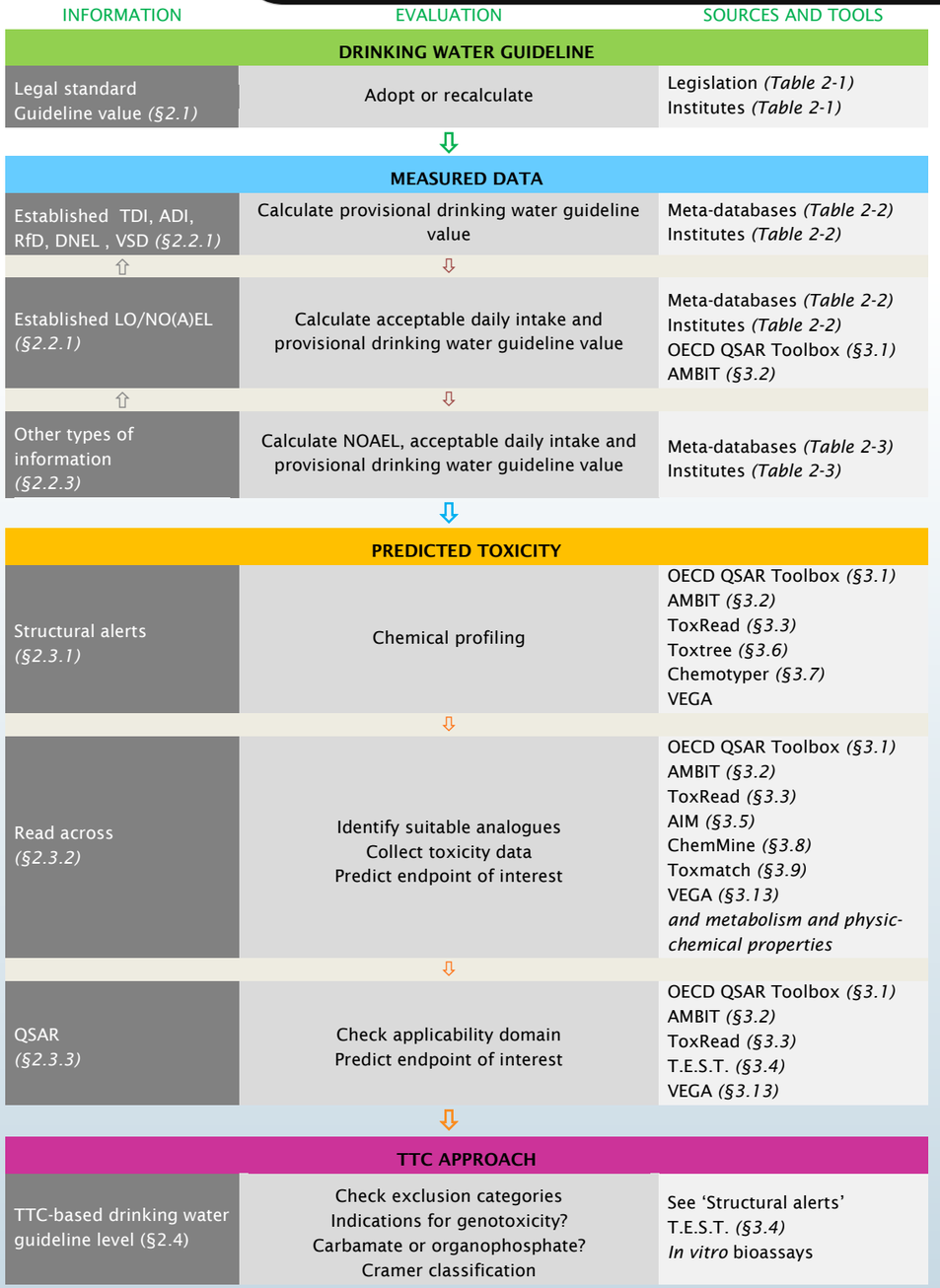
> 60 pharmaceuticals (metabolites)

> 15 antibiotic resistance genes (ARG) (Q-PCR=advanced & efficient)

Risk Assessment chemicals in water

Workflow

1. Apply (legal) guideline
2. Use measured data to calculate provisional guideline value (e.g. ADI / TDI / NOAEL)
3. Predict toxicity
4. Toxicological Threshold of Concern (TTC) (exposure level with negligible health risk, conservatieve generic threshold value used for substances which have no toxicity data.



Prediction toxicity in silico tools

- OECD QSAR toolbox (v 4.2)
- AMBIT
- ToxRead
- ToxTree
- Chemotyper
- VEGA

Prediction hazard (several endpoints)

- Human health effects
- Chronic toxicity
- Ecotoxicity

PREDICTED TOXICITY		
Structural alerts *(§2.3.1)*	Chemical profiling	OECD QSAR Toolbox *(§3.1)* AMBIT *(§3.2)* ToxRead *(§3.3)* Toxtree *(§3.6)* Chemotyper *(§3.7)* VEGA
⇩		
Read across *(§2.3.2)*	Identify suitable analogues Collect toxicity data Predict endpoint of interest	OECD QSAR Toolbox *(§3.1)* AMBIT *(§3.2)* ToxRead *(§3.3)* AIM *(§3.5)* ChemMine *(§3.8)* Toxmatch *(§3.9)* VEGA *(§3.13)* *and metabolism and physic-chemical properties*
⇩		
QSAR *(§2.3.3)*	Check applicability domain Predict endpoint of interest	OECD QSAR Toolbox *(§3.1)* AMBIT *(§3.2)* ToxRead *(§3.3)* T.E.S.T. *(§3.4)* VEGA *(§3.13)*