Achieving safe management: A case for strengthening the attention to liquid streams in on-site and local sanitation

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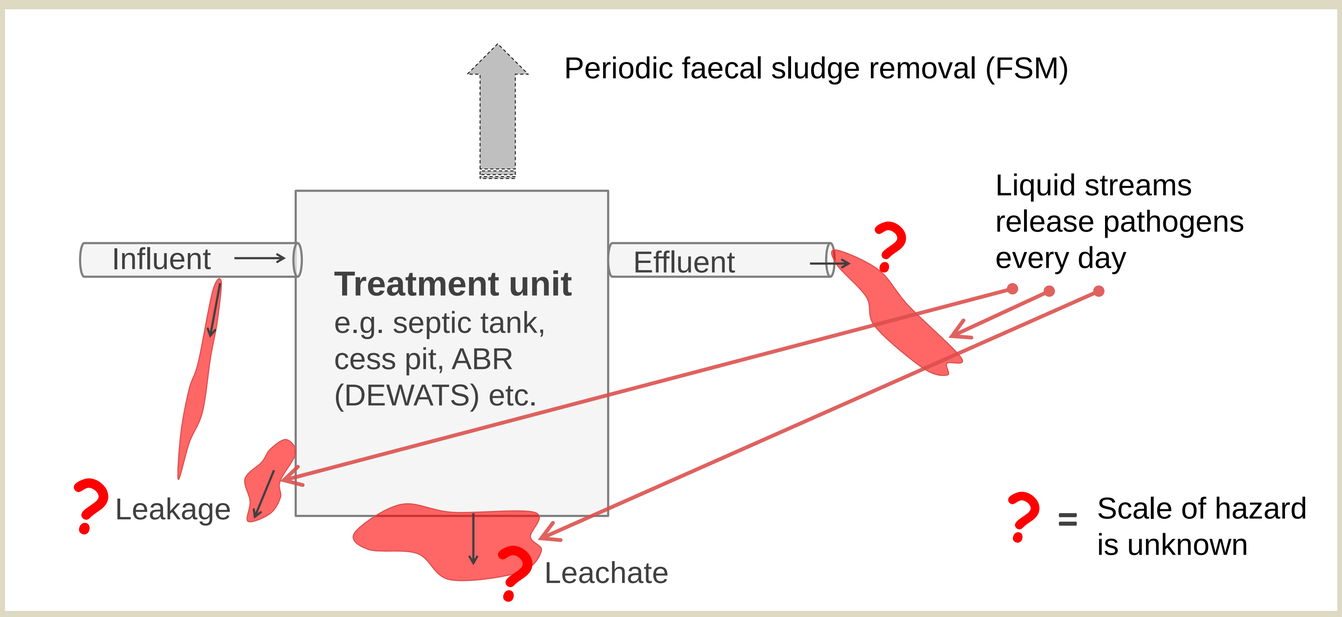
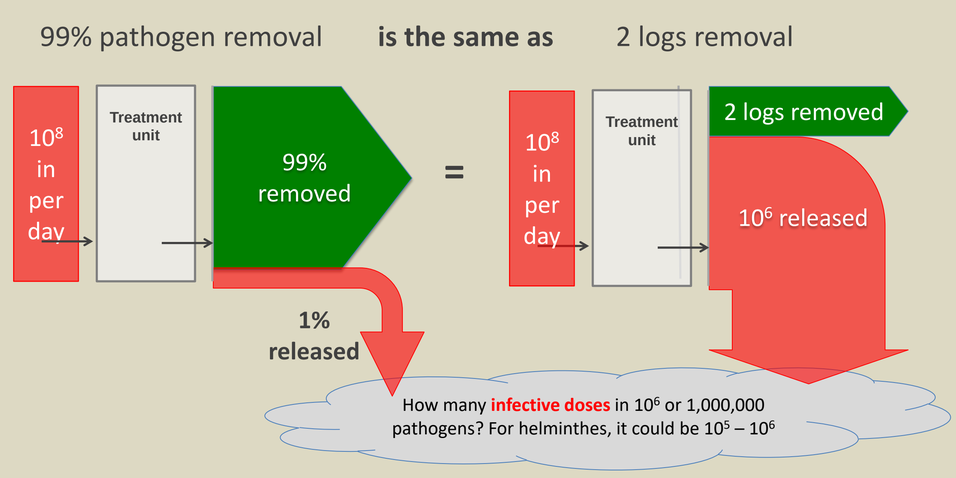
The situation unseen

Liquid streams (effluent, leachate, unintended leakage) from onsite and networked water-based sanitation systems can pose a significant health hazard, but have received little attention.

Faecal sludge management (FSM) has led to essential gains, yet reaching 'safely managed' sanitation requires making pathogen hazards visible in all discharges, and assessing all local exposure paths.



Removal of 99% of pathogens by our basic treatment systems sounds impressive. But what matters most? Is it the ***reduction*** in pathogens in relation to ***influent***, or the pathogen ***hazard*** remaining in the ***effluent***?



When the numbers are large, risk is better represented through **a log scale**, **or infective doses estimate**, than percentage removed.

Introducing the Pathogen Hazard Diagram

We need a tool to help us identify which intended and unintended discharges from wastewater treatment systems are likely to contain hazardous levels of pathogens, which, if exposed to people, could represent a significant public health risk.

We have very little reliable location-specific pathogen data, because measuring and monitoring pathogens is still complex, expensive and technically difficult.

