To: Felicia Marcus, via David Balgobin
Fm: Dr Edo McGowan
Re: The choice of an ND is inappropriate

I would appreciate some indication that this was forwarded to Felicia Marcus

The email I received from the SWRQB indicated the following:
The proposed General Order and Draft Initial Study/Negative Declaration are available at http://www.waterboards.ca.gov/water_issues/programs/land_disposal/waste_discharge_requirements.shtml.

Since recycled water as currently produced carries large numbers of antibiotic resistant microbes and their antibiotic resistant genes ARGs), a ND will not do and a full EIR needs to be under taken with testing of the water by a third party, say like Amy Pruden. This fact that recycled water as currently produced is full of pathogens is hardly new information. The US-EPA did a major study on this topic back in 1981, citing studies on the topic going back into the 1950s. I find it hard to imagine how your board could come up with an ND with this kind of history and material in the literature. It is not as if we have an abundance in workable antimicrobials. In fact we are running out of functional drugs while at the same time the bugs are gaining in resistance. Sewer plants and their production of these resistant orgainsms and their genes continue to pump out industrial volumes daily into the environment. Just for academic interest, It would be interesting to discuss this with you, I would welcome the opportunity.

BACKGROUND

Sewer plants by their design generate antibiotic resistant microbes and their genes. We and others have tested recycled water meeting state requirements. These tests have documented the fact that the finished recycled water carries multi-drug resistant bacteria and their genes. This information has been repeadly reported to the state (your board as well as CalEPA, and CDPH,) all apparently without effect. It should be recognized that because the ARGs are small. Genes are designed to fit through nuclear pores, the opening of which (functional diameter) is about 9 nanometers wide, but that is the size of the globular state but they can string out. Because they are not "alive" cells, but protein, they are unaffected by chlorine at contact times and concentrations typically used by plants producing recycled water. If you look at the screen sizes of filters typically used for recycled water, it will see that there is a large disparity and that's why we are finding ARGs in the finished recycled water. They are also essentially unaffected by UV. The effects of UV on antibiotic resistant organisms is discussed in the US-EPA report, where it actually enhances resistance and survival (see: http://aem.asm.org/content/43/2/371.full.pdf).

WERF documented that the finished and disinfected recycled water contained an array of pathogens (see WERF report 00-PUM-2T as well as the paper by Valerie Harwood---abstract appended below).

Our own work shows that while the water as first discharged from the plant to the purple pipes may meet Title 22 standard on indicator organisms, it contains many pathogens of which there is a mix of multi-drug resistance (see inserted picture)

Above picture is from the El Estero plant in Santa Barbara showing bacteria resistant to 11 of the 12 challenge antibiotics. Work done in medical microbiology lab on Muller Hinton agar, disk diffusion drops from Kirby Bauer.

If, in addition to testing as the water just leaves the plant we also test at the POU, we are finding with typical indicator using the MPN, that the numbers are off the chart and we are still picking up multi-drug resistant organisms. Something is going on in the pipes on the way to the POU. We opine that either or both of the following may be happening: resuscitation of viable but non-culturable (VBNC), bloom of persisters, or shedding of biofilms that grow in the purple pipes. The up-shot is this water is hardly safe. WERF found something similar with sewage sludge where 20 minutes following successfully meeting bacterial counts, testing again showed that the numbers jumped several magnitudes. Thus the standardized tests are throwing false negatives and this is a serious flaw that could adversely impact public health..

By giving your program an ND, the above issues are neatly covered up----something I would not

expect from a state agency charged with protection of public health.

Validity of the Indicator Organism Paradigm for Pathogen Reduction in Reclaimed Water and Public Health Protection†

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ABSTRACT

The validity of using indicator organisms (total and fecal coliforms, enterococci, *Clostridium perfringens*, and F-specific coliphages) to predict the presence or absence of pathogens (infectious enteric viruses, *Cryptosporidium*, and *Giardia*) was tested at six wastewater reclamation facilities. Multiple samplings conducted at each facility over a 1-year period. Larger sample volumes for indicators (0.2 to 0.4 liters) and pathogens (30 to 100 liters) resulted in more sensitive detection limits than are typical of routine monitoring. Microorganisms were detected in disinfected effluent samples at the following frequencies: total coliforms, 63%; fecal coliforms, 27%; enterococci, 27%; *C. perfringens*, 61%; F-specific coliphages, ~40%; and enteric viruses, 31%. *Cryptosporidium* oocysts and *Giardia* cysts were detected in 70% and 80%,

respectively, of reclaimed water samples. Viable *Cryptosporidium*, based on cell culture infectivity assays, was detected in 20% of the reclaimed water samples. No strong correlation was found for any indicator-pathogen combination. When data for all indicators were tested using discriminant analysis, the presence/absence patterns for *Giardia* cysts, *Cryptosporidium* oocysts, infectious *Cryptosporidium*, and infectious enteric viruses were predicted for over 71% of disinfected effluents. The failure of measurements of single indicator organism to correlate with pathogens suggests that public health is not adequately protected by simple monitoring schemes based on detection of a single indicator, particularly at the detection limits routinely employed. Monitoring a suite of indicator organisms in reclaimed effluent is more likely to be predictive of the presence of certain pathogens, and a need for additional pathogen monitoring in reclaimed water in order to protect public health is suggested by this study.

FOOTNOTES

- Received 27 September 2004.
- Accepted 20 December 2004.

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Reclaimed water as a reservoir of antibiotic resistance genes: distribution system and irrigation implications.

Fahrenfeld N[1], Ma Y, O'Brien M, Pruden A.

Author information

Abstract

Treated wastewater is increasingly being reused to achieve sustainable water management in arid regions. The objective of this study was to quantify the distribution of antibiotic resistance genes (ARGs) in recycled water, particularly after it has passed through the distribution system, and to consider point-of-use implications for soil irrigation. Three separate reclaimed wastewater distribution systems in the western U.S. were examined. Quantitative polymerase chain reaction (qPCR) was used to quantify ARGs corresponding to resistance to sulfonamides

(sul1, sul2), macrolides (ermF), tetracycline [tet(A), tet(O)], glycopeptides (vanA), and methicillin (mecA), in addition to genes present in waterborne pathogens Legionella pneumophila (Lmip), Escherichia coli (gadAB), and Pseudomonas aeruginosa (ecfx, gyrB). In a parallel lab study, the effect of irrigating an agricultural soil with secondary, chlorinated, or dechlorinated wastewater effluent was examined in batch microcosms. A broader range of ARGs were detected after the reclaimed water passed through the distribution systems, highlighting the importance of considering bacterial re-growth and the overall water quality at the point of use (POU). Screening for pathogens with qPCR indicated presence of Lmip and gadAB genes, but not ecfx or gyrB. In the lab study, chlorination was observed to reduce 16S rRNA and sul2 gene copies in the wastewater effluent, while dechlorination had no apparent effect. ARGs levels did not change with time in soil slurries incubated after a single irrigation event with any of the effluents. However, when irrigated repeatedly with secondary wastewater effluent (not chlorinated or dechlorinated), elevated levels of sul1 and sul2 were observed. This study suggests that reclaimed water may be an important reservoir of ARGs, especially at the POU, and that attention should be directed toward the fate of ARGs in irrigation water and the implications for human health.

KEYWORDS:

antibiotic resistance genes, irrigation, reclaimed water distribution systems, water reuse
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