



THEME

GPs and the environment



Joanne O'Toole

BAppSc, MBA, is a PhD scholar, Department of Epidemiology and Preventive Medicine, Monash University, and Cooperative Research Centre for Water Quality and Treatment, Victoria. joanne.o'toole@med.monash.edu.au

Karin Leder

MBBS(Hons), FRACP, MPH, is Head, Infectious Disease Epidemiology, Department of Epidemiology and Preventive Medicine, Monash University, and Cooperative Research Centre for Water Quality and Treatment, Victoria.

Martha Sinclair

BSc(Hons), is Senior Research Fellow, Department of Epidemiology and Preventive Medicine, Monash University, and Cooperative Research Centre for Water Quality and Treatment, Victoria.

Recycled water and human health effects

BACKGROUND

Recent drought conditions and diminishing drinking water storage levels in Australian capital cities have led to increasing attention being directed to water recycling and the use of alternative water sources for urban domestic use. Despite the 'in principle' acceptance by the Australian public for water recycling, support for proposed schemes is constrained by public perception of possible adverse health effects from exposure to micro-organisms and chemical contaminants.

OBJECTIVE

This article describes current research investigating the health impacts of using recycled water for urban nondrinking purposes.

DISCUSSION

Two complementary research approaches, quantitative microbial risk assessment and epidemiology, may be employed to assess health impacts of using recycled water for nondrinking or drinking purposes. The first of these approaches involves water quality monitoring and experimental studies. The second involves disease surveillance in which general practitioners may play a part.

Water recycling is a critical component of our efforts as a community toward a sustainable future. As a consequence of the imperative to address the issue of water recycling, innovative urban recycling schemes have been implemented, or are being planned, throughout Australia.

Despite the 'in principle' public support for water recycling in Australia, acceptance of recycled water schemes has been constrained by the perception of possible adverse health effects associated with exposure to recycled water.¹ Most people accept the use of recycled water for forage crops, creating wildlife habitats, and for industrial cooling purposes. However, recycling which involves intimate human contact such as irrigating golf courses and playgrounds, producing food crops, or some uses in the home (eg. laundry) has faced public resistance.²

Existing and proposed recycled water schemes include dual reticulation supplies, which distribute two grades of water through separate pipe networks. One grade of water is of high quality and is used for drinking, cooking

and other household purposes. The other is of lower quality and is used for nondrinking purposes such as toilet flushing, garden watering, fire fighting and industrial use. Recently, the scarcity of drinking water in some communities in Australia has led to proposals for indirect potable reuse, where highly treated wastewater is used to supplement sources of drinking water supplies. However, indirect potable reuse has not yet received widespread endorsement by Australian regulatory authorities and was rejected by residents of Toowoomba (Queensland) in a referendum held in 2006.³ Since the initial public rejection of the Toowoomba scheme, continuing drought conditions have led the Queensland government to proceed with plans for indirect potable reuse to supplement the Brisbane water supply without public endorsement through a referendum. The Australian Capital Territory government is also considering augmenting drinking water supplies with treated wastewater. Provision of recycled water for direct potable reuse, where treated wastewater is introduced directly into a water distribution system without intervening storage in a dam or aquifer, is currently

not being contemplated in Australia.

Appropriate communication with the public regarding the microbial safety of recycled water for specific domestic and urban use is needed. This will assist in the expansion of recycled and alternative water use to meet water sustainability targets. Information that allays public concern about the safety of recycled water is particularly important.

Potential health threats

The potential acute health threats that arise from the use of recycled water for urban nondrinking use are primarily those that relate to microbial waterborne disease. Other health concerns that might potentially arise from chronic exposure, such as carcinogenic, hormonal, heavy metal and radiological effects, are not as relevant when the nondrinking use of recycled water is contemplated because consumption of recycled water would at most, occur irregularly and inadvertently. If recycled water is to be considered for drinking purposes, these effects assume greater importance and need to be considered.

Surveillance

Existing surveillance systems are designed for early warning purposes and not to detect low levels of disease in a community. Therefore, using current Australian waterborne disease surveillance mechanisms, it is not possible to compare background disease levels between areas or populations with different water systems. Even waterborne outbreaks may not be detected by surveillance, particularly if small populations are exposed. Symptoms may be mild and self limiting and not warrant presentation to a doctor or laboratory confirmation of the causative micro-organism.

