We will begin shortly.
Participants, kindly note the following for this seminar.

Please rename your Zoom name to: Name, Org or Project
(e.g. Las Fernando, ADB)

PLEASE TURN YOUR MIC OFF DURING THE PRESENTATION

RAISE HAND WHEN YOU WANT TO TALK

USE THE CHAT BOX FOR QUESTIONS/CONCERNS

WE HAVE A Q&A PORTION AFTER THE PRESENTATION

Pacific WASH Webinars

A Closer Look at Water Quality for Public Health

26 May 2021

TA6551-REG: Strengthening WASH Practices and Hygiene Behavioral Change in the Pacific

Schedule

Allotted time	
10 min	Introductions: **Emma Veve**, Deputy Director General, Pacific Department, ADB **Lusia Sefo-Leau**, CEO PWWA
15 min	Presentation: Link between water and public health (**Lisa Proctor**)
15 min	Presentation: Drinking Water Treatment and Disinfection (**Peter Greenhalgh**)
30 min	Exercise – Applying technologies based on raw water quality
15 min	Discussion: Community involvement in treatment (**Clara Laydon**)
5 min	Closing remarks

Speakers

Lisa Proctor	Peter Greenhalgh	Clara Laydon
Hunter H2O	Hunter H2O	Hunter H2O
		
Sector Lead – Operations	Principal Process Engineer	Principal Process Engineer

What is public health?

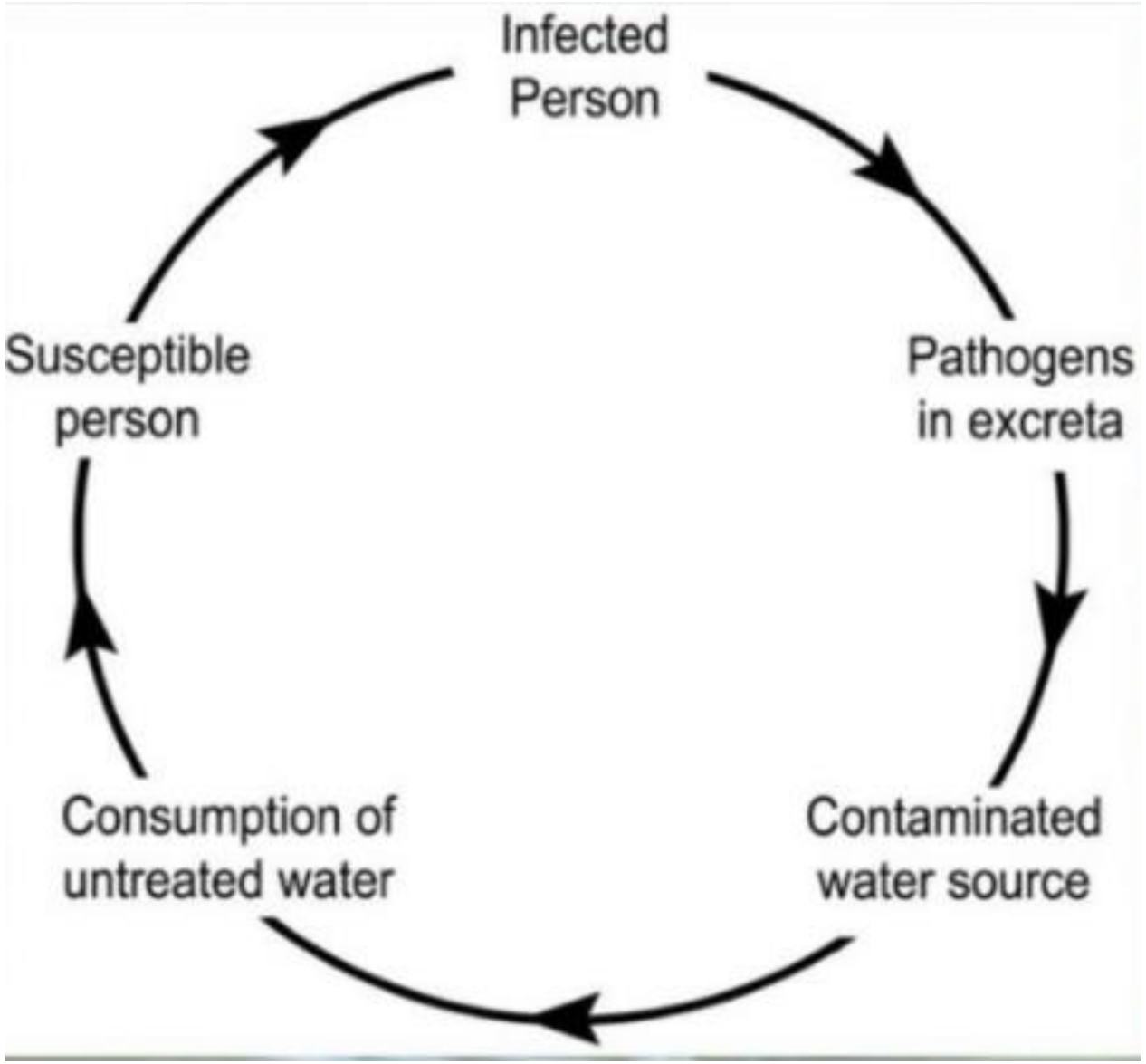
Public Health is defined as *“the art and science of preventing disease, prolonging life and promoting health through the organized efforts of society”* (Acheson, 1988; WHO).

A bit of history….

