Water recycling — forwards or backwards for public health?

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A stringent, preventive risk-management approach could ensure potable reuse is a safe option

As a result of prolonged drought, Australians are increasingly relying on alternative water sources — including rainwater, greywater, and water recycled from stormwater or sewage — for many community and household uses. Health professionals therefore need to be aware of the likelihood, if any, of illness related to water usage. In particular, careful consideration should be given to the safety of water recycling, especially as, at face value, it seems to represent a backward step from John Snow's mid 19th century discovery of the importance of keeping drinking water and sewage separate.[1] The obvious question is: is water recycling safe?

There are different types of recycling, and different end uses for recycled water. In Australia, recycled water is currently used for irrigation of parks, golf courses and certain crops, and by various industries. Increasingly, new housing developments are incorporating separate pipes to distribute two grades of water: drinking water, supplied to kitchens and bathrooms; and recycled water for outdoor purposes (garden watering, car washing) and limited indoor use (toilet flushing, sometimes in laundries). As these uses of recycled water should not involve intimate human exposure, they are generally considered to incur negligible health risks. However, plumbing errors or use of recycled water for unendorsed purposes could result in intentional or unintentional ingestion. Fortunately, no recognised disease outbreaks associated with these schemes have so far occurred, and the public seems to be tolerant of these forms of water recycling.

The more controversial issue relates to the potential health consequences of using treated recycled water to augment drinking water supplies (also called "potable reuse"). Australian water and health agencies have recognised the need for detailed technical guidance on minimising health risks from reuse schemes, resulting in production of the *Australian guidelines for water recycling* (AGWR).[2,3] Phases 1 and 2 of these guidelines have been endorsed by the Australian Health Ministers' Conference, and Phase 2 by the National Health and Medical Research Council (NHMRC). The AGWR recognise that the health consequences of system failure in a water recycling scheme could be catastrophic, with the potential for large gastroenteritis outbreaks, and that the greatest threat to public heath is from poor maintenance or poor quality control of water treatment processes. Consequently, the guidelines recommend proactive identification and management of risks, and include a "framework for management of recycled water quality and use".[2,3]

One of the framework's 12 elements involves undertaking a comprehensive risk assessment of each reuse scheme to determine the appropriate type and number of treatment steps required to "clean" the water. Another fundamental aspect of the framework is continuous monitoring of operational characteristics such as disinfection (chlorine concentration) and filtration (turbidity) that indicate water treatment processes are functioning efficiently. In other words, assuring adequate water quality is best achieved by monitoring the performance reliability and integrity of water treatment systems, and not by testing for all possible microbial or chemical contaminants.[2,3] This lack of reliance on water quality testing is likely to seem counterintuitive to clinicians; however, the degree of assurance provided by negative test results is constrained by detection limits and the representativeness of small water sample volumes. Water quality testing is thus better suited to providing verification of system performance rather than being used as a routine management tool.

There are two main issues raised by opponents of recycling schemes. First, they question whether water treatment processes can be guaranteed to always function effectively. This is a key focus of the AGWR, and it is essential that operators of potable reuse schemes have adequate skills and resources to provide the high level of quality control required to ensure safety. The second issue relates to adequate removal of chemical contaminants, given the large number of substances present in sewage (eg, hormones, pharmaceuticals, personal care products). This is a complex issue, particularly as the health consequences of low-level exposure to many of these substances are currently ill defined by toxicological and health data. The AGWR take a conservative approach to this issue and are consistent with international practices. Moreover, any incremental risks associated with potable reuse are likely to be negligible compared with other sources of direct exposure to these chemicals and with exposure from conventional drinking water supplies.

So what is the bottom line? Evidence shows that current public supplies of drinking water in Australian cities do not incur an increased risk of gastroenteritis.[4,5] Potable reuse is not yet occurring in Australia, but such water recycling schemes have existed internationally for more than 30 years, with schemes in Europe, the United States and Singapore having no recognised adverse health outcomes.[6] Gastroenteritis outbreaks are unlikely when water treatment processes are well managed, so clear guidelines supporting prospective implementation of a preventive risk-management framework are fundamental to ensuring the safety of potable reuse.[2,3] Health surveillance, although a relatively insensitive marker, can provide a retrospective indication of health outcomes associated with such schemes. The AGWR acknowledge that safety is not predicated on achieving zero health risk, but that there is an upper limit of tolerable risk (10^{-6} disability-adjusted life-years per person per year).[3]

The *Australian drinking water guidelines*, although now under review, currently contain no health-based target for microbial risk.[7] This means that more stringent requirements for water quality are currently applied to potable reuse schemes than to conventional drinking water. While not advocating for or against potable reuse, it is thus paradoxically possible that planned potable reuse could be among the safest approaches to the provision of drinking water.

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