Max A. Zarate-Bermudez, PhD

Enhancing the Public Health Perspective on Onsite Wastewater Systems

Editor's note: NEHA strives to provide up-to-date and relevant information on environmental health and to build partnerships in the profession. In pursuit of these goals, we feature a column from the Environmental Health Services Branch (EHSB) of the Centers for Disease Control and Prevention (CDC) in every issue of the Journal.

In this column, EHSB and guest authors from across CDC will highlight a variety of concerns, opportunities, challenges, and successes that we all share in environmental public health. EHSB's objective is to strengthen the role of state, local, and national environmental health programs and professionals to anticipate, identify, and respond to adverse environmental exposures and the consequences of these exposures for human health. The services being developed through EHSB include access to topical, relevant, and scientific information; consultation; and assistance to environmental health specialists, sanitarians, and environmental health professionals and practitioners.

The conclusions in this article are those of the author(s) and do not necessarily represent the views of the Centers for Disease Control and Prevention.

Max Zarate-Bermudez is an epidemiologist who joined CDC in June 2008. Previously, he was an assistant professor of environmental health at East Carolina University in Greenville, North Carolina, where he taught safe water and wastewater management courses.

In 2007, approximately 20% of U.S. households—60 to 65 million Americans—were served by some type of onsite wastewater (OWW) system (American Housing Survey, 2008). We expect these systems to safely disperse treated household wastewater into the soil and help to recharge aquifers. But these systems have been associated with groundwater contamination and are possibly a threat to public health. Our knowledge of the performance of OWW systems remains inadequate. Thus, we need to enhance the public health perspective on OWW systems by better understanding their performance through

- developing monitoring methodologies, and
- conducting epidemiologic studies to determine their impact on human health.

Most OWW systems in the United States are conventional systems (see Figure 1). Data on performance of these systems and their components are limited. Hoover, Rubin, & Humenik (1998) reported that OWW systems result in desirable levels of treatment. Only a few researchers, however, have reported on the quality of wastewater entering or leaving septic tanks without assessing performance of these systems (Valiela et al., 1992; Viraraghavan & Hashem, 1986). Levels of solids, organic matter, nutrients, microorganisms, and other constituents of raw wastewaters and effluents are unknown for conventional and alternative OWW systems, making it difficult to determine the overall performance of these systems.

Groundwater Contamination

A review of studies conducted over the last several decades suggests a link between OWW systems and groundwater contamination (Ahmed, Neller, & Katouli, 2005; Harris, 1995; Vaughn, Landry, & McHarrell, 1983; Viraraghavan & Warnock, 1976). Studies that support those findings have focused on

- movement of wastewater discharged into the dispersion field to explain how groundwater contamination occurs (Starr & Sawhney, 1980), and
- aquifer recharge and the quality of drinking water coming from groundwater sources (Sworobuk, Law, & Bissonnette, 1987).

A study in Florida focused on how OWW systems may affect the quality of surface waters and groundwater under the influence of surface water (Paul, Rose, Jiang, Kellogg, & Shinn, 1995). Contamination of surface water in urban settings is normally associated with housing density and high fecal bacteria counts associated with malfunctioning OWW systems. Effluents from these systems are dispersed into the soil; therefore, they must be characterized for a thorough investigation of potential links to groundwater contamination.

Approximately 45 million Americans (about 15% of the U.S. population) are served by either small water systems or private wells (U.S. Environmental Protection Agency, 2006). These systems are not regulated under the *Safe Drinking Water Act*; therefore, people might unknowingly be exposed to contaminated drinking water. People served by both private wells and OWW systems might be at greater risk because of the possibility that effluent disposed into the soil might reach the groundwater.

Data on the occurrence of waterborne disease outbreaks associated with drinking water have been gathered and published by the Centers for Disease Control and Prevention (CDC) since 1971. Data since 2002 reveal that the percentage of outbreaks associated with drinking water from private wells has not declined, although that percentage has fluctuated (Table 1). Occurrence of these outbreaks reveals that drinking water systems in the United States can be vulnerable to contamination. Although current statistics do not reflect the true incidence of waterborne illness, outbreak surveillance provides the following information:

- important waterborne pathogens, and
- risks associated with water sources and treatment processes.

Possible Links to Disease

Published studies on outbreak investigations and epidemiologic studies that link OWW systems to disease causation are still limited. The following are examples of such studies.