- From the mid-1850's to the 1900's "the city faced a sanitary and hygiene crisis of major dimensions."
- The Hunter District Water Board was established in Newcastle in 1892 in response to "the city's poor water supply and abominable sanitation" (*For the Public Health*, p.1 1992).
- The Board's motto? *Pro Salute Civium* – for the safety of the citizens

Water Related Disease

Typical water-disease cycle



Incidence of water related disease

- Contaminated water can transmit diseases such diarrhoea, cholera, dysentery, typhoid, and polio
- Two (2) pathogens, Escherichia coli and rotavirus, are responsible for most cases of moderate-to-severe diarrhoea in low-income countries. Other important pathogens include Cryptosporidium.
- WHO recently estimated that 60% (54–65%) of all deaths due to diarrhoea in low and middle income countries are attributable to inadequate drinking-water (35%), sanitation (31%) and hygiene (12%), resulting in 829 000 deaths annually.

WHO | Safer water, better health

Water Related Disease

- There is a long list of other diseases though!
- Different types of pathogens cause the different diseases.
- Each pathogen has a different life cycle and infection pathway.

Pathogen	Health significance	Persistence in water supplies	Resistance to chlorine	Relative infectivity	Important animal source
Bacteria					
Campylobacter jejuni, C. coli	High	Moderate	Low	Moderate	Yes
E. coli – pathogenic	High	Moderate	Low	Low	Yes
E. coli – enterohaemorrhagic	High	Moderate	Low	High	Yes
Legionella spp.	High	Multiply	Low	Moderate	No
Salmonella typhi	High	Moderate	Low	Low	No
Other *Salmonella* spp.	High	May multiply	Low	Low	Yes
Shigella spp.	High	Short	Low	Moderate	No
Vibrio cholera	High	Short	Low	Low	No
Yersinia enterocolitica	High	Long	Low	Low	Yes
Viruses					
Adenoviruses	High	Long	Moderate	High	No
Enteroviruses	High	Long	Moderate	High	No
Hepatitis A	High	Long	Moderate	High	No
Hepatitis E	High	Long	Moderate	High	Potentially
Noroviruses and sapoviruses	High	Long	Moderate	High	Potentially
Rotaviruses	High	Long	Moderate	High	No
Protozoa					
Cryptosporidium parvum	High	Long	High	High	Yes
Entamoeba histolica	High	Moderate	High	High	No
Giardia intestinalis	High	Moderate	High	High	Yes
Helminths					
Dracunculus medinensis	High	Moderate	Moderate	High	No
Schistosoma spp.	High	Short	Moderate	High	Yes

Source: WHO, 2004 (p. 122).

Improvements due to better water

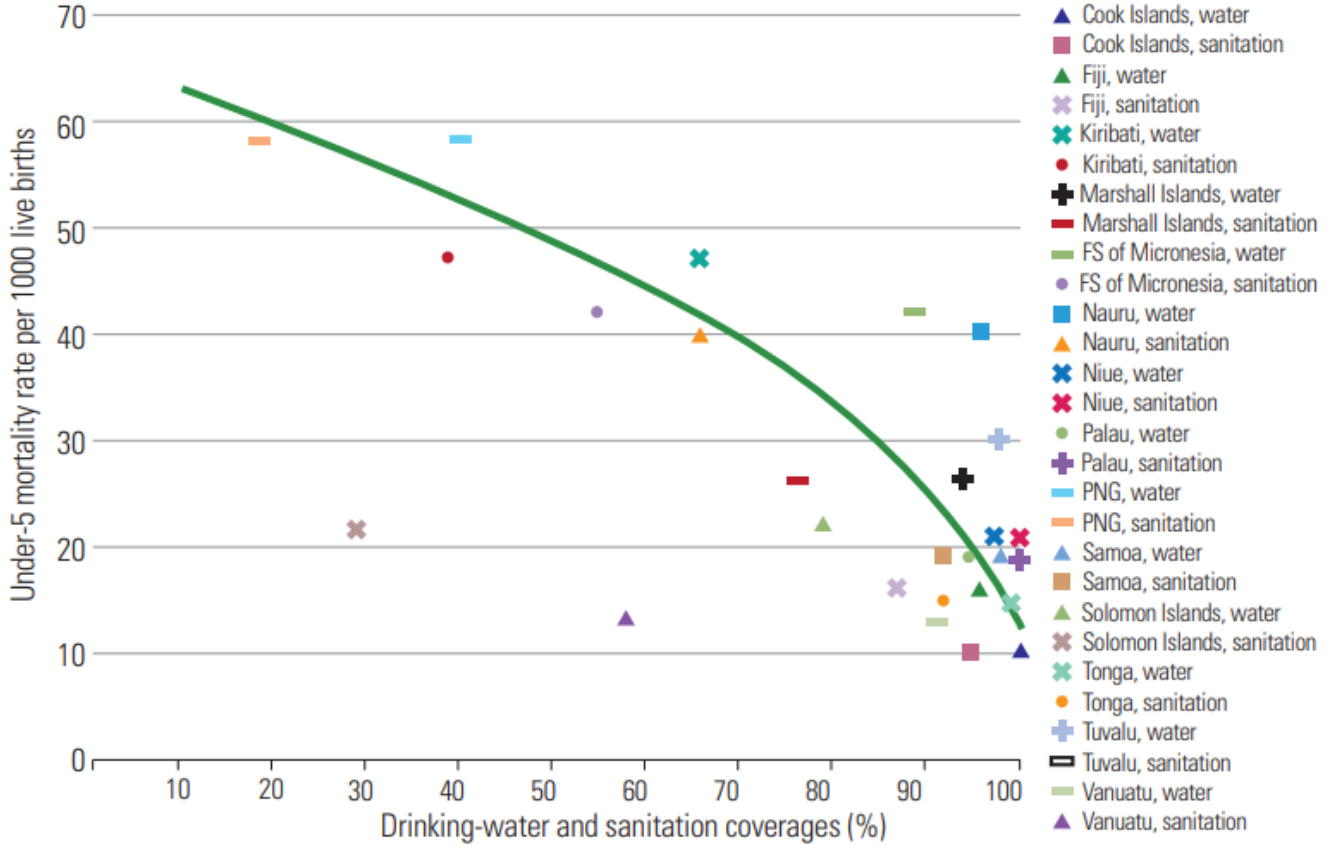
- Improved water supply and sanitation significantly reduces the incidents of water borne illness and death significantly.
- Between 1990 and 2015, the proportion of people with improved sanitation increased from 29 to 31 % of the total population
- During the same period, the proportion of people accessing improved drinking water increased from 46-52%

