MAKING INFORMED DECISIONS

A PRACTICAL APPROACH TO SELECTING WATER MICROBIOLOGY TESTS

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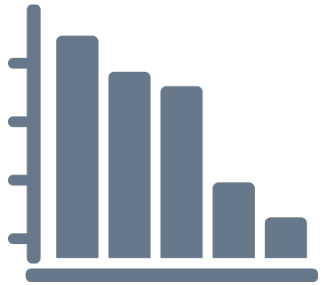
Background

Over 15 years as a microbiologist I've noticed the following:

1. Under-utilisation of *'Health Outcome Targets'* as a reference point when selecting tests.

2. A lack of recognition of the limitations of microbiology tests.



3. The use of tests that do not necessarily contribute to public health.

Key Ideas Covered

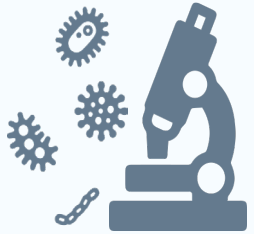
1

What does "*Safe*" actually mean?

2

Health Outcome Targets as a Measure of Safety

3



The role of microbiology tests

4

How to assess microbiology test performance

5

Avoiding Reasoning Errors

1. What does “safe” mean?

Rarely means the elimination of all risks.

This would be technically almost impossible.

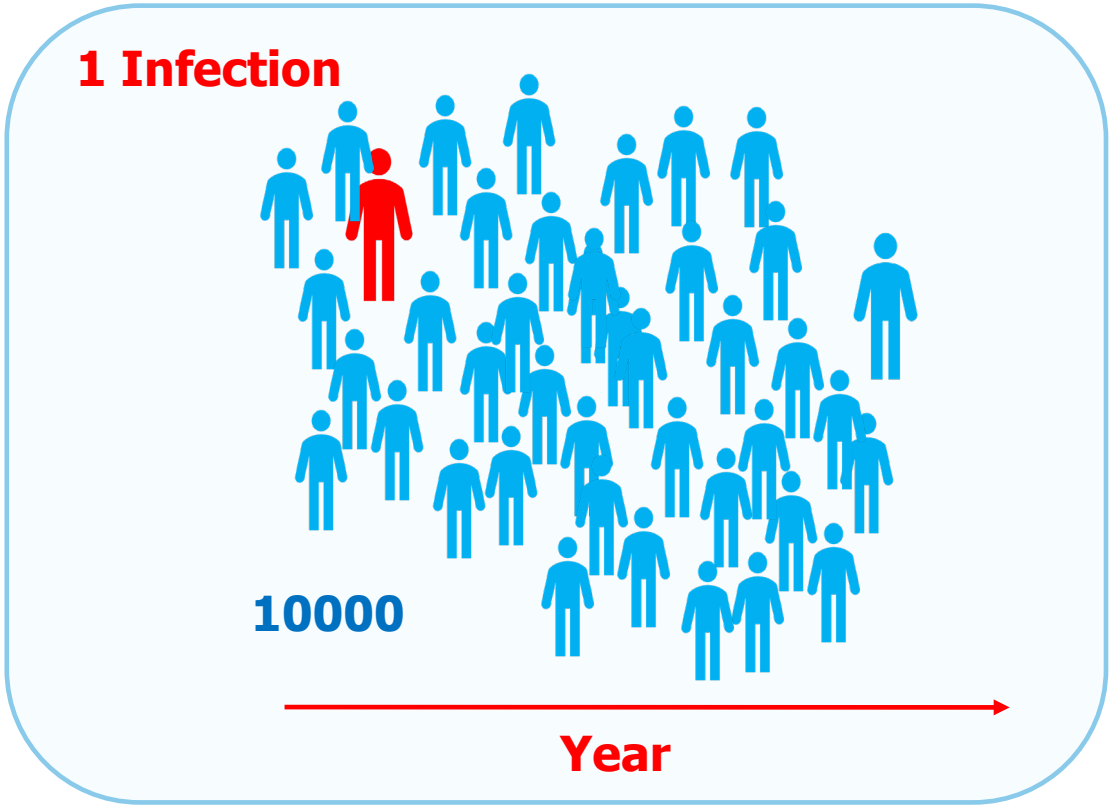
Typically means risks have been managed to an acceptable level.

Health Outcome Targets provide a quantitative definition of the level of risk accepted.

