Why a POU Device?

By Kelly A. Reynolds, MSPH, PhD

Water treatment POU devices come in all sorts of shapes and sizes, with a range of capabilities and prices. As a microbiologist with a specialty in waterborne contaminants, I'm often asked if having a POU device is really necessary or worth the expense. Determining the benefit and cost of any consumer product is not trivial. Here we evaluate factors to consider when weighing whether or not to purchase a POU device and examine risk-reduction benefits of a properly maintained POU system.

Device types

POU devices treat water at the point of consumption, in the home, providing a final barrier of water treatment just prior to drinking. Although no single POU technology can remove all waterborne contaminants of concern, the most commonly used technologies are activated carbon filtration, distillation, RO and UV light. The most effective POU treatment utilizes a combination of processes to remove a wide array of contaminants.

Activated carbon (AC) is perhaps the most universally used technology, primarily used to remove organic chemicals. The filters act as an adsorbant to remove or reduce levels of water contaminants that affect the taste and odor of water as well as harmful solvents, pesticides and hazardous chemical wastes. They can also reduce radioactive compounds, chlorine, DPBs and lead. It does not, however, remove harmful microbes. Costs range from $20 for a faucet filter to $600 for plumbed-in systems. Distillation purifies water by heating it to evaporation where it transforms into steam. Cooling the steam condenses the water back into liquid but inorganic contaminants (such as arsenic, lead and nitrate), in addition to some organic compounds, do not evaporate as quickly as water and are discarded from the system. Prices range from $80 for countertop units to $3,500 for continuous, large-capacity units.

Reverse osmosis is a process where water and contaminants are separated by passage through a thin semipermeable membrane. The membrane creates a barrier between water molecules and chemical or microbial contaminants as high pressure forces water through the membrane, leaving contaminants behind. RO systems can remove most bacteria, organics, metals and nitrate but are often used in succession with AC and UV light for increased efficiency and for removal of inorganic compounds. This multi-barrier approach eliminates a wide variety of contaminants that no single system can fully address. Prices range from $75 for mini portable units to an average price of around $400 for plumbed-in units. UV light utilizes radiation disrupting cellular DNA to kill microbes but is not utilized for removal of chemical contaminants. This treatment tool is generally used as a final step in RO systems to improve the efficiency of microbe removal originating from the source water or that may grow in the POU system over time. Costs average around $400–$500 for household systems.

All units require some level of routine maintenance, which may include cleaning and sanitizing and filter or light changes. In addition, some units require professional installation with associated labor fees.

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Illness prevention

Treatment of water at the point of use allows for removal of contaminants that might have entered the water during transport from public utilities or the premise plumbing. Thus, no matter how effectively water treatment plants remove waterborne contaminants, there is always the potential for recontamination in the distribution network. The US EPA's *Clean Water Act* and *Safe Drinking Water Act* are federal regulations aimed at controlling contaminants released into the environment that might impact water supplies and at monitoring and treating drinking water supplies to meet acceptable health standards, respectively. The primary concern of waterborne hazards is the risk of cancer and microbial infections. While the risk of waterborne illness is low in drinking water that meets *Safe Drinking Water Act* standards, system vulnerabilities exist and are often unpredictable.

Pathogenic microbes, including bacteria (*E. coli*, *Legionella*), viruses (rotavirus, norovirus) and protozoa (*Cryptosporidium, Giardia*), originate from either the natural environment or from human and animal wastes. Through surface runoff or disposal they can be transmitted to surface and groundwater used for drinking water supplies. Chemical contaminants from manufacturing processes (benzene, trichloroethylene, vinyl chloride), pesticide use (atrazine, alachlor), naturally occurring compounds (radon) and other hazards introduced from water treatment, storage and distribution (lead, chlorine byproducts, trihalomethanes), may find their way into drinking water supplies post-treatment by public utilities. In addition, consumers using untreated groundwater sources may be at increased risk of exposure to waterborne contaminants.

Each year in the US, a reported 33 drinking water outbreaks occurred from 2009–2010 resulting in 1,040 cases of illness and 85 hospitalizations.[1] Typically, this data reflects only a fraction of waterborne disease cases that result in the sick seeking physician diagnosis that leads to formal reporting to tracking agencies, like a state health department or the Centers for Disease Control and Prevention (CDC). Researchers estimate the true burden of waterborne disease to be closer to 19 million illnesses per year,

resulting in 1,000 deaths.[2,3] This burden of disease could be dramatically reduced if a final POU barrier were in place.

Benefits of POU

Proper use of well-maintained POU devices can improve one's quality of life by reducing risks of diarrheal disease and stomach upset related to exposure to waterborne pathogens. They may even be life-saving given that, in rare cases, microbial illness could result in hospitalization or death, particularly in immunocompromised populations (children, elderly, pregnant women and chronically ill persons). Further, POU devices can remove harmful carcinogens in water that lead to an increased risk of cancer deaths in the population. Despite state-of-the-art municipal water treatment facilities in the US, waterborne outbreaks and consistent health risks continue to exist. Common events such as frozen pipes in the winter, bacterial regrowth in the summer, periodic flooding, etc., can lead to contamination in the drinking water distribution system post-treatment. Unknown or intermittent events such as increased turbidity or power outages related to storms or natural disasters (earthquakes or hurricanes, mechanical problems, disinfection failures, line breaks or leaks, pressure differentials and random chemical or microbial contamination events) are primary causes of tap water hitches that could lead to human and animal health risks.

Conclusions

Although there are plenty of examples describing events where community or individual illnesses were traced back to tap water exposures (with some resulting in severe or fatal outcomes), these events are still considered rare given that we all consume one to three liters of water each and every day. It is the nature of this frequent exposure, however, that increases the risk of infection or cancer. Most exposures to waterborne contaminants do not result in anything more than mild stomach upset, but the severity of these health outcomes is unpredictable. POU devices provide a constant, predictable barrier against contaminants at the point of drinking water consumption and provide the best defense against waterborne contaminants.

References

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