UNICEF | Pacific Islands: Water, Sanitation and Hygiene

The link between safe water and infant mortality

Figure 45

Coverage with improved drinking-water and sanitation compared with under-5 mortality rate per 1000 live births, Pacific island countries, 2012



Source: WHO (2013) (under-5 mortality); UNICEF and WHO (2015) (coverage)

Key quality guidelines

- **W**orld **H**ealth **O**rganisation has a guidance document [WHO | Drinking Water Quality Guidelines]

- Other countries have developed their own or adopt WHO

Major contaminants

Microbiological

Inorganic

Organic

Radionuclide

Microbial contaminants

Bacterial, e.g.

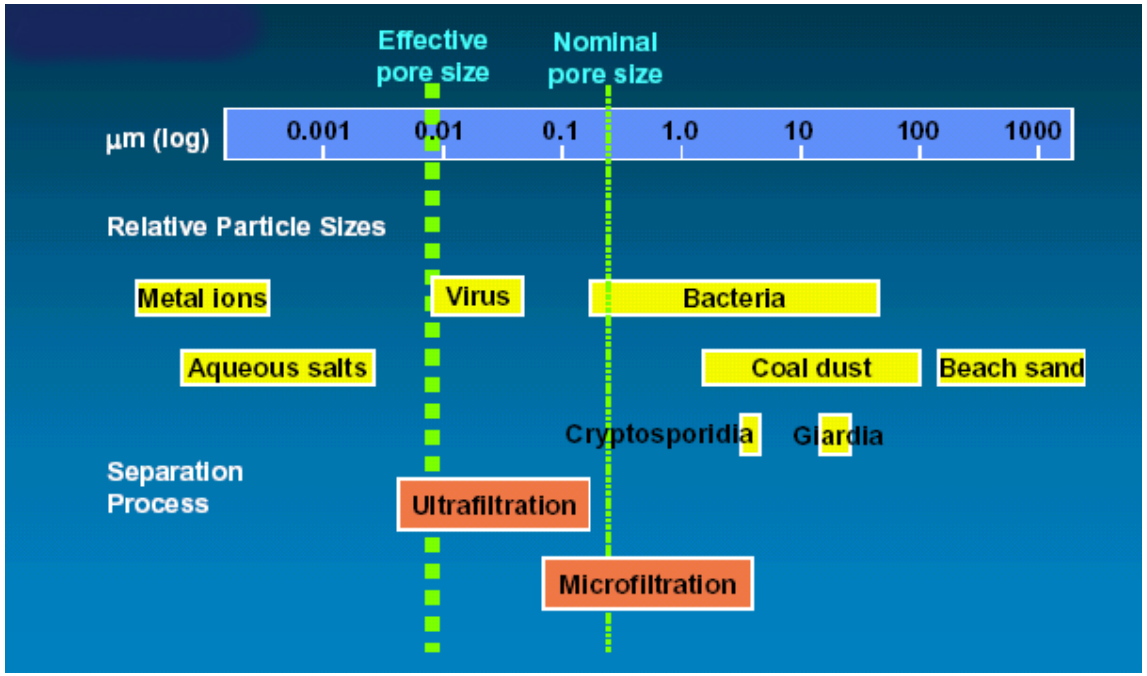
- E. Coli
- Campylobacter

Viral, e.g.

- Enteroviruses
- Hepatitis A and E

Protozoan e.g.

- Cryptosporidium parvum
- Giardia intestinalis



Inorganic Contaminants

- Heavy metals such as mercury, cadmium and lead. Naturally occurring or from mining waste. Can cause brain damage, liver or kidney damage.
- Nitrates from fertilizer or sewage effluent. Can cause Methemogobinemia (blue baby) in children younger than 2 yrs.

Radionuclide and Organic Contaminants

- Radionuclide
  - Radon and uranium
  - Can be naturally occurring in ground water
  - Possible also from improperly disposed of / poorly contained waste
- Organic Contaminants
  - Typically from improperly disposed of waste and / or leaking containment, include:
    - Hydrocarbons
    - Pesticides
    - Organochlorides

How to we know what risks are present?

- Assess risk
- Testing
- Planning
- Cooperation
- Then repeat
- The Water Safety Plan Process

Treatment

Basic water treatment

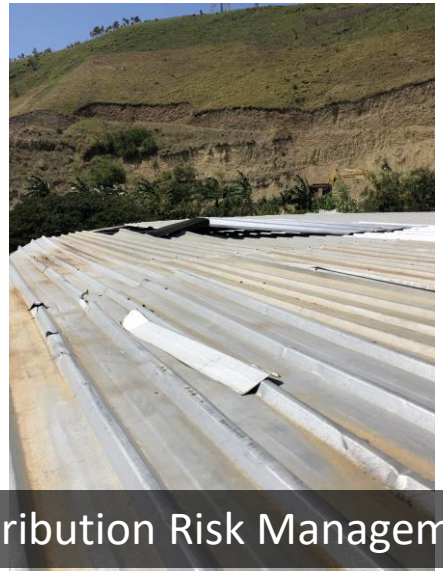
- Screening
- Organics removal
- Oxidation
- Coagulation
- Flocculation
- Sedimentation / Flotation
- Filtration
- Disinfection
- Oxidation
- Residual handling (sludge handling and treatment)








