# Ist Propofol eigentlich

# umweltschädlich

Dr. med. Julian Vaith

# Nimm TIVA fürs Klima!

# Halt Stop! Aber Propofol…

## Water Pollution and Environmental Concerns in Anesthesiology

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Received: 25 July 2019 / Accepted: 3 August 2020


Anaesthesia / Volume 78, Issue 3 / p. 337-342

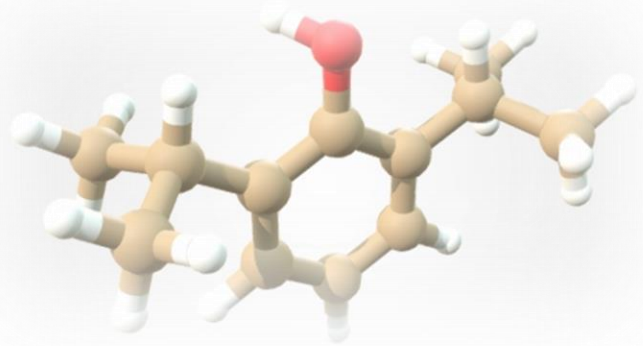
Review Article | Full Access

## Environmental risk assessment of propofol in wastewater: a narrative review of regulatory guidelines

J. Waspe, T. Orr

First published: 25 January 2023
https://doi.org/10.1111/anae.15967

# 2,6 Diisopropylphenol



- Bioakkumulation: niedriges Risiko
- schädigende Wirkung auf Wasserorganismen (Alge, Plankton, Fisch)
- nicht biologisch abbaubar
- Zerstörung nur durch Hitze > 1000°C
- am häufigsten verworfenes Medikament in Kliniken bis 45%

Kostrubiak et al. Water Pollution and Environmental Concerns in Anesthesiology. J Med Syst. 2020

# Environmental Risk Assessment Data
# Propofol

Propfol is not readily biodegradable and is not expected to undergo significant biodegradation under aerobic or anaerobic conditions. The ocatnol water partition coefficient, Log P = 3.9, indicates a potential for bioaccumulation, however the fish bioaccumulation assay shows that the risk of bioaccumulation is low. The Predicted Environmental Concentration (PEC) / Predicted No Effect Concentration (PNEC) ratio is 0.41, which means that, based on the worst-case exposure assessment, the use of propofol is predicted to present a low risk to the environment.

AstraZeneca

https://www.astrazeneca.com/content/dam/az/our-company/Sustainability/2017/Propofol.pdf

# Danke für die Aufmerksamkeit!

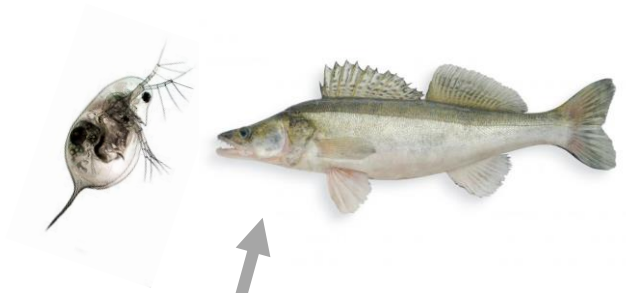
# Propofolschicksal

1% unverändert

60% hepatische Glucuronidierung

39% Hydroxilierung → Sulfo-Glucuronidierung

Urin



Favetta P. et al. Propofol metabolites in man following propofol induction and maintenance. Br J Anaesth. 2002