2. Health Outcome Targets

United States Environmental Protection Agency

<1 Infection per 10000 people per year



Quantitative benchmark defining the risks accepted from pathogens

2. Health Outcome Targets

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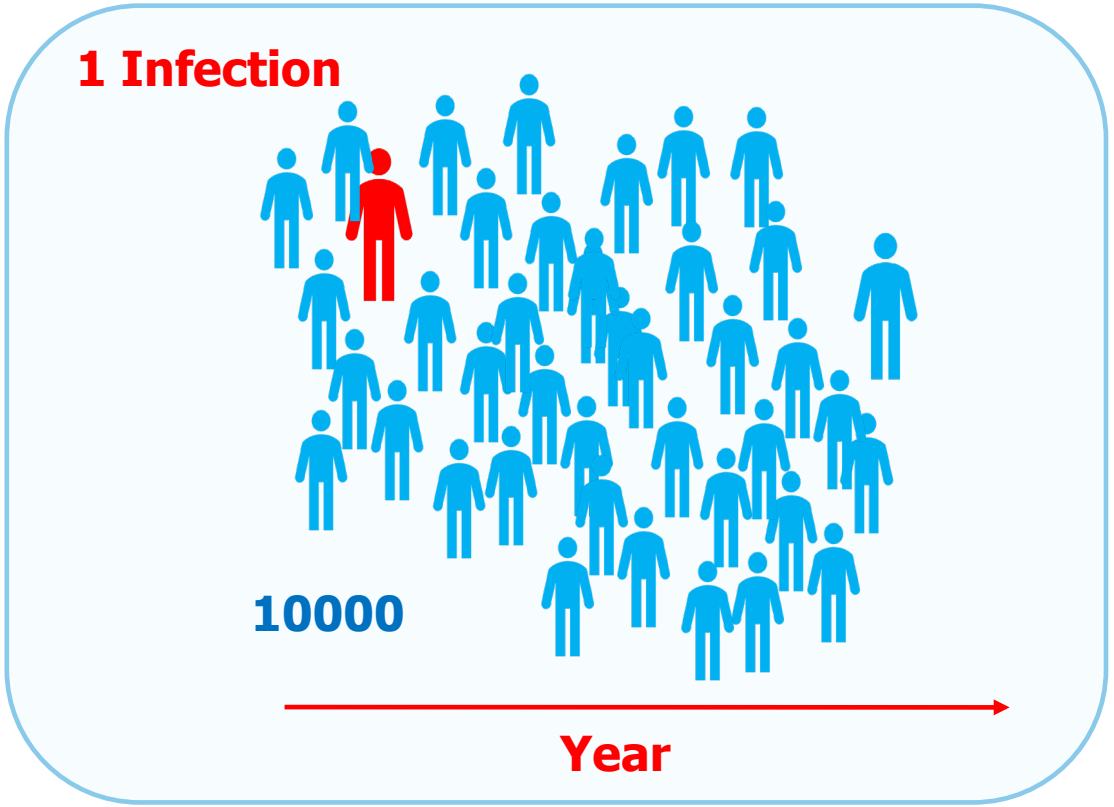


\+ Severity =

WHO Australia & Canada

Disability Adjusted Life Years (DALYs)

Quantitative benchmark defining the risks accepted from pathogens

2. Health Outcome Targets

Historical Context:

- WHO Drinking Water Guidelines recommended use as early as 2004.
- Adopted in Australian Guidelines for Water Recycling (2006, 2008).
- Recognised by Health Canada (2019).
- Incorporated in the Australian Drinking Water Guidelines (2022).

Sensitive nature of risk acceptance.

- Must be informed by local social, cultural, environmental, economic, and political considerations.
- Set at National or Regional level and be acceptable to the communities involved.