Catchment Risks Management

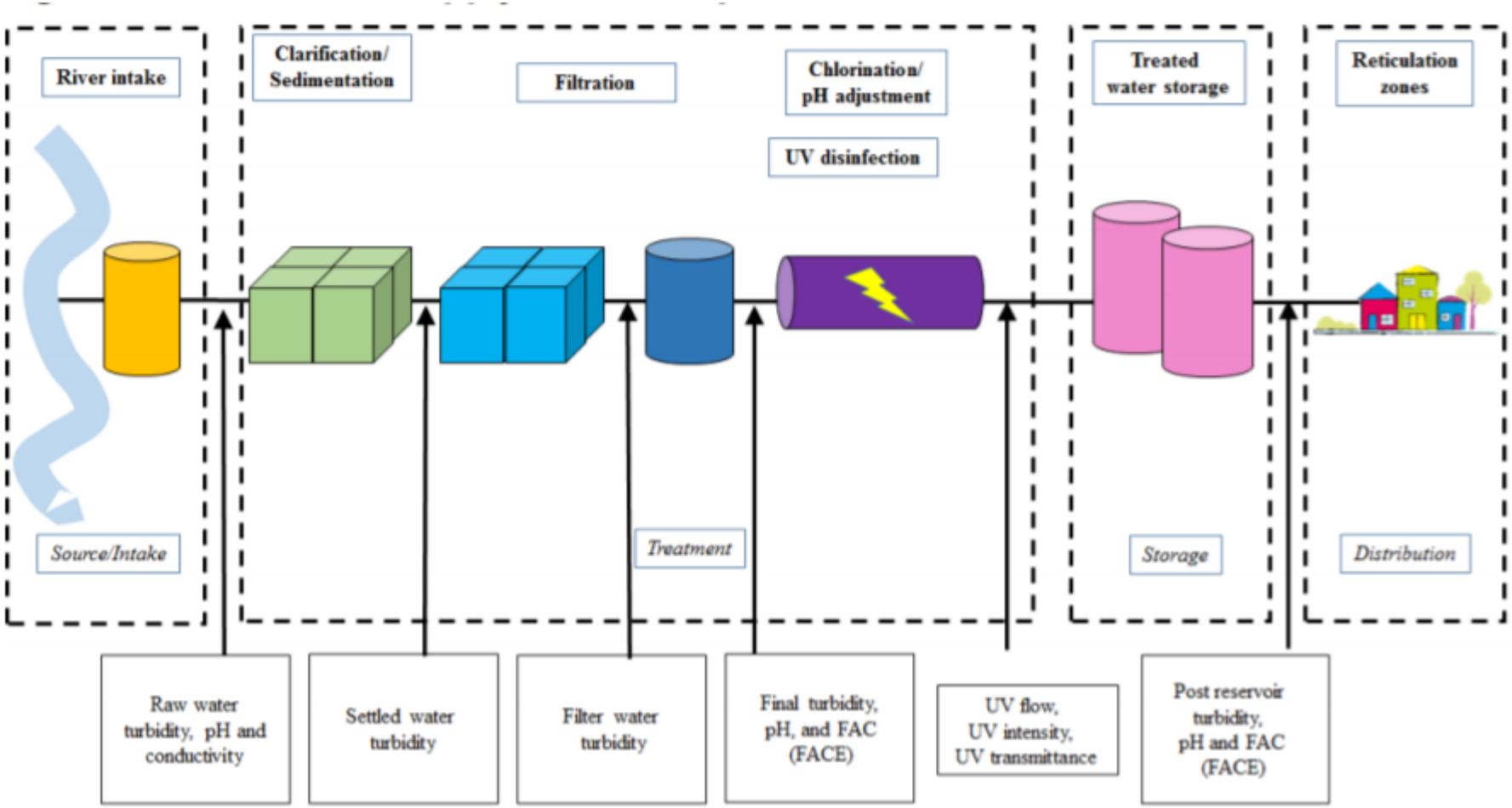

Distribution Risk Management


Customer Risk Management

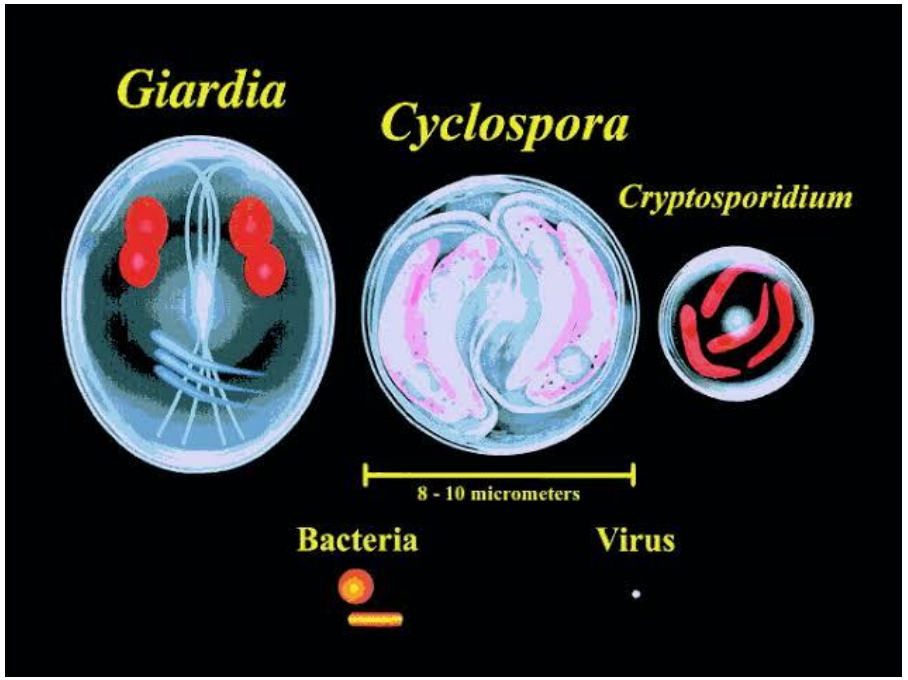

Treatment Risk Management

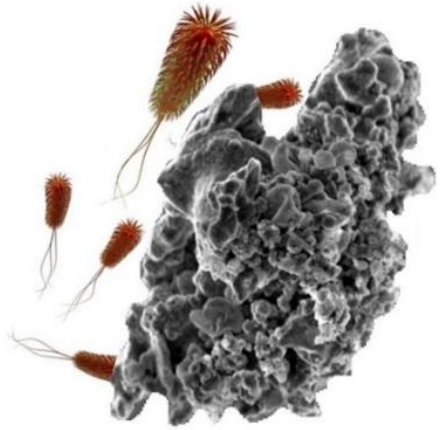
That’s not the entire process though

Basic process diagram



Turbidity- Disinfection Shielding





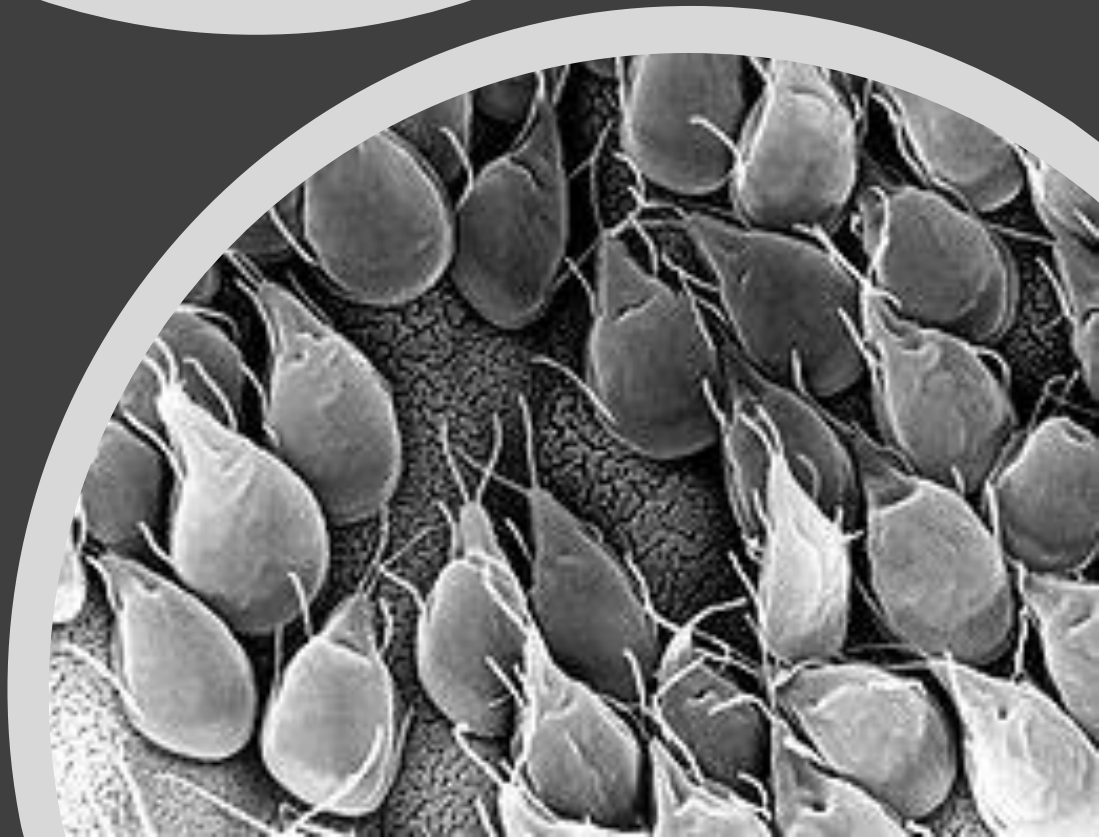
To ensure that the water is ‘clear’ with minimal particulates this allows the chlorine to work most effectively as the particulates can act as a shield and protect the pathogens.
Target < 1 NTU
This doesn’t mean chlorine doesn’t work >1 NTU but it wont be as effective as standard tests

Microbiological indicators

- It is too difficult to test for all dangerous pathogens and on a frequency that would reduce risk.
- The presence of some organisms may indicate the presence of fecal contamination.
- E. Coli is a commonly used indicator organism. i.e. if there is E. Coli there is a contamination risk.

