



MMWRTM

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Surveillance Summaries

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Surveillance for Waterborne Disease and Outbreaks Associated with Drinking Water and Water not Intended for Drinking — United States, 2003–2004

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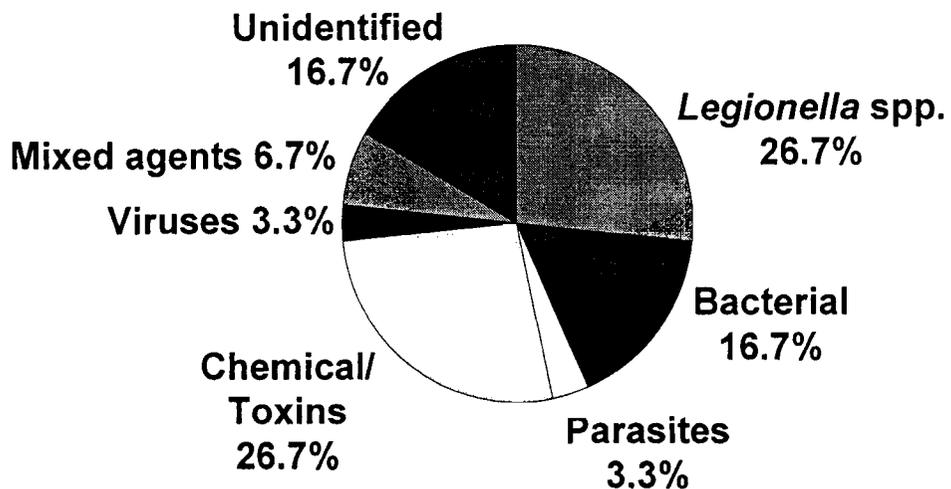
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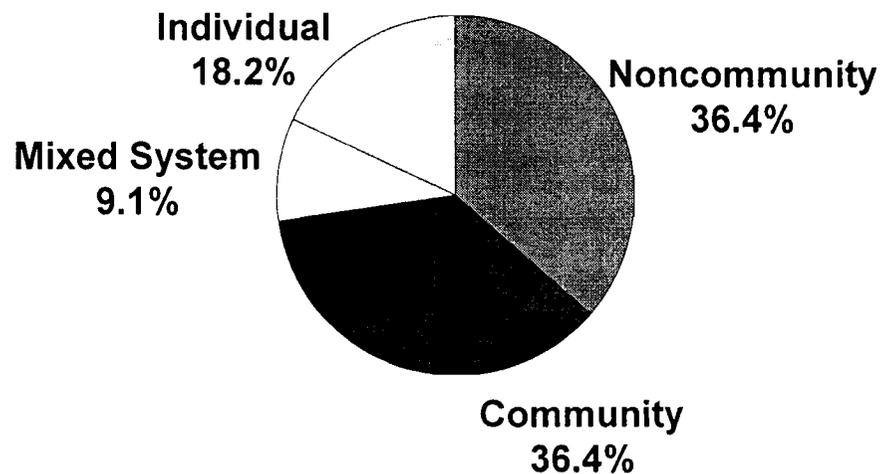
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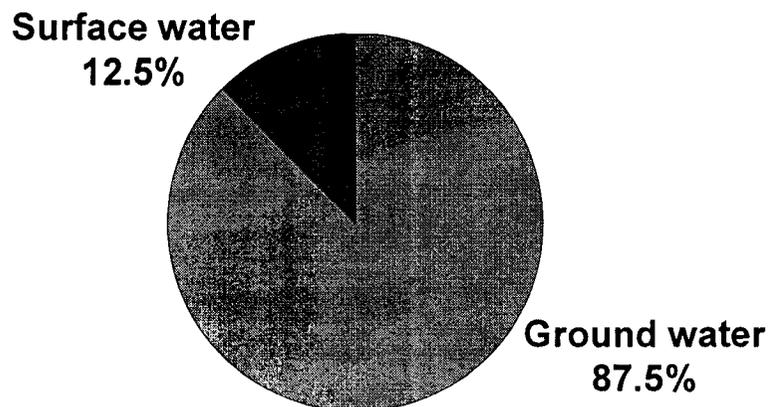
Etiologic agent (n=30)