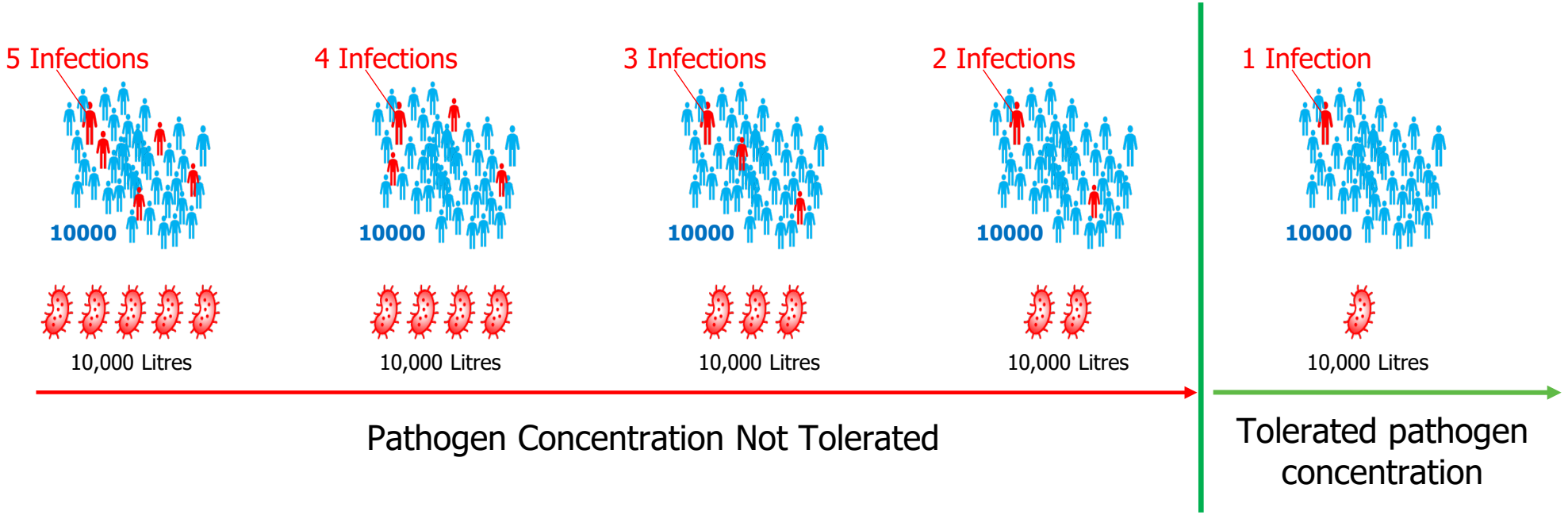
Points to Remember:

- Residual risks exist, whether quantified or not.
- Quantifying them brings them into focus.
- Enables coordinated action towards a defined target.
- Allows us to verify that acceptable residual risks have been achieved.

3. The role of Microbiology tests

First translate the Health Outcome Target into a Pathogen Concentration

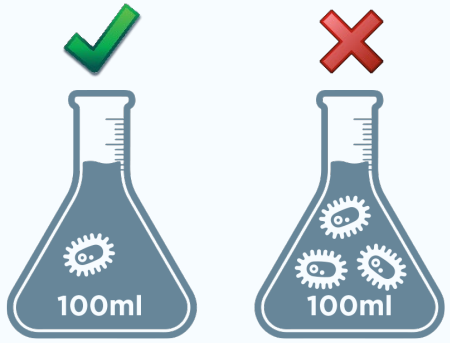
Quantitative Microbial Risk Assessment (QMRA)



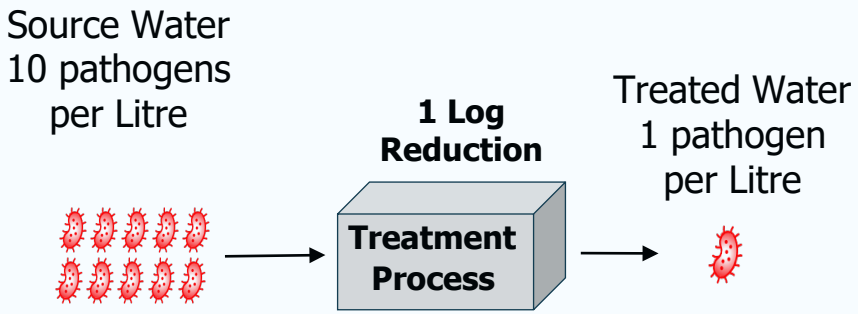
3. The role of Microbiology tests

Use maximum tolerable pathogen concentration, to set corresponding "secondary" water quality targets.