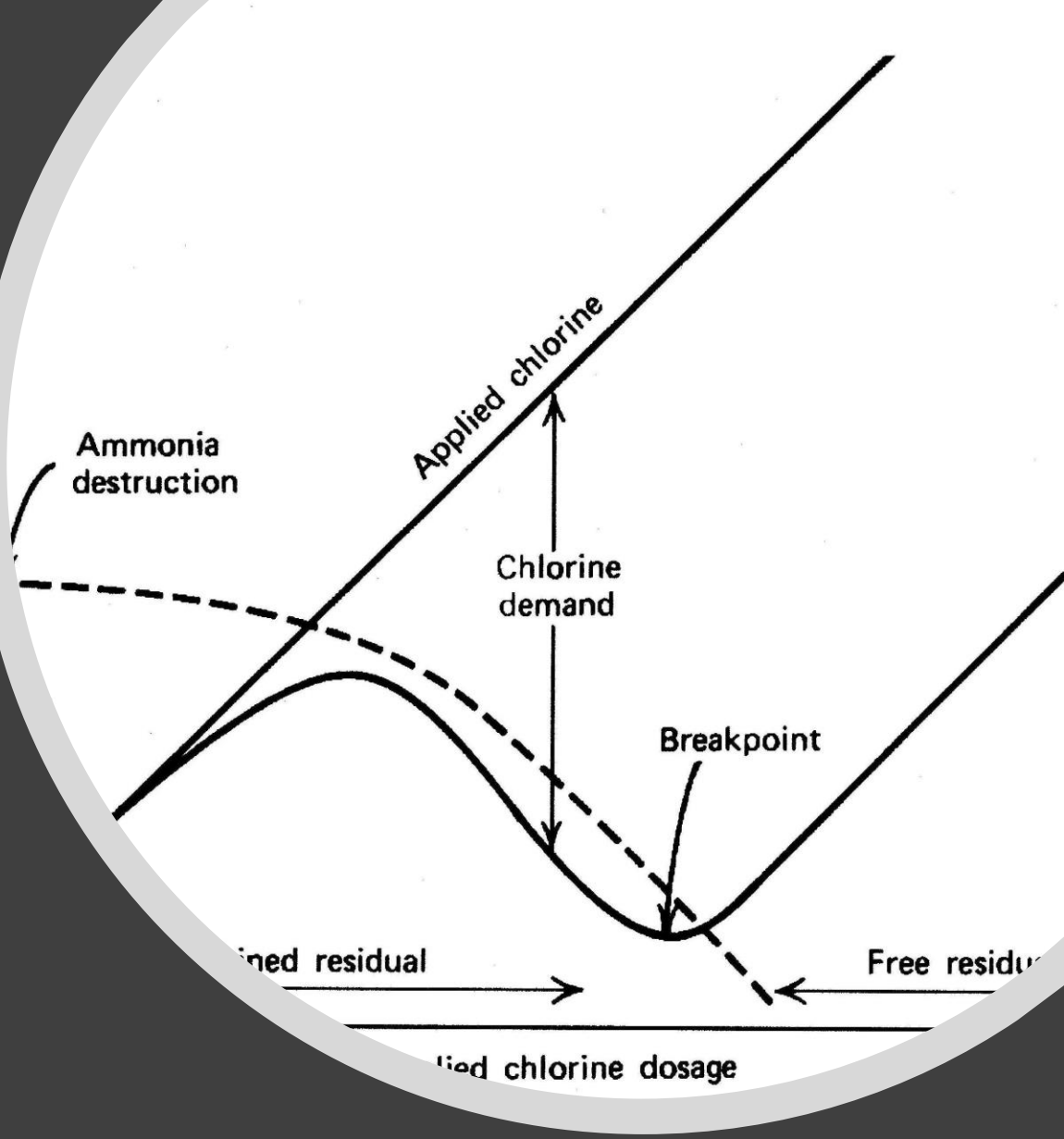
Why disinfect?

- Disinfection is used to kill / inactivate pathogens.
- Without disinfection the water treatment process would not achieve its purpose of making water safe to drink.
- The disinfection should be targeted at the level of risk



Disinfection Processes

- Most common:
  - Gas chlorine
  - Sodium hypochlorite, hypo solution
  - Ultraviolet (UV) disinfection
- Less commonly used
  - Chlorine dioxide
  - Chloramines
  - Ozone



Chlorination

- Free chlorine is an effective disinfectant
- The residual continues to protect the distribution system
- It needs sufficient contact time to be effective
- It may be consumed by other compounds
- It needs the right pH to be effective
- It is slower to act the lower the temperature is

UV Disinfection

- UV use is becoming more widespread.
- Good at removing bacteria and unlike chlorine can kill cryptosporidium, giardia
- Less effective against virus.
- Needs contact time and right dose to be effective.
- Needs clear water to be effective.
- No residual protection of distribution.

At home treatment

- Boil water prior to use – Effective against most pathogens
- Filtration prior to use – Limited effectiveness against virus and bacteria unless membrane filtration
- Chlorine tablets and solutions – Can be effective against virus and bacterial pathogens. Difficult to control dose and effectiveness

https://purewatersystems.com.au/

Exercise

Breakout rooms

- We'll look at sets of raw water quality data
- Sources with variability
- What would we do?

Water types

- **Water 1** – Bore water from high permeability aquifer with houses in the catchment area
- **Water 2** – Run of the river water extraction with settlements in upper catchment

