U.S. Army Public Health Command

Public Health Information Paper

Microbial Risk Assessment for Unrestricted Wastewater Reuse during Army Deployments, May 2014

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Purpose

The purpose of this supplement is to provide additional information on the meaning of the yearly risk estimates from the risk assessment. The yearly risk of gastrointestinal (GI) illness is shown in the third column of Table 1 below.

Table 1. Field Wastewater Unrestricted Reuse Risk-Based Water Concentrations (RBWC's)[a,b]

Target Daily Risk of GI Illness (prevalence)	Predicted *E. coli* Concentration in the Treated Wastewater (CFU/100 mL)	Predicted Annual Risk of GI Illness (incidence)
Assuming 1 Shower per Day		
1 in 100 per day	10 CFU/100 mL	54 in 100 per year
1 in 1,000 per day	1 CFU/100 mL	74 in 1,000 per year
1 in 10,000 per day	1 CFU/L[c]	76 in 10,000 per year

Notes:
[a] Summarized from Table 21 and Table C1 from PHIP 39-01-0514 .
[b] The information in the table is based on an analysis that assumes personnel are showering in treated wastewater and incidentally ingesting 10 ml of water each showering event.
[c] The units for this concentration are different than the two above it. The concentration is fractional in a 100ml sample volume; however, in a 1L sample volume the RBWC is 1 CFU/L.

Explanation of the Predicted Annual Risk

The values in the third column of Table 1 are the risk a member of the population will experience *one or more* cases of GI illness during a year of showering in treated wastewater, where each case of GI illness can last up to 5 days. There is a chance a member of the population will experience multiple cases of GI illness. If all members of the population are equally likely to develop illness, cases are random, and the development of cases follows a binomial process[1], the chance a member of the population experiences multiple GI cases can be estimated. Table 2 shows the likelihood a member of the population will experience GI illness multiple times for each target daily risk of GI illness.

[1] A binomial process is applicable to an event with two and only two outcomes. In the wastewater reuse analysis, the two outcomes are a person experiences GI illness from a shower or a person does not experience GI illness from a shower.

Table 2. Chance an Individual Will Experience a Specific Numbers of GI Illness Cases

A. Binomial distribution predicted probabilities* that a population member will experience a specific numbers of GI illness cases from showering in treated wastewater daily for a year under a specific set of conditions

Conditions			Assumed shower rate:										1 shower per day
			Assumed water incidentally ingested per shower										10 mL
			Assumed duration of illness:										5 days
Target daily risk of GI illness	Predicted E. coli concentration (i.e. RBWC):	Predicted annual risk of GI illness:	Number of GI illness from showering experienced by an individual during a year										
			0	1	2	3	4	5	6	7	8	9	10
1 in 100	10 CFU / 100mL	54 in 100	46%	36%	14%	3.5%	0.66%	0.10%	0.01%	0.001%	0.0001%	^	^
1 in 1,000	1 CFU / 100mL	74 in 1,000	93%	7.1%	0.27%	0.007%	0.0001%	^	^	^	^	^	^
1 in 10,000	10CFU / 1L	76 in 10,000	99%	0.76%	0.003%	^	^	^	^	^	^	^	^

Legend
* Probabilities have been rounded to simplify the presentation.
^ Probabilities are less than 1 in a million chance (i.e., $<10^{-6}$ chance).

B. How to interpret a white cell in the above table

Target daily risk of GI illness	Predicted E. coli concentration (i.e. RBWC):	Predicted annual risk of GI illness:	Number of GI illness from showering experienced by an individual during a year	Interpretation
			2	
1 in 1,000	1 CFU / 100mL	74 in 1,000	0.27%	There is a 0.27% chance that any individual in the exposed population will experience 2 cases of GI illness during a year while showering in wastewater containing 1 CFU *E. coil* per 100mL.

Points of Contact for Further Information

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