Maximum Acceptable Values (MAVs):



Performance Targets (log reductions)



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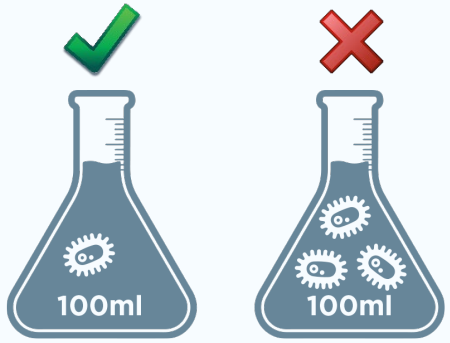

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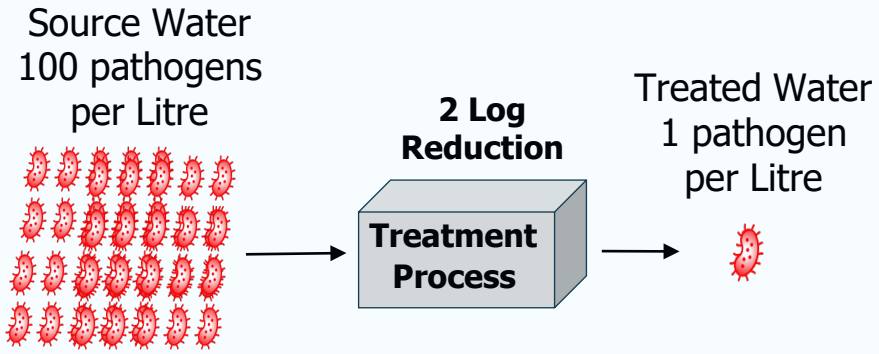
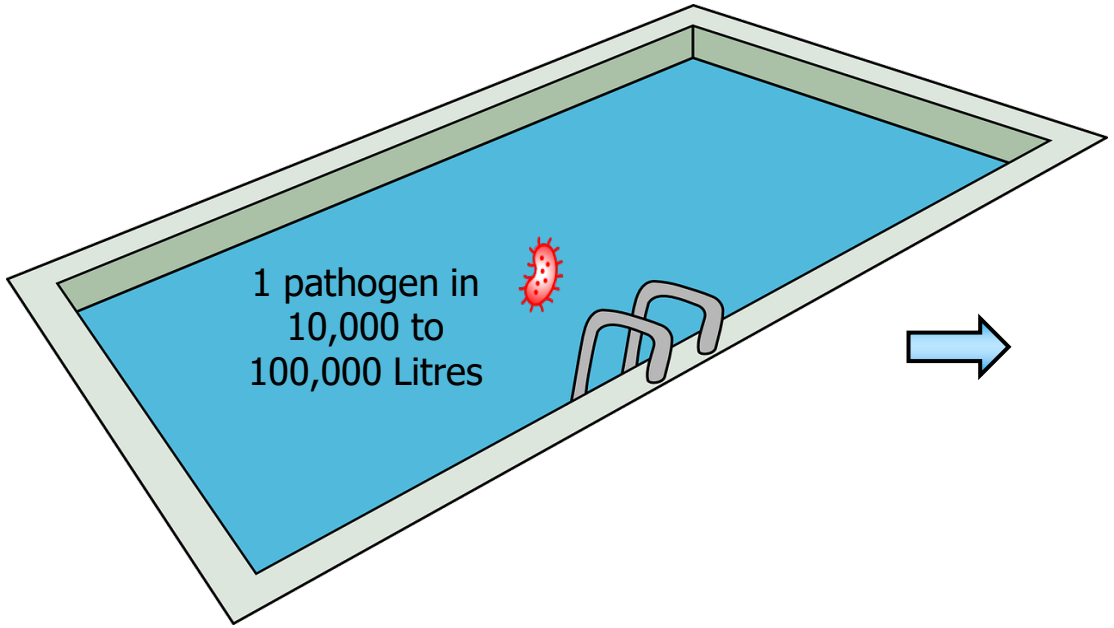


3. The role of Microbiology tests

Very low pathogen concentrations have significant health impacts

Concentrations of pathogens equivalent to a Health Outcome Target of 10^{-6} DALY per person per year are typically amount to less than 1 pathogen per 10^4–10^5 litres of drinking water (WHO, 2017).



Breach of the WHO Health Outcome Target for drinking water.