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Breakout Debrief

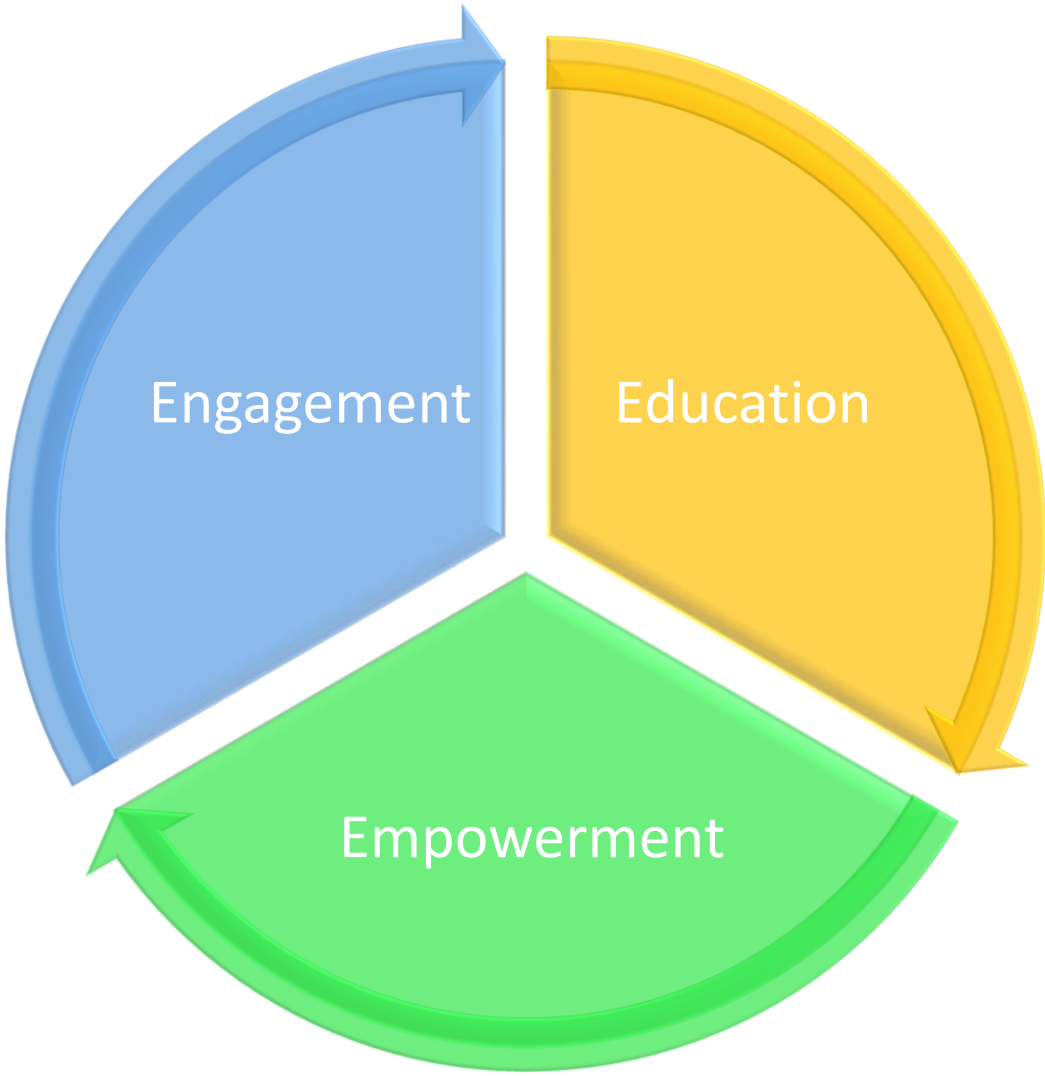
- What might be causing the trends?
- What would be the recommended treatment process?
- What would be the recommended disinfection process?
- Are they both needed?
- How would you convince your community?

Community Involvement in Treatment

Community Acceptance

- Engagement
- Education
- Empowerment

Reflected in Water Safety Plan Process



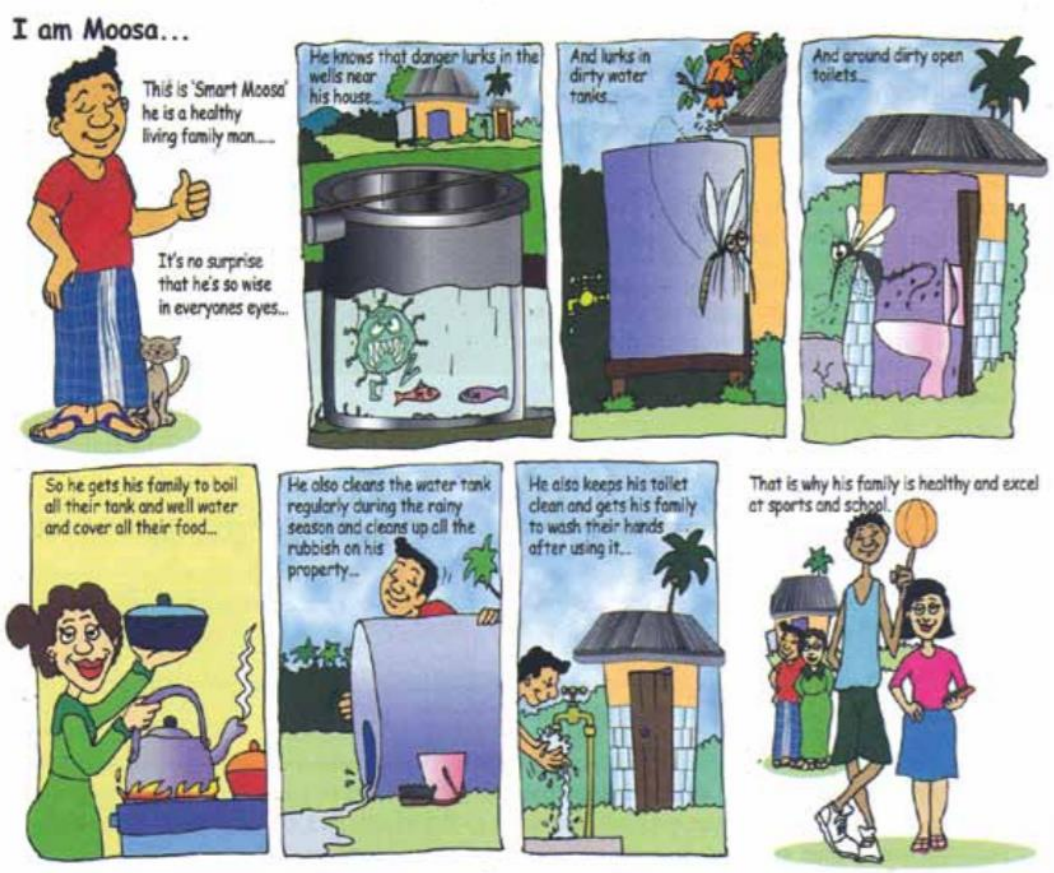
Community Engagement

- Early Engagement
- Engaging with the community is a 2 way process
- Sitting down and understanding the water system in each community, to work through a mutual understanding:
  - Understanding of community's acceptance of treatment
  - Understanding and acknowledgement of concerns
  - Ask what the community what would they like to know more about
- Understanding and engagement can then be used to create the right education tools