Reporting is incomplete for many notifiable illnesses, and many pathogenic organisms that can cause waterborne disease are not on the list of notifiable infections. Hence, it is only in circumstances where there are sufficient numbers of reports of the same disease or pathogen, at about the same time in the same locality, and where epidemiological investigations are initiated, that a waterborne outbreak (primarily gastroenteritis) is likely to be detected. As a consequence, failure of surveillance to detect disease in communities supplied with recycled water may provide a false sense of security about the potential for transmission of waterborne disease. This lack of sensitivity of surveillance mechanisms is also true in other industrialised countries such as the United States of America and the United Kingdom.⁴ Hence, specific health assessment investigations are required to assess whether there are any adverse health effects of recycled water use.

Health risk assessment

Quantification of the microbial health risk threats associated with recycled and alternative water used for domestic and urban purposes may be achieved using separate but complementary research approaches: epidemiological and/or quantitative microbial risk assessment (QMRA) methods.

Epidemiology provides information about characteristics and behaviours that may increase (or reduce) the risk of disease and a means to evaluate public health or therapeutic interventions. In epidemiological studies, the risks of illness in groups with differing degrees of exposure to the presumed risk factor are compared to determine whether the exposure is associated with adverse health outcomes. The merit of well conducted epidemiological research is that it can measure the actual effect on the population being exposed under real life conditions. Results of such studies have been successfully used to reduce uncertainty in risk assessment and in the evaluation of the beneficial effects of public health control measures.⁵ The disadvantage of epidemiological studies is that measuring health effects can be performed with only limited sensitivity. Therefore, in the context of researching health outcomes from using recycled water, it is possible that small increases in illness among exposed populations cannot be detected even by targeted epidemiological studies. Another disadvantage of this approach is the high cost, as recruitment of a large number of participants would be required.

Quantitative microbial risk assessment is a process that permits prediction of the risk associated with human exposure to specific micro-organisms. This contrasts with epidemiology where the focus is on clinical outcomes rather than specific pathogens. Estimation of risk is accomplished by using existing data to model and extrapolate what might be occurring in 'real life'. There are four broad steps to QMRA: hazard identification, dose response assessment, exposure assessment, and risk characterisation.

The merit of QMRA is that it can estimate very low levels of risk. However, there are major sources of risk assessment uncertainty which are difficult to estimate directly due to limitations of monitoring procedures and available data. Nevertheless, this method has been used in the development of recently released Australian national water recycling guidelines for nondrinking use⁶ and draft guidelines for augmentation of drinking water supplies.⁷

A number of research studies that address data gaps and contribute toward quantifying the health risk associated with the use of recycled water in an urban context are currently being performed by the Department

of Epidemiology and Preventive Medicine at Monash University and the Cooperative Research Centre for Water Quality and Treatment. These studies use a combination of epidemiological and QMRA approaches, comprising experimental studies, water quality surveys, questionnaires, and examination of health outcomes.

Experimental studies to refine input data for QMRA include:

- the investigation of the transmission of micro-organism in the laundry setting if contaminated water which simulates recycled water is used in washing machines
- determination of the survival of micro-organisms on recreational playing fields irrigated with recycled water at various time periods
- sizing of aerosols produced during domestic activities such as showering and toilet flushing
- measuring concentrations of endotoxin in recycled water and comparing these levels to those present in conventional drinking water supplies.

In addition, computer assisted telephone interviews and water activity diaries have been administered to residents of households in Rouse Hill, New South Wales who are supplied with recycled water for nondrinking purposes. This study will refine assessment of their exposure to recycled water, which is important for QMRA calculations. An epidemiological approach to detect adverse health outcomes among this same population is also being performed. This study involves examination of the reason(s) for presentation to a GP by residents supplied with recycled water compared to residents of a control area to determine whether the rates of presentation with symptoms that could plausibly related to exposure to pathogens in recycled water (ie. gastrointestinal, respiratory and dermal illnesses) are different.

Summary of important points

- Health effects research addressing the use of recycled water is important as recycled water will be increasingly used in the urban and domestic context.
- It is critical that the rationale for, methodology employed, and outcomes of such health effects research is effectively communicated to the Australian public.
- Two complementary research approaches, QMRA and epidemiology, may be employed to assess the potential health impact of recycled water used for drinking and nondrinking purposes. The first of these involves water quality monitoring and experimental studies. The second involves disease surveillance in which GPs may play a part.

Conflict of interest: none declared.

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