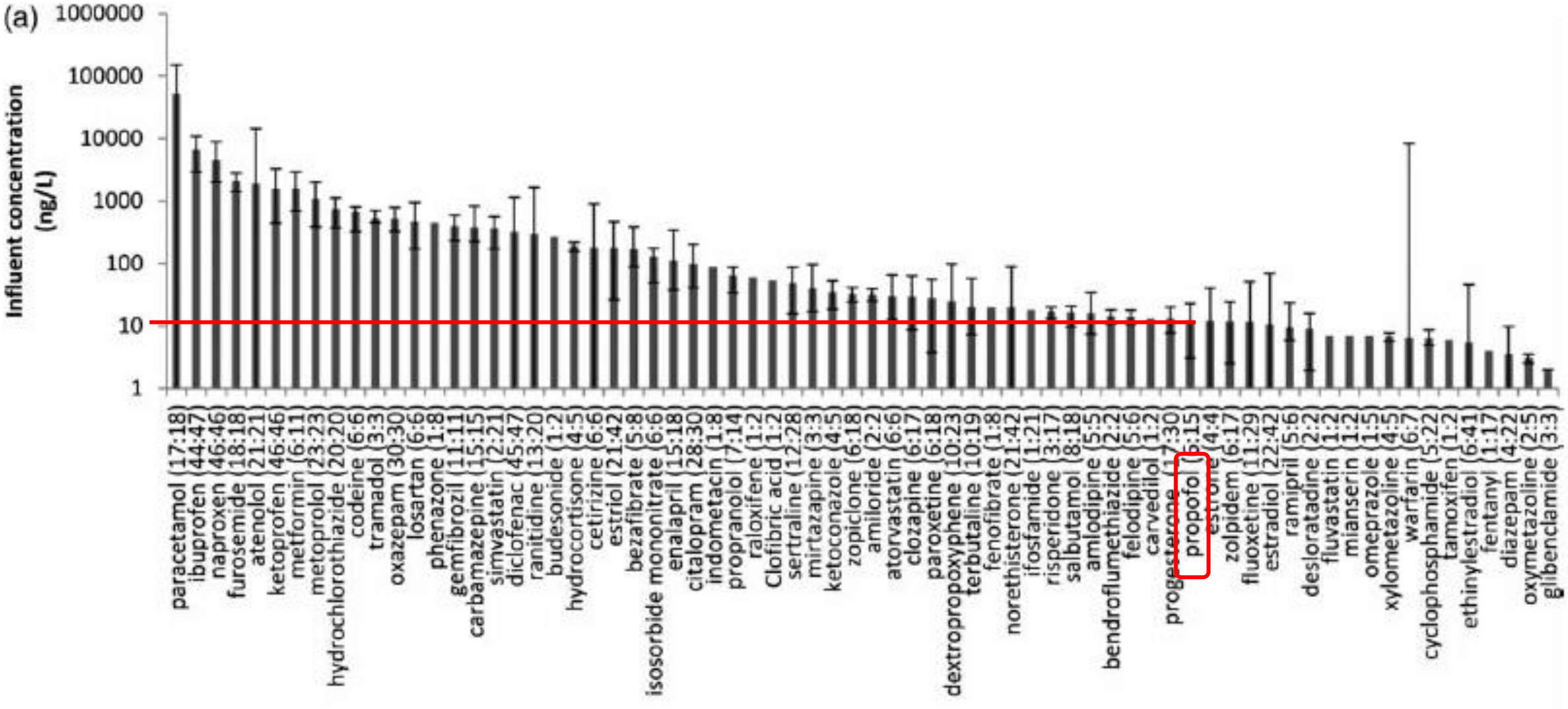
# Environmental Risk Assessment Data
# Propofol