Source: WHO | Water Safety Planning for Small Community Water Supplies

Community Education

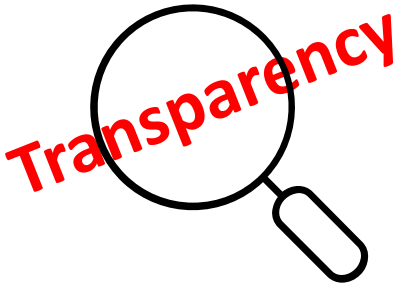
- Education programs to highlight key risks and identify safe practice
- Highlight the need for reporting of disease
- Care needs to be taken when simplifying complex problems such as disease risk.
- School and children education packages, with delivery from schools, can also help educate the greater community



Source: WHO | Water Safety Planning for Small Community Water Supplies

Community Education

- Use engagement to tailor or create different education based on the variety of concerns from the community
- Be transparent on and about information, some concerns are relevant and need to be explained accurately.
- There can be misinformation as well as information that can be taken out of content.
- Transparency and communication are key.



Empowerment

- Working through the issues and understanding concerns can create an understanding of what communities want to be involved with.
- Empowering community can provide a powerful way of participating in reviewing water system directly or indirectly.
- The water supply system is to serve the benefit of the community and it is important that the community are part of that process

Source: WHO | Water Safety Planning for Small Community Water Supplies

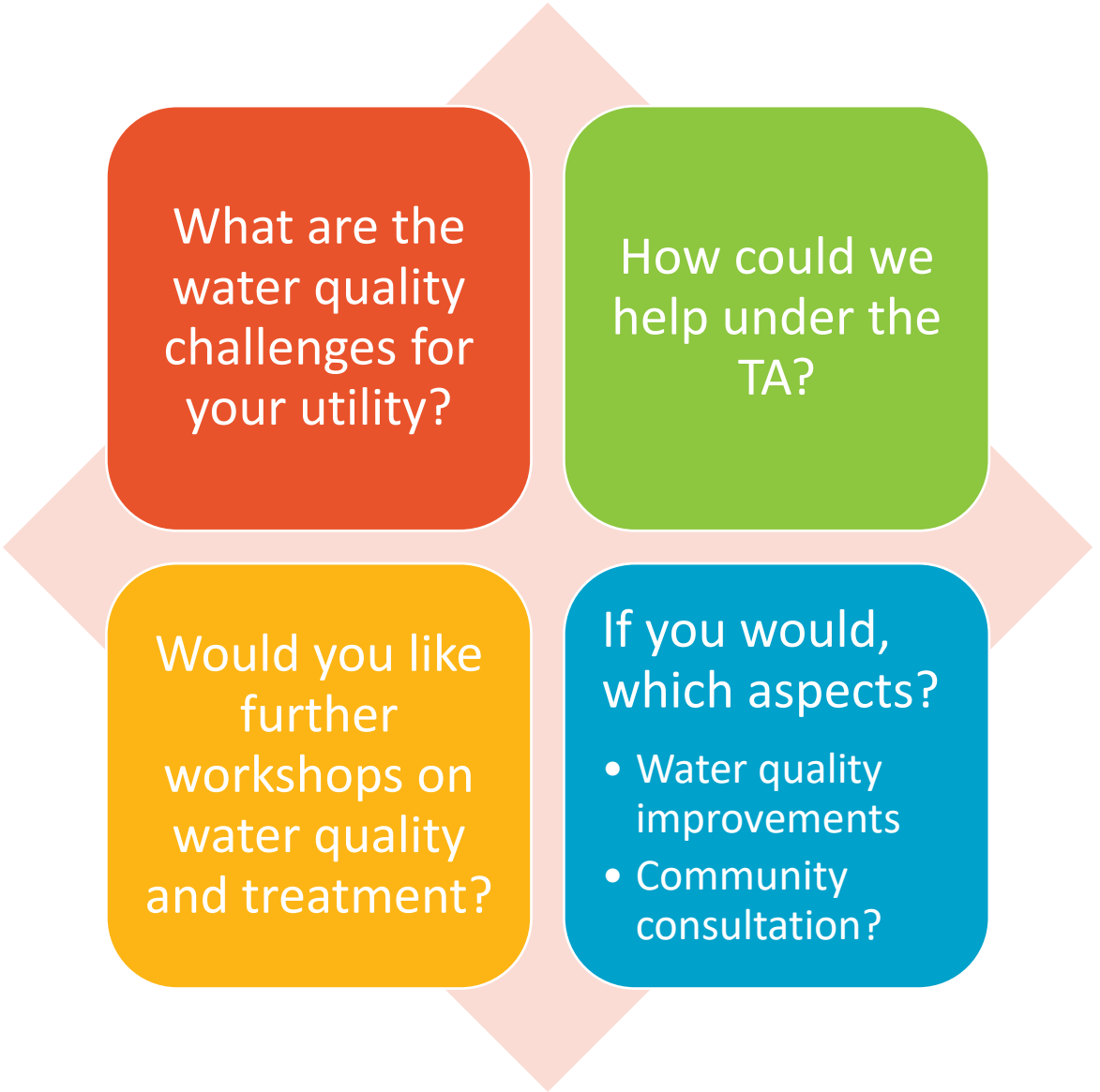
“empowerment specifically involves people acting collectively to gain greater control over their community, including their health and the quality of life”

Community engagement: a health promotion guide for universal health coverage in the hands of the people, WHO, 2020.

Cook Islands Experience

- 5 minutes

Challenges and Opportunities - Discussion



Thank you.