- Raina, Pollari, Teare, Goss, Barry, & Wilson (1999) found that people whose systems are located closer to their private wells experienced less gastrointestinal illness, suggesting that they might have acquired immunity.
- Rates of gastrointestinal illness symptoms between long-term and new residents in rural areas served by private wells were compared (Strauss, King, Ley, & Hoey, 2001). The authors found that rates for long-term residents were lower than those for new residents.
- A case-control study by Borchardt, Chyou, DeVries, & Belongia (2003) found that OWW system density was associated with endemic diarrheal illness in children in central Wisconsin.
- The Environmental Health Services Branch (EHSB) of CDC funded an external study to investigate the potential link between OWW systems and human exposure to wastewater pathogens in New Mexico. Findings suggested that having an onsite private well and a septic system may increase the risk for *Cryptosporidium* infection (Tollestrup, Frost, Kunde, Jackson, & Yates, 2006).
- *Salmonella* infection was associated with the use of a private well as a drinking water source in a matched case-control study that assessed risk factors for childhood sporadic enteric infections in three Washington State counties (Denno et al., 2009). Findings also linked *Salmonella* and *E. coli* O157 infections to the use of OWW systems.

FIGURE 1

Components of Conventional Onsite Wastewater Systems

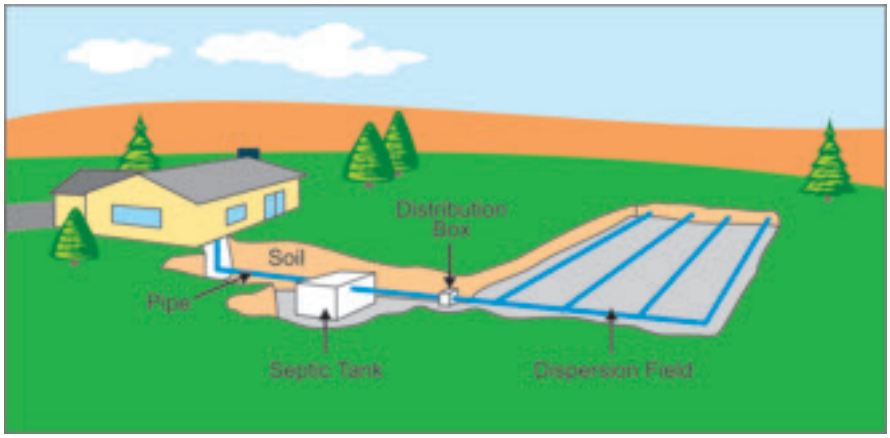

TABLE 1

Review of Waterborne Disease Outbreaks (WBDOs) Associated with Drinking Water from Private or Noncommunity Wells[a]

Date	% (npw/nT)b	Reference
1999–2000	46 (18/39)	Lee, S.H., Levy, D.A., Craun, G.F., Beach, M.J., & Calderon, R.L. (2002). Surveillance for waterborne-disease outbreaks—United States, 1999–2000. *MMWR 51(SS-8),* 1–48.
2001–2002	29 (9/31)	Blackburn, B.G., Craun, G.F., Yoder, J.S., Hill, V., Calderon, R.L., Chen, N., Lee, S.H, Levy, D.A., & Beach, M.J. (2004). Surveillance for waterborne-disease outbreaks associated with drinking water—United States, 2001–2002. *MMWR 53(SS-8),* 23–45.
2003–2004	17 (5/30)	Liang, J.L., Dziuban, E.J., Craun, G.F., Hill, V., Moore, M.R., Gelting, R.J., Calderon, R.L., Beach, M.J., & Roy, S. (2006). Surveillance for waterborne-disease outbreaks and outbreaks associated with drinking water and water not intended for drinking—United States, 2003–2004. *MMWR 55(SS-12),* 31–58.
2005–2006	30 (6/20)	Yoder, J., Roberts, V., Craun, G.F., Hill, V., Hicks, L., Alexander, N.T., Radke, V., Calderon, R.L., Hlavsa, M.C., Beach, M.J., & Roy, S.L. (2008). Surveillance for waterborne-disease outbreaks and outbreaks associated with drinking water and water not intended for drinking— United States, 2005–2006. *MMWR 57(SS-9),* 39–69.

[a] Data from the *Morbidity and Mortality Weekly Report Surveillance Summaries* published between 2002 and 2008.
[b] n_{pw} = number of WBDOs associated with private or noncommunity wells; n_T = total number of WBDOs reported to CDC.

The need for enhancing the public health perspective on OWW systems remains. We could start by developing science-based methodologies for monitoring the performance of OWW systems. EHSB is committed to working with environmental public health and research partners to contribute to the better understanding of OWW system performance and to minimize the potential risks to human health.

Corresponding Author: Max A. Zarate-Bermudez, Epidemiologist, Environmental Health Services Branch, Division of Emergency and Environmental Health Services, National Center for Environmental Health, CDC, 4770 Buford Highway, N.E., M.S. F-60, Atlanta, GA 30341. E-mail: mzarate-bermudez@cdc.gov.

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