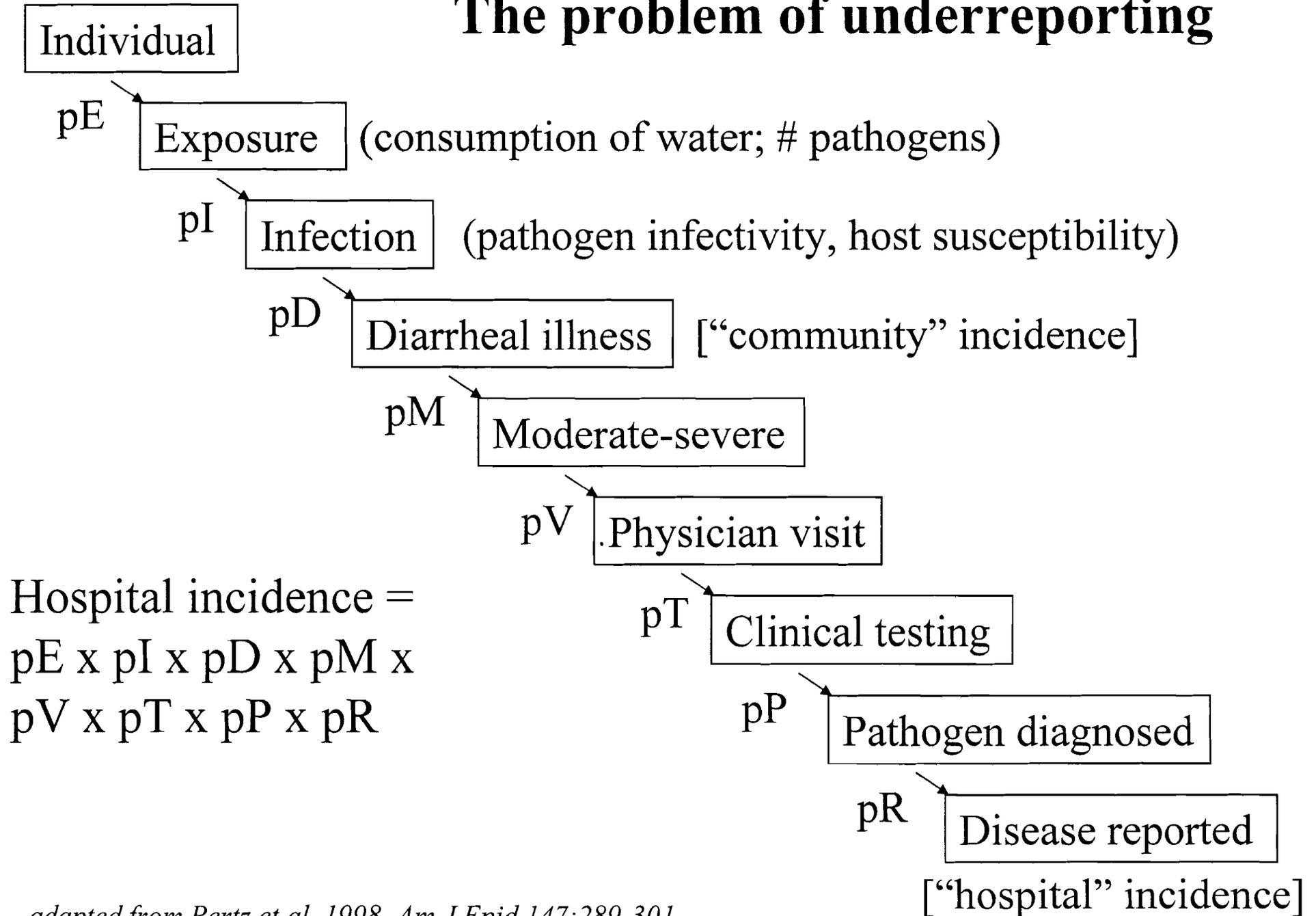
Water system (n=11)