## Predicted Environmental Concentration (PEC)

PEC = 0.15 µg/L = 150 ng/l

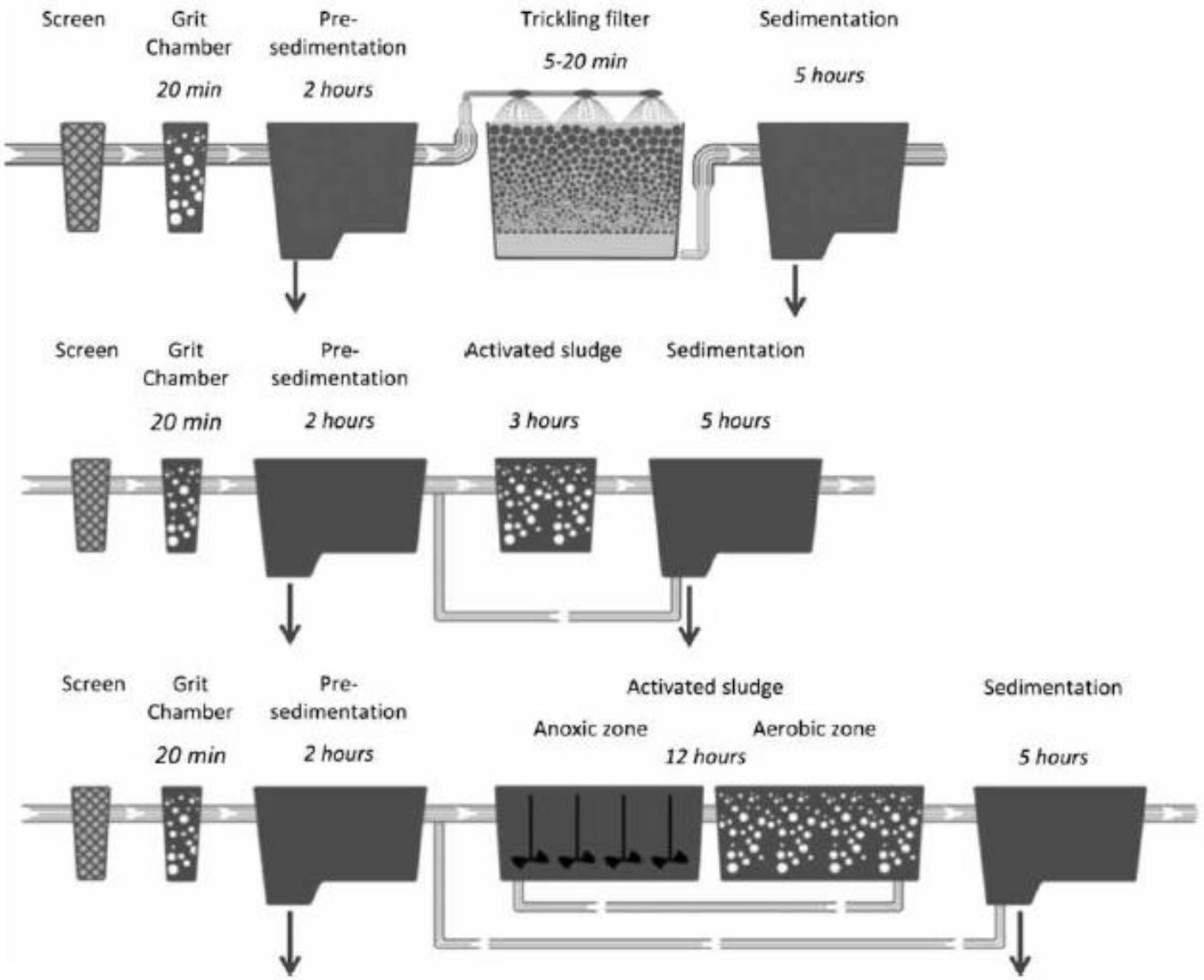
AstraZeneca

https://www.astrazeneca.com/content/dam/az/our-company/Sustainability/2017/Propofol.pdf

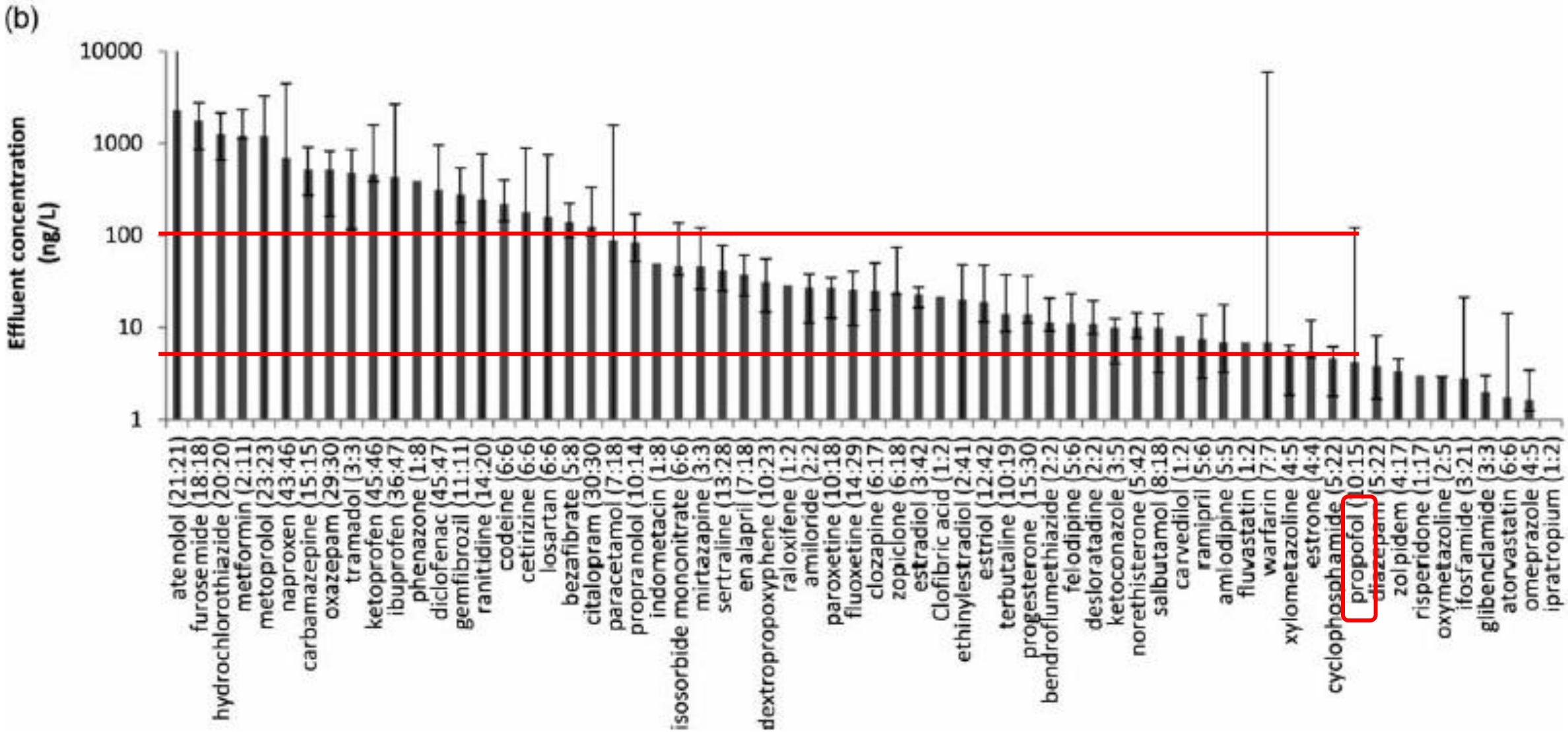



Falås P, et al. Occurrence and reduction of pharmaceuticals in the water phase at Swedish wastewater treatment plants. Water Sci Technol. 2012

**Figure 2** | Typical process schemes for trickling filter plants, and activated sludge plants with and without extended nitrogen removal. The tables show the normal removal of suspended solids (SS), biochemical oxygen demand (BOD), phosphorus and nitrogen when chemical precipitation is applied.




