Putting evidence into practice

Figure 1: Decision-making tool for practitioners considering a line of action in response to finding a positive *E.coli* result in drinking water

Actions/Considerations	Yes	✓	No	✓
• Examine all routine operating and physical parameters upstream and downstream of the positive sample location to confirm or refute a positive *E. coli* result:				
a) Check the chlorine residual upstream and downstream of the positive sample location. Is it below 2 mg/L?	Favours a fecal contamination.		Favours a sampling error: If chlorine residual readings up- and downstream from where the positive *E. coli* sample was collected are 2 mg/L, this suggests no contamination. *E. coli* should be inactivated by 2 mg/L of residual chlorine; the positive result can be attributed to a sampling error if water flow rate is normal. Sampling errors can be due to a dirty tap or non-aseptic sampling practices. Examine the site where the positive *E. coli* sample was collected, e.g., condition of tap, signs of cross-connection and contamination, aerator on the tap. Did the person taking the sample detect unusual conditions while sampling, or modify the sampling protocol? Test his/her familiarity with the sampling protocol (e.g., an old bottle could have been used).	
b) Is there any increase in chlorine demand at the collection site? (e.g., lower chlorine residual at sampling location compared to upstream and downstream locations)	Favours a fecal contamination.		Favours a sampling error.	
• Examine physical parameters (e.g., pH, turbidity) within the distribution system and compare with readings at sites located up- and down-stream of the positive sample location. This will provide immediate results.				
a) Are they out of range?	Favours a treatment failure that could explain the presence of fecal		Most likely, contamination was limited to that one single location and could be due to an internal plumbing, dirty tap	

Actions/Considerations	Yes	✓	No	✓
b) Are there any spikes?	contamination into the water.		or improper sampling technique.	
• Examine operating parameters within water treatment plant including records, filtering parameters (filter run-time, flow rates, head-loss), turbidity, chlorine residual, and operational pressure.				
a) Are there any abnormal fluctuations?	Points towards a microbial breakthrough, contamination or inadequate treatment.		Favours a sampling error.	
• Check operating conditions within the distribution system.				
a) Are there any changes in operating conditions, such as o Water flow rates o Demand o Pressure	Favours a contamination from cross-connections. Changes in operating conditions may indicate backflow or back siphonage. This could be caused by major events leading to increased water demand, such as fire fighting, hydrant flushing or a main break.		Favours a sampling error.	
• Was there any breach in the treatment system?				
a) Did work done lead to a break in the water lines, contamination of storage tanks, or a dead end in the system? For the case of a sand filter: **b)** When chlorine is used, was chlorine added before or after sand filtration? **c)** When was the sand filter last	Favours a contamination event: a) If any breach in the treatment system exists. b) If chlorine was added before the sand filtration. c) Never cleaned or past due: the		Favours a sampling error: a) If no breach in the treatment system is apparent. b) If chlorine is added after the sand filtration. Chlorine should always be added after sand filtration to preserve the effectiveness of the schmutzdecke. c) Cleaning schedules are respected.	

Actions/Considerations	Yes	✓	No	✓
cleaned?	sand filter cannot function properly.			
• Discuss with local physicians and directors of long term care facilities				
a) Have there been any increased cases of gastrointestinal illnesses or other unusual symptoms?	Supports the theory of a contamination event.		Favours a sampling error.	
• Check with the operator				
a) Have there been any recent complaints by residents about water quality (colour, taste, and odour)?	Supports theory of a water treatment issue and therefore points to a possible contamination of the water.		Favours a sampling error.	
Other considerations for specific cases				
a) For surface water and ground water under the influence of surface water, were there any particular weather events (e.g., cold, snowmelt or rain)?[1] For the particular case of a sand filter, cold weather might also affect the effectiveness of the sand filter.	Supports the theory of contamination, as some treatment systems may become overwhelmed by weather conditions.		Favours a sampling error.	
b) Is there any discharge of sewage waste from lagoon or other operations upstream from the water source?	Supports the theory of a contamination event.		Favours a sampling error.	
c) Did follow-up testing confirm the initial positive *E. coli* findings?	Favours fecal contamination of the drinking water; proceed to next stage of checklist.		Favours a sampling error.	