Water source (n=8)



The problem of underreporting



adapted from Pertz et al. 1998. *Am J Epid* 147:289-301

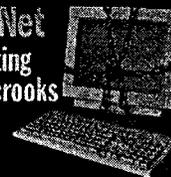
Canada's Weekly Newsmagazine

Maclean's

June 12, 2000 www.macleans.ca \$4.50

The Rocket
Celebrating a Legend

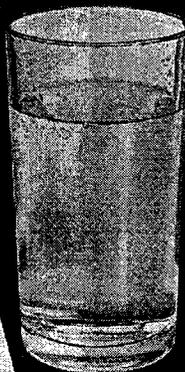
The Net
Fighting
Cyber-crooks



Beyond Walkerton

When

KILLS

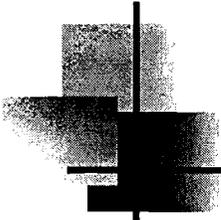


Factory farms: Mountains of deadly waste
Who's taking your water: A province-by-province breakdown

\$4.50



24



Walkerton, Ontario - 2000

May 12: Torrential downpour washes bacteria from CAFO into well

May 17: Complaints of bloody diarrhea, vomiting, cramps, fever

May 18: Tests of water sampled May 15 reveal *E. coli* contamination, but not notified

May 21: Independent testing, boil-water advisory.

May 22: First death directly linked to *E. coli*.

May 23: *E. coli* O157:H7 recognized. Two-year-old girl dies, > 150 people seek hospital treatment, another 500 have symptoms.

May 24: Two more die.

May 25: Fifth person dies. At least four children in critical condition.

May 29: Sixth death.

May 30: Seventh death.

Examples of causative agents of documented outbreaks from contaminated groundwater	Microbes/chemicals discharged in wastewater that are suspected to contaminate groundwater
<p>Pathogens:</p> <p><i>E coli</i> O157</p> <p><i>Campylobacter</i> spp.</p> <p>Norovirus</p> <p><i>Giardia</i> spp.</p> <p><i>Salmonella typhimurium</i></p> <p><i>Cryptosporidium parvum</i></p> <p><i>Entamoeba</i> spp.</p>	<p>Microbes & associated products:</p> <p>Opportunistic pathogens</p> <p>Antibiotic resistance genes</p> <p>Virulence genes</p> <p>Toxins</p>
<p>Chemicals:</p> <p>Pesticides</p> <p>Arsenic & selenium</p> <p>Nitrate</p> <p>Petroleum products</p> <p>TCE, Benzene & others</p>	<p>Chemicals:</p> <p>Antibiotics</p> <p>EDCs</p> <p>PCPs</p>