Falås P, et al. Occurrence and reduction of pharmaceuticals in the water phase at Swedish wastewater treatment plants. Water Sci Technol. 2012




Falås P, et al. Occurrence and reduction of pharmaceuticals in the water phase at Swedish wastewater treatment plants. Water Sci Technol. 2012

# Propofolschicksal

## Deglucoronidierung !

→ 61% Propofol ? →

Kostrubiak et al. Water Pollution and Environmental Concerns in Anesthesiology. J Med Syst. 2020

**Table 1** | Measured concentrations (μg/L, mean ± s.d.) for the selected pharmaceuticals in the wastewater of the three hospitals. In brackets, the ratio corresponds to the number of positive samples over the number of samples analysed. A campaign consisted in daily sampling during one week (i.e. 5 or 6 samples). Campaigns were carried out over 2–4 weeks in the three hospitals. Some samples are missing because of autosampler failure

| Molecule | Hospital A | Hospital B | Hospital C |
|---|---|---|---|
| Propofol | 3.5 ± 2.6 (5/5) | 10.1 ± 7.4 (2/5) | 1.1 ± 1.1 (7/8) |

Mullot Juet al. Modeling of hospital wastewater pollution by pharmaceuticals: first results of Mediflux study carried out in three French hospitals. Water Sci Technol. 2010


**Figure 10.** *Overview of all 3,647 water samples in the compiled data set*

*Source:* Data submitted by Denmark, Estonia, Finland, Germany, Poland, and Sweden.

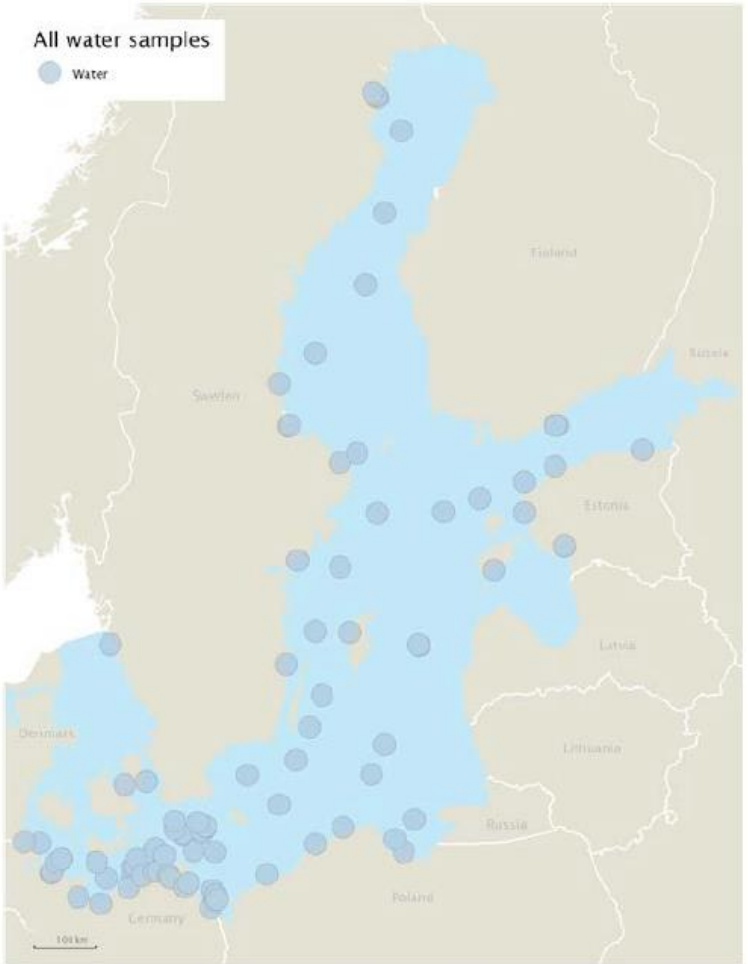
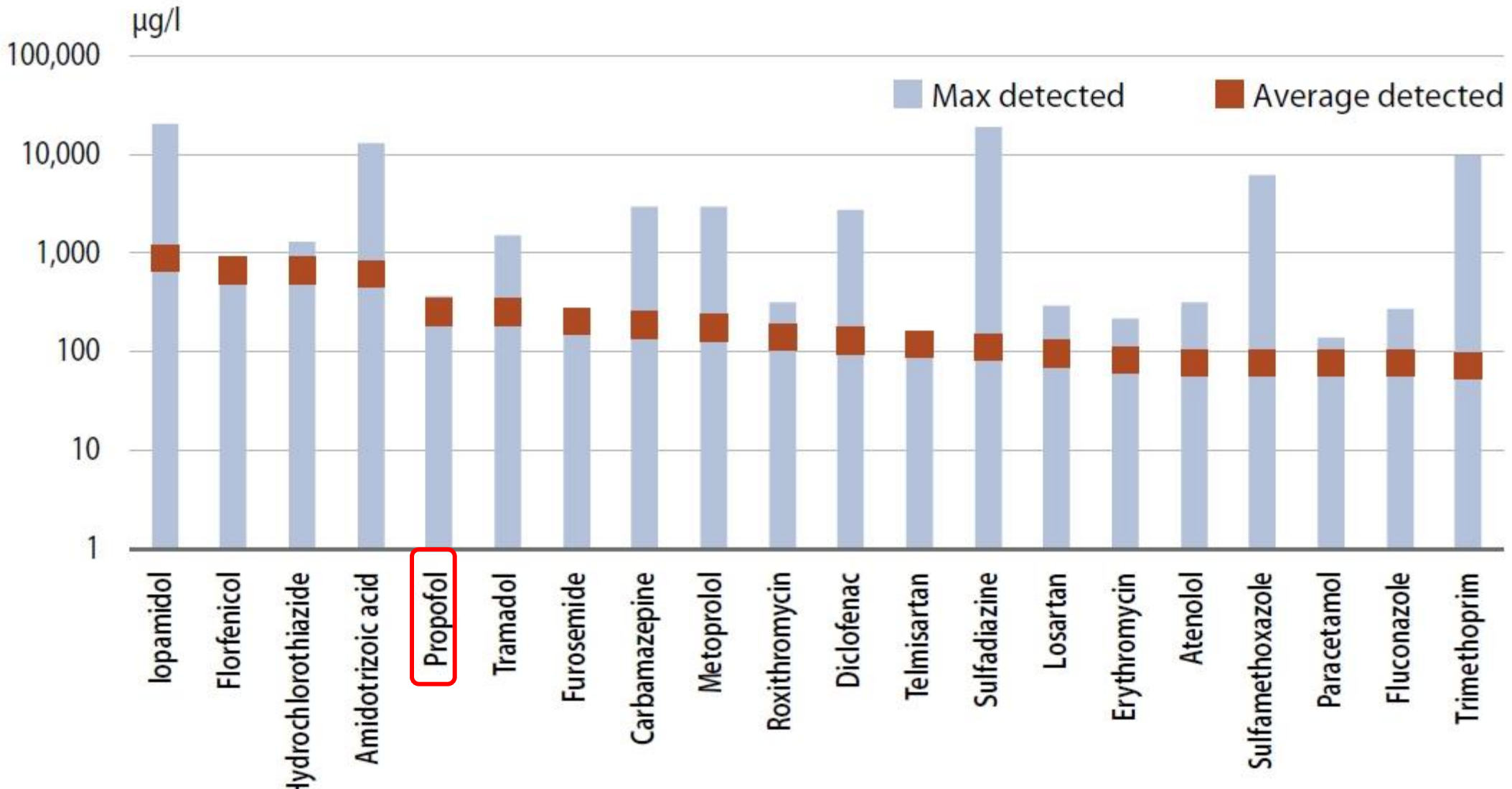