The Pathogen Hazard Diagram is offered as a simple thinking tool that relies on first principles and text-book data to identify and assess hazards locally.

Use of the tool draws attention to:

- What different sewage treatment technology are able to achieve in reducing/removing pathogens
- What pathogen levels might remain in planned and unplanned discharges from the treatment system
- What is the potential hazard of these pathogens in terms of **infective doses**
- Where those pathogens go in the environment.

A *Pathogen Hazard Diagram* prompts practitioners to explore three key questions about the influent, all the exiting streams and hazard levels:

This is a *Pathogen Hazard Diagram (PHD)* that practitioners prepared for *a* **sealed tank** with no secondary treatment (e.g. septic tank, anaerobic baffled reactor (ABR)).

A. How many pathogens are in the influent?

Pathogens from an Infected individual (#/day)

10^{10} bacteria [a,b]

10^{11} virus particles [b,c]

10^{7} protozoa [a]

10^{6} helminth eggs [a]

B. How many pathogens are leaving the system?

Inactivated & contained pathogens → Periodic sludge removal

Pathogens (#/day) after 1-2 Log removal[a]

10^{8} – 10^{9} bacteria

10^{10} virus particles

10^{6} protozoa

10^{5} helminths → Piped treated liquid effluent

Boundary of the treatment system

Leakage or leachate (A sealed septic tank would have no flow here)

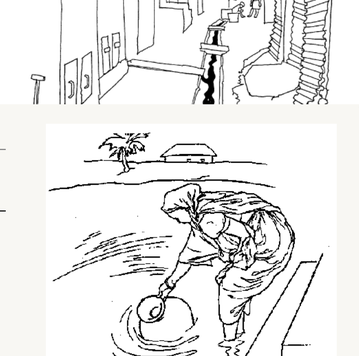
C. How much do the surviving pathogens matter?

What is the *hazard level* in the piped treated effluent?

	Minimum infective dose	Potential hazard (# doses)
bacteria [b]	10^{2} - 10^{8}	Up to 10^{7}
viruses [b]	10^{0} - 10^{1}	Up to 10^{10}
protozoa [b]	10^{0} - 10^{2}	Up to 10^{6}
helminth eggs [a]	10^{0} - 10^{1}	Up to 10^{5}

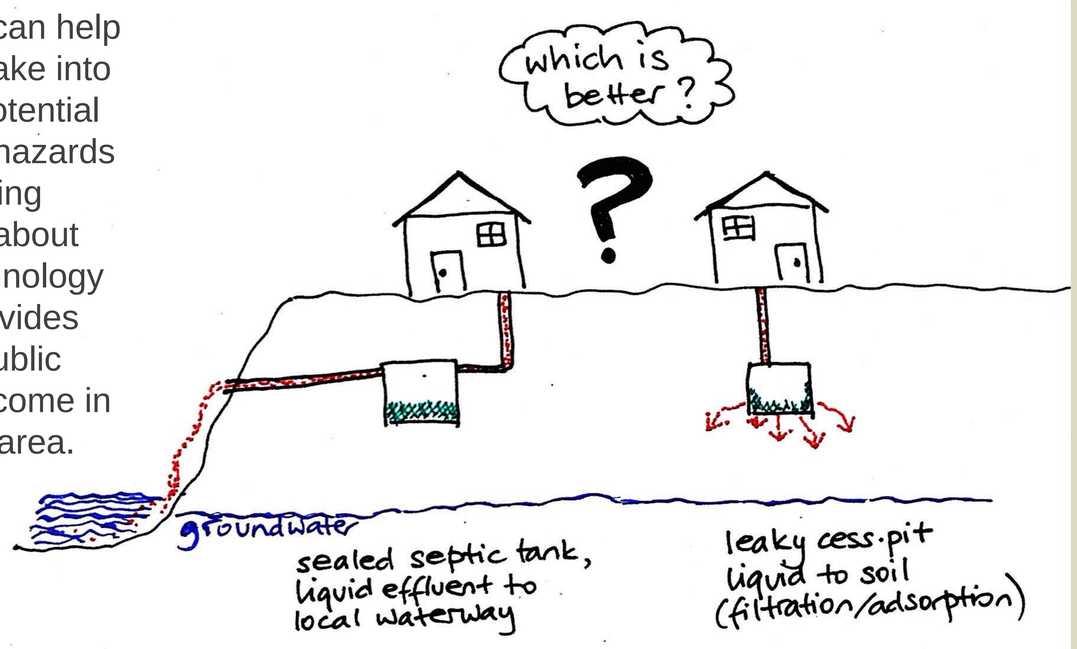
[a] Feachem et al., 1983
[b] Leclerc et al., 2002
[c] McCray et al., 2009

What are the potential *exposure pathways*?



What might this mean in practice?

The PHD can help planners take into account potential pathogen hazards when making decisions about which technology choice provides the best public health outcome in their local area.



Credits

This research was conducted under the Australian Development Research Award Scheme, investigating sanitation governance for community scale systems in Indonesia.
Other outputs from this project are available at: http://communitysanitationgovernance.info

This paper has more details on the Pathogen Hazard Diagram (the paper is freely available):
Mitchell, C., Abeysuriya, K. and Ross, K., 'Making pathogen hazards visible: a new heuristic to improve sanitation investment efficacy'. *Waterlines* vol 35 no 2, April 2016.

KEY REFERENCES

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