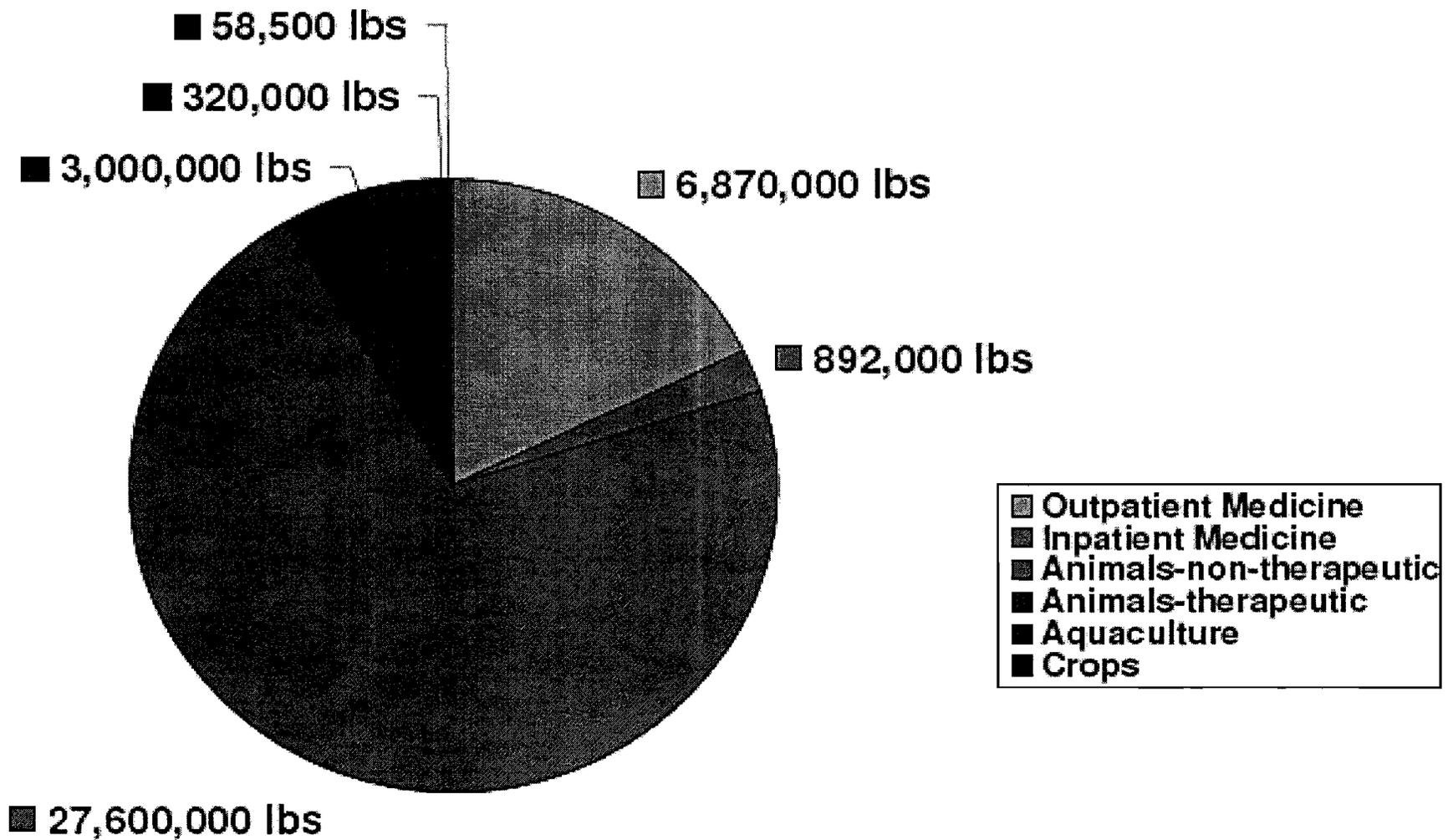
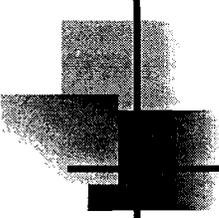
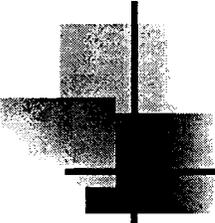


Figure 2.2 Annual U.S. antibiotic use for all applications.



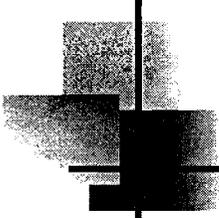
What are the causes of WBDOs

- No treatment (contaminated source water)
- Breakthrough at treatment plant (faulty treatment practices)
- No disinfectant residual (no protection in the distribution system)
- Direct sewage contamination through pipe leakage, breakage, back-siphoning, cross-connections



A multibarrier approach

- Watershed protection that minimizes anthropogenic and wildlife impacts on source water
- A treatment system with sufficient capacity to maintain adequate pressure throughout the distribution system for 24 hours/day
- A rigorous program to upgrade distribution system networks and prevent interconnections through leakage, backflushing, improper hydrant use, etc.



Groundwater is our Source Water

- The more we discharge untreated or minimally treated wastewater to our groundwater supplies, the more sophisticated (and expensive) our treatment systems will need to be to protect public health
- Treatment does not address most chemicals, antibiotics, PCPs, etc.
- Many microbes are increasingly resistant to treatment
- Source water protection is therefore our most critical barrier

Massive Microbiological Groundwater Contamination Associated