**Figure 9.** *The top 20 pharmaceuticals measured in highest concentrations in river water samples*

*indicates the average concentration of the measurements and* *indicates the maximum measured concentration.*

*Source:* Original data.




Baltic Marine Environment Protection Commission: Pharmaceuticals in the aquatic environment of the Baltic Sea region: a status report; 2017

| Study Type | Method | Result | Reference |
|---|---|---|---|
| Acute toxicity to *Daphnia magna* | None Standard Method | 48 hour EC50 (immobility) = 1-10 mg/L[#] | 7 |
| Acute toxicity to blue gill sunfish fish, *Lepomis macrochirus* | FDA Technical Assistance Document 4.11 | 96 hour LC50 (mortality) = 0.62 mg/L | 8 |
| Acute toxicity to rainbow trout, *rhynchus mykiss* | FDA Technical Assistance Document 4.11 | 96 hour LC50 (mortality) = 0.37 mg/L | 9 |
| Chronic toxicity to *Daphnia magna* | FDA Technical Assistance Document 4.09 | 21 day LOEC (survival, reproduction and growth) = 0.46 mg/L<br>21 day NOEC (survival, reproduction and growth) = 0.23 mg/L | 10 |

| | |
|---|---|
| # | Range finding test, based on nominal values. |
| NOEC | No Observed Effect Concentration |
| LOEC | Lowest Observed Effect Concentration |
| EC50 | the concentration of the test substance that results in a 50% effect |
| LC50 | the concentration of the test substance that results in a 50% mortality |

AstraZeneca

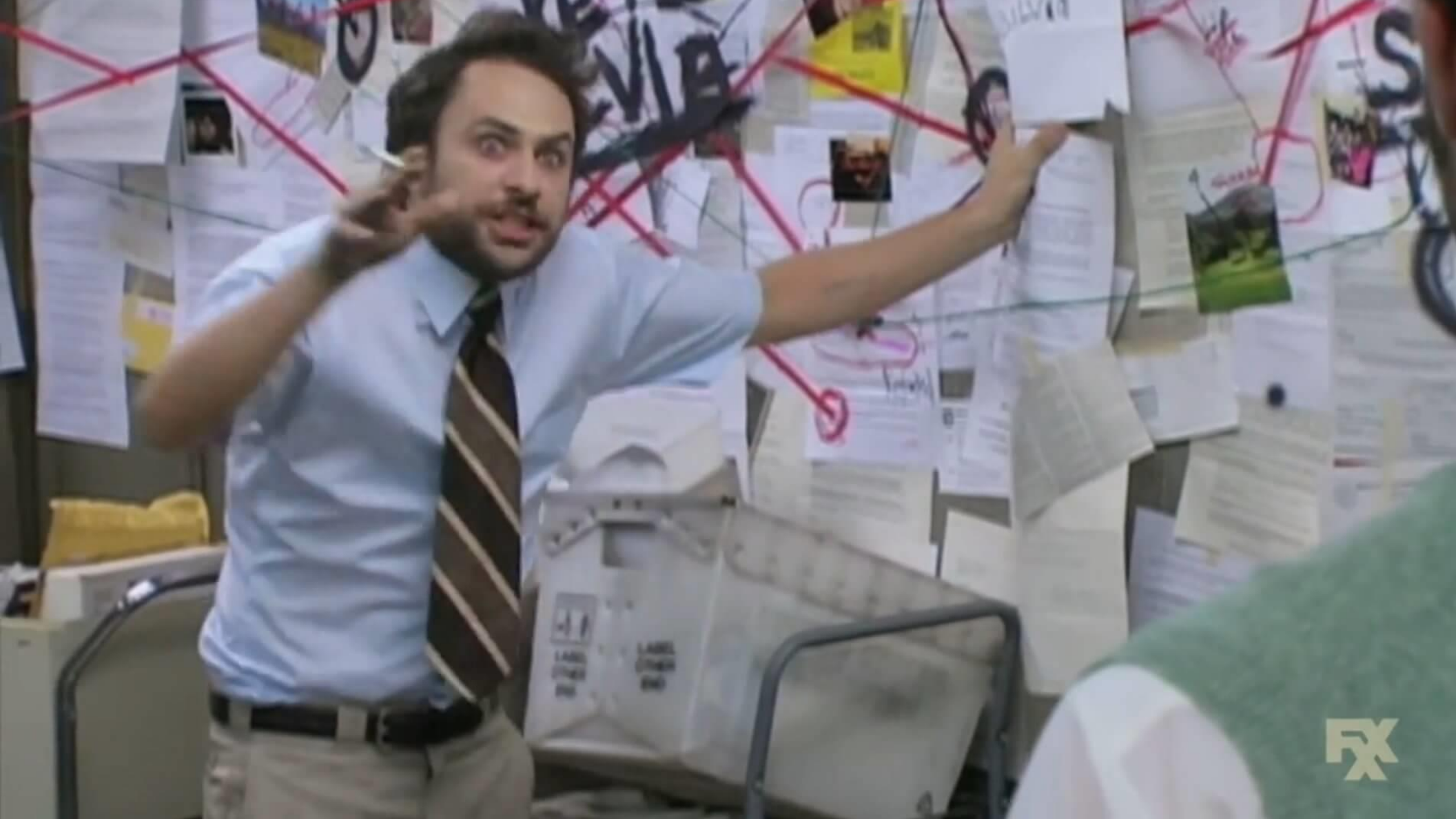
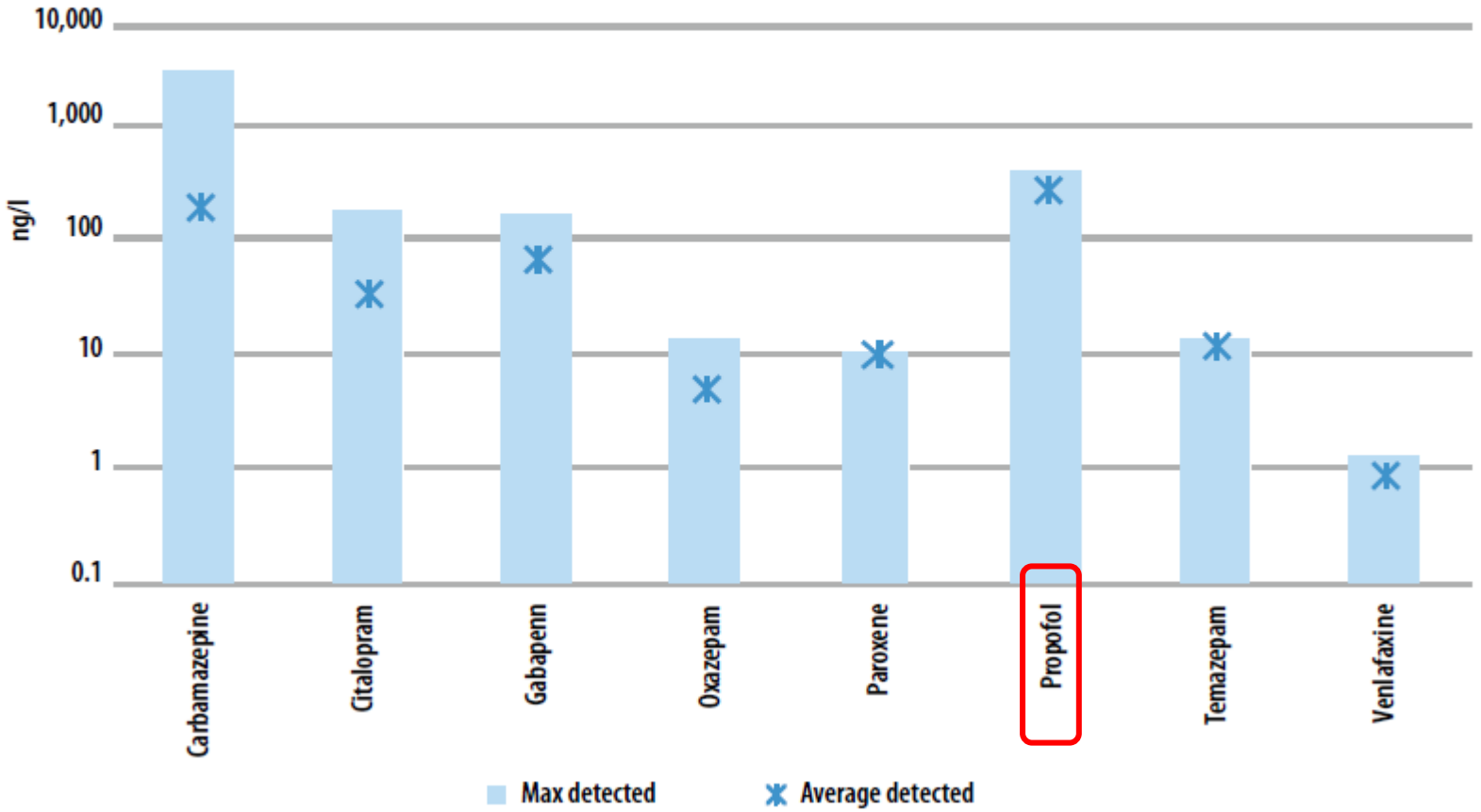


**Figure A3.20** *The average and maximum concentrations of central nervous system agents in river water samples*

*Source:* Original data.




Baltic Marine Environment Protection Commission: Pharmaceuticals in the aquatic environment of the Baltic Sea region: a status report; 2017

# Environmental Risk Assessment Data
## Propofol

**Predicted No Effect Concentration (PNEC)** = 0.37 µg/L

AstraZeneca

https://www.astrazeneca.com/content/dam/az/our-company/Sustainability/2017/Propofol.pdf

# Propofol darf NICHT ins Abwasser!

# What about ism

“analysis of surface water samples across Scotland”:

- erythromycin
- clarithromycin
- ibuprofen
- diclofenac
- ethinylestrodiol
- metformin
- propranolol

“highest ecotoxicological risk“

Waspe J, Orr T. Environmental risk assessment of propofol in wastewater: a narrative review of regulatory guidelines. Anaesthesia. 2023

# Konsequenz

- Verwurf von Propofol reduzieren


16.05.2023

# Propofol: Risiko für Sepsis bei Mehrfachentnahme aus einem Behältnis

*Zusammenfassung*

- **Propofolhaltige Arzneimittel sind ausschließlich für den einmaligen Gebrauch bei einem einzelnen Patienten zugelassen.**
- **Angebrochene Behältnisse sind nach der Benutzung zu entsorgen. Eventuell verbleibende Reste sind unbedingt zu verwerfen und dürfen keinesfalls weiterverwendet werden.**
- **Die Entnahme von Propofol aus einem Behältnis muss unter aseptischen Bedingungen erfolgen.**
- **Nichtbeachtung der Anwendungsempfehlungen kann zu lebensbedrohlichen und tödlichen Verläufen inklusive Sepsis und Tod führen.**

Propofoldosis in mg/kg/h

| Körpergewicht in kg | 1 | 2 | 3 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 5 | 10 | 15 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 |
| 10 | 10 | 20 | 30 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 | 130 | 140 | 150 |
| 15 | 15 | 30 | 45 | 75 | 90 | 105 | 120 | 135 | 150 | 165 | 180 | 195 | 210 | 225 |
| 20 | 20 | 40 | 60 | 100 | 120 | 140 | 160 | 180 | 200 | 220 | 240 | 260 | 280 | 300 |
| 25 | 25 | 50 | 75 | 125 | 150 | 175 | 200 | 225 | 250 | 275 | 300 | 325 | 350 | 375 |
| 30 | 30 | 60 | 90 | 150 | 180 | 210 | 240 | 270 | 300 | 330 | 360 | 390 | 420 | 450 |
| 35 | 35 | 70 | 105 | 175 | 210 | 245 | 280 | 315 | 350 | 385 | 420 | 455 | 490 | 525 |
| 40 | 40 | 80 | 120 | 200 | 240 | 280 | 320 | 360 | 400 | 440 | 480 | 520 | 560 | 600 |
| 45 | 45 | 90 | 135 | 225 | 270 | 315 | 360 | 405 | 450 | 495 | 540 | 585 | 630 | 675 |
| 50 | 50 | 100 | 150 | 250 | 300 | 350 | 400 | 450 | 500 | 550 | 600 | 650 | 700 | 750 |
| 55 | 55 | 110 | 165 | 275 | 330 | 385 | 440 | 495 | 550 | 605 | 660 | 715 | 770 | 825 |
| 60 | 60 | 120 | 180 | 300 | 360 | 420 | 480 | 540 | 600 | 660 | 720 | 780 | 840 | 900 |
| 65 | 65 | 130 | 195 | 325 | 390 | 455 | 520 | 585 | 650 | 715 | 780 | 845 | 910 | 975 |
| 70 | 70 | 140 | 210 | 350 | 420 | 490 | 560 | 630 | 700 | 770 | 840 | 910 | 980 | 1050 |
| 75 | 75 | 150 | 225 | 375 | 450 | 525 | 600 | 675 | 750 | 825 | 900 | 975 | 1050 | 1125 |
| 80 | 80 | 160 | 240 | 400 | 480 | 560 | 640 | 720 | 800 | 880 | 960 | 1040 | 1120 | 1200 |
| 85 | 85 | 170 | 255 | 425 | 510 | 595 | 680 | 765 | 850 | 935 | 1020 | 1105 | 1190 | 1275 |
| 90 | 90 | 180 | 270 | 450 | 540 | 630 | 720 | 810 | 900 | 990 | 1080 | 1170 | 1260 | 1350 |
| 95 | 95 | 190 | 285 | 475 | 570 | 665 | 760 | 855 | 950 | 1045 | 1140 | 1235 | 1330 | 1425 |
| 100 | 100 | 200 | 300 | 500 | 600 | 700 | 800 | 900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 |
| 105 | 105 | 210 | 315 | 525 | 630 | 735 | 840 | 945 | 1050 | 1155 | 1260 | 1365 | 1470 | 1575 |
| 110 | 110 | 220 | 330 | 550 | 660 | 770 | 880 | 990 | 1100 | 1210 | 1320 | 1430 | 1540 | 1650 |
| 115 | 115 | 230 | 345 | 575 | 690 | 805 | 920 | 1035 | 1150 | 1265 | 1380 | 1495 | 1610 | 1725 |
| 120 | 120 | 240 | 360 | 600 | 720 | 840 | 960 | 1080 | 1200 | 1320 | 1440 | 1560 | 1680 | 1800 |
| 125 | 125 | 250 | 375 | 625 | 750 | 875 | 1000 | 1125 | 1250 | 1375 | 1500 | 1625 | 1750 | 1875 |
| 130 | 130 | 260 | 390 | 650 | 780 | 910 | 1040 | 1170 | 1300 | 1430 | 1560 | 1690 | 1820 | 1950 |
| 135 | 135 | 270 | 405 | 675 | 810 | 945 | 1080 | 1215 | 1350 | 1485 | 1620 | 1755 | 1890 | 2025 |
| 140 | 140 | 280 | 420 | 700 | 840 | 980 | 1120 | 1260 | 1400 | 1540 | 1680 | 1820 | 1960 | 2100 |
| 145 | 145 | 290 | 435 | 725 | 870 | 1015 | 1160 | 1305 | 1450 | 1595 | 1740 | 1885 | 2030 | 2175 |
| 150 | 150 | 300 | 450 | 750 | 900 | 1050 | 1200 | 1350 | 1500 | 1650 | 1800 | 1950 | 2100 | 2250 |
| | 20 ml = 1 Amp Propofol 0,5% genügen | | | | | | | | | | | | | |
| | 20 ml = 1 Amp Propofol 1% genügen | | | | | | | | | | | | | |
| | 40 ml = 2 Amp Propofol 1% genügen [ Aufziehen in 50 ml Spritze] | | | | | | | | | | | | | |
| | Disoprivan 2% verwenden | | | | | | | | | | | | | |

# Propofolverbrauch in mg/h

Dr. Sebastian Gibb, vorschlag-sop-nachhaltige-anaesthesie

# Konsequenz

- Verwurf von Propofol reduzieren
- Propofolreste in den Restmüll geben
- statt Sedierung Videobrille nutzen


Happymed.org

# Konsequenz

- Verwurf von Propofol reduzieren
- Propofolreste in den Restmüll geben
- statt Sedierung Videobrille nutzen
- Überversorgung stoppen
- Forschung

# Offene Fragen

- wird Propofol mit dem normalen Klinikmüll ausreichend zerstört?
- gäbe es die Möglichkeit Propofol zu filtern?
- wie toxisch sind die metabolisierten Produkte?