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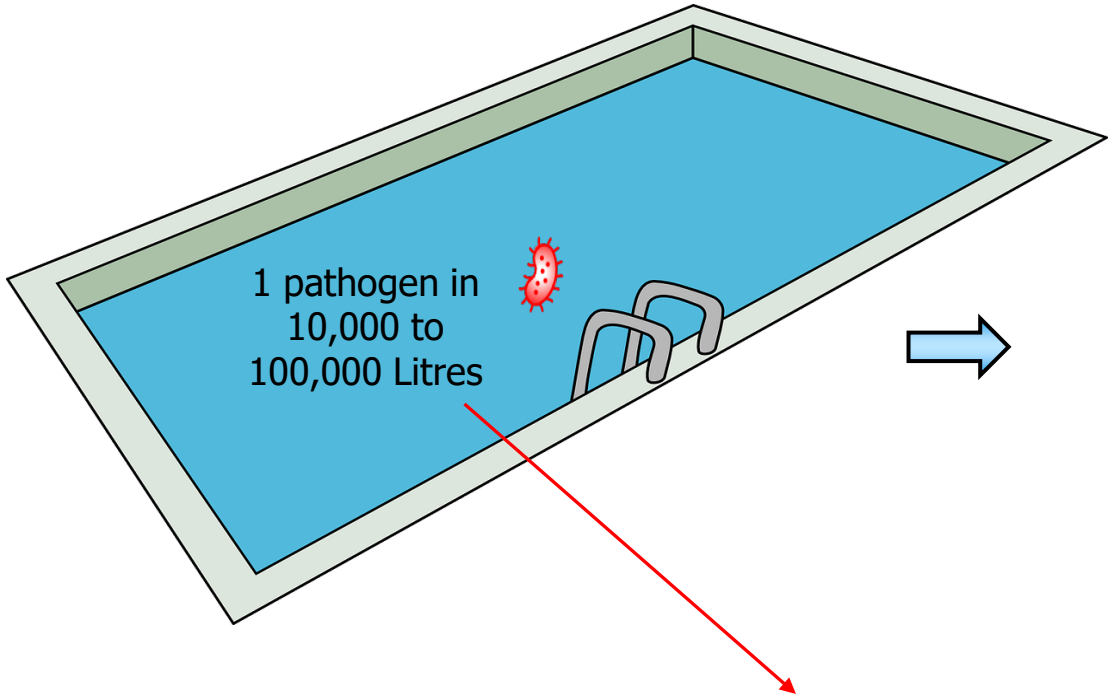
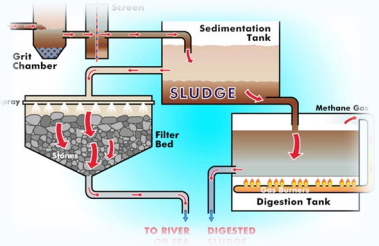


Breach of the WHO Health Outcome Target for drinking water.

MAV for drinking water set at <1 *Cryptosporidium* oocyst per 100 Litres

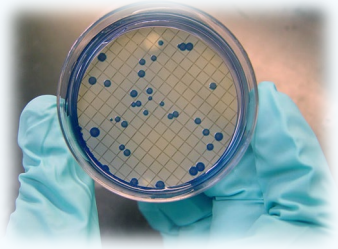
4. Are the tests "fit for purpose"

Start by selecting the right microorganism



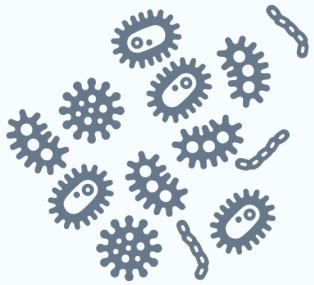
Process Indicators

Used to assess the effectiveness of water treatment processes (e.g. total coliforms)



Faecal Indicators

Signal potential faecal contamination (e.g. Faecal coliforms & *E. coli*)



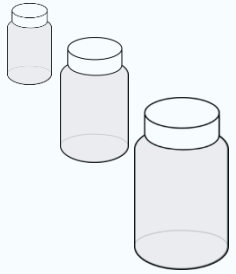
Reference Pathogens

Serve as representativeness of a broader pathogen group in QMRA studies.

- *Rotaviruses*
- *Campylobacter jejuni*
- *Cryptosporidium parvum*

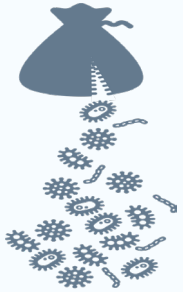
4. Are the tests “fit for purpose”

1. Representative Sampling



Collect enough samples to provide a true representation of the water.

2. Recovery Rates

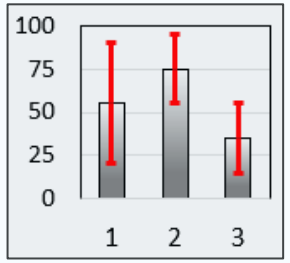


Understand how much of the pathogen is recovered by the test.

3. Turnaround Times

Match test turnaround times with public health decision-making needs.

4. Method Uncertainty



Understand uncertainty before drawing conclusions.

5. Avoid reasoning errors

Arguments from authority

Relying on an authoritative opinion as the primary motivation for testing without directly addressing the inconsistency.

- Referring to "Best practice" without clarifying the foundation of that practice.
- ”A prominent microbiology professor recommended the testing”
- ”If we follow the Australian guidance document everyone will accept that we have tested the right parameters”

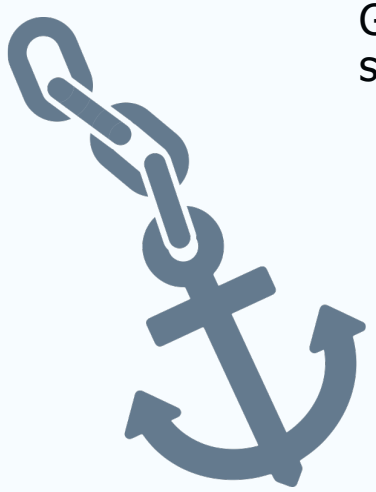
5. Avoid reasoning errors

Appeals to Common Practice:

The fact that a practice is common does not in itself make it effective.

- *"We've always done it this way"*
- *"Everyone is familiar with this testing process, why should we change it"*
- *"There is an expectation for us to continue with it."*

5. Avoid reasoning errors



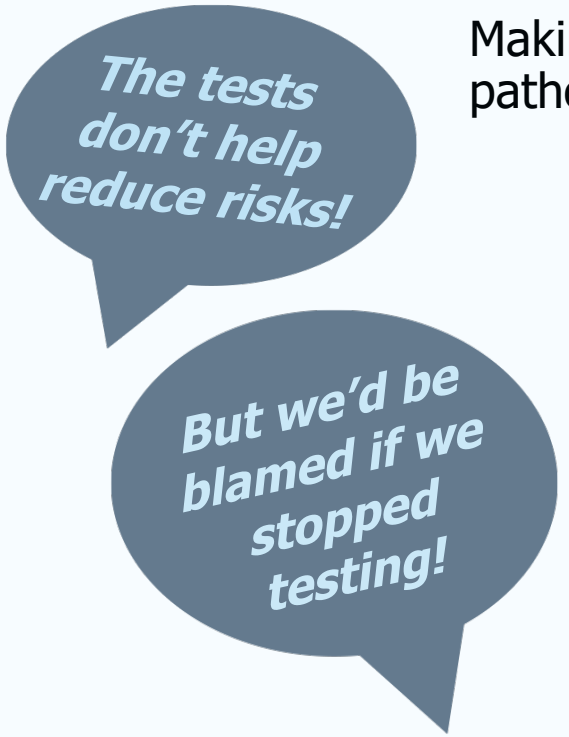
Anchoring:

Giving too much weight to an initial piece of information, and then overlooking subsequent weaknesses.

- "*Adenoviruses are always present when other enteric viruses are present. We should use them as indicators, even though the methods to detect them have significant limitations.*"
- The "Anchor" is the strong association between Adenoviruses and other enteric viruses.
- The implications of the limited detection methods are then overlooked.

5. Avoid reasoning errors

Arguments from Adverse Consequences



Making decisions based on fear of negative outcomes unrelated to pathogen risk reduction.

- "*If we didn't test and something went wrong, we would be blamed for not conducting the testing, even though the tests don't reduce the risks*".
- The justification for conducting the tests is based on the negative consequences (reputational risk) that would arise, rather than on the actual efficacy or relevance of the tests.
- Remember, presenting results as an indication of safety when they are not can also pose challenges.

5. Avoid reasoning errors

Addressing These Patterns

- Recognition of these reasoning patterns represents the first step in addressing them.
- If they are observed, deliberately identify them. Ask for more detail to understand the core reasons behind decisions.
- Be particularly vigilant of shifting justifications. Shifts suggest a weakness in the first justification offered.
- Conduct periodic reviews of decisions and invite reviews from other parties.

Remember these 3 messages:

Understand Health Outcome Targets:

- Whether set nationally or derived from international standards, these targets provide clear benchmarks for water quality management.

Evaluate Microbiology Test Carefully:

- It's vital to ensure that the chosen tests are both technically sound and relevant to the Health Outcome Targets.

Address Inconsistencies:

- When discrepancies between tests and Health Outcome Targets are identified, they should be addressed directly. Relying on unsound reasoning patterns doesn't resolve core technical issues.

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