Risk-based water quality thresholds for coliphage in surface waters: Effect of temperature and contamination aging

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Supporting Information

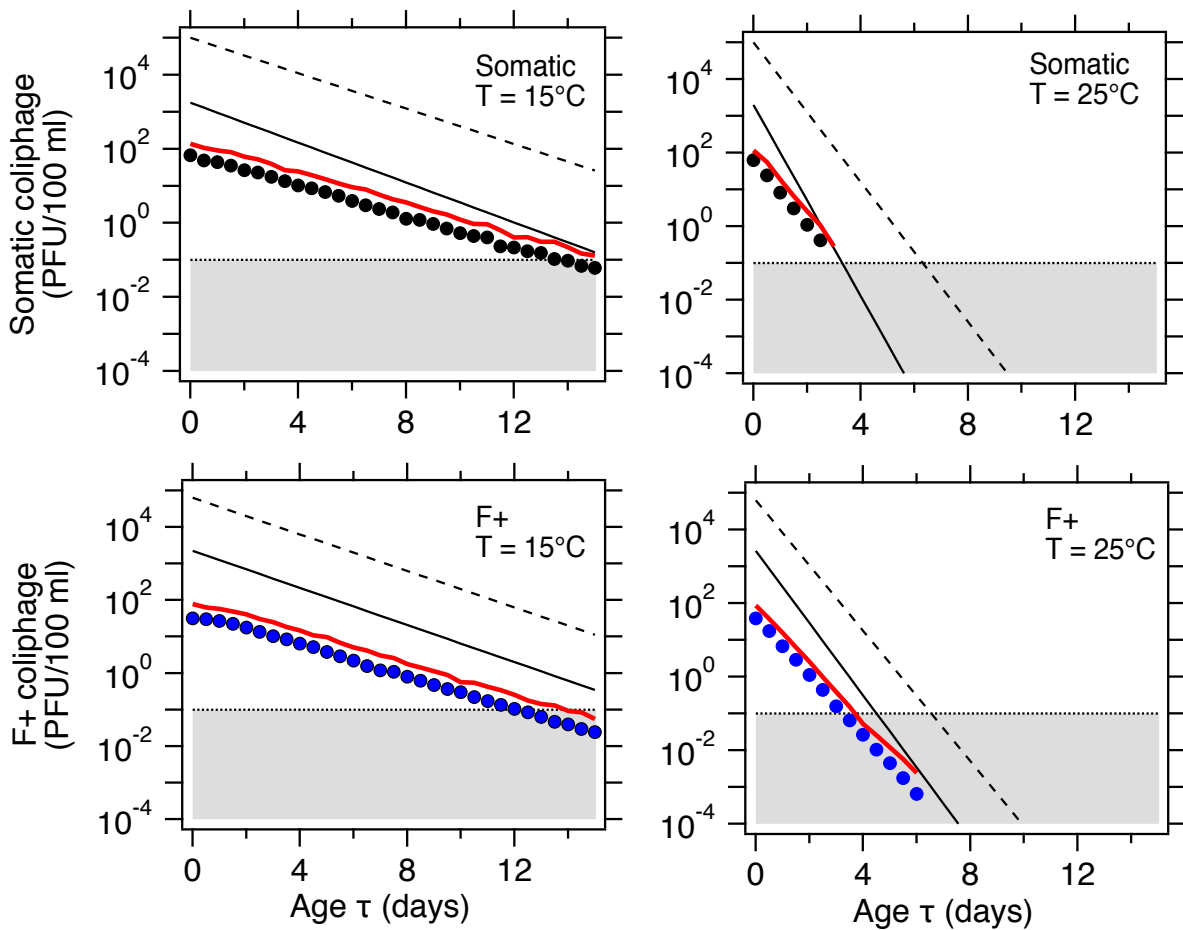*Environmental Science: Processes and Impacts*

Figure S1. This is the same figure as Figure 3 in the manuscript except a red line has been added to each plot. This red line represents the risk-based threshold for the indicated coliphage at the indicated temperature when the dose response function for norovirus shown in Table1 is replaced with a weighted result from the 2 published dose-response curves for norovirus. The methods for carrying out this approach are published in Brown et al.[1] and Soller et al.[2]. In brief, the risk of infection from exposure to norovirus is calculated using the dose-response function in Table 1 ($P_{inf\_noro\_1}$), the risk of infection from exposure to norovirus is calculated using the dose-response function published by Messier et al.[3]: $P_{inf\_noro\_2}= P*exp(1-\mu/\lambda)$ where $P = 0.72$ and $\lambda = 1106$, and then a weighted average of these two risks of infection is calculated and used as P_{inf_noro} in the QMRA: $P_{inf\_noro} = a*P_{inf\_noro\_1}+(1-a) P_{inf\_noro\_2}$ where a is a random number drawn from a uniform distribution bounded by 0 and 1. The C_{max1} and C_{max2} lines (see caption of Figure 3) are unchanged. The risk-based thresholds are slightly higher when the 2 norovirus dose-response functions are used together. The risk-based thresholds are about 2 times higher, on average, for both indicators at both temperatures, as seen on the plot by comparing the red line with the solid markers on each panel.

Indicator	Temp (°C)	Threshold (PFU/100 mL) when C_{max1} is used	Threshold (PFU/100 mL) when C_{max2} is used
F+	15	19	3
F+	25	16	2
Somatic	15	54	8
Somatic	25	45	7

Table S1. Risk-based thresholds when contamination age is unknown when the weighted form of the 2 norovirus dose-response functions is used in the QMRA. Please see caption of Figure S1 for further information on the approach. Compared to Table S2 which shows the results when a single dose-response function is used, these risk-based thresholds are 2-6 times higher.

Indicator	Temp (°C)	Threshold (PFU/100 mL) when C_{max1} is used	Threshold (PFU/100 mL) when C_{max2} is used
F+	15	3	0.5
F+	25	3	0.5
Somatic	15	14	1
Somatic	25	14	1

Table S2. Risk-based thresholds when contamination age is unknown when the norovirus dose-response function in Table 1 alone is used in the QMRA.

References

(1)   Brown, K. I.; Graham, K. E.; Soller, J. A.; Boehm, A. B. Estimating the Probability of Illness Due to Swimming in Recreational Water with a Mixture of Human- and Gull-Associated Microbial Source Tracking Markers. *Environ. Sci. Process. Impacts* **2017**, *19* (12), 1528–1541. https://doi.org/10.1039/C7EM00316A.

(2)   Soller, J. A.; Schoen, M.; Steele, J. A.; Griffith, J. F.; Schiff, K. C. Incidence of Gastrointestinal Illness Following Wet Weather Recreational Exposures: Harmonization of Quantitative Microbial Risk Assessment with an Epidemiologic Investigation of Surfers. *Water Res.* **2017**, *121*, 280–289. https://doi.org/10.1016/j.watres.2017.05.017.

(3)   Messner, M. J.; Berger, P.; Nappier, S. P. Fractional Poisson--a Simple Dose-Response Model for Human Norovirus. *Risk Anal.* **2014**, *34* (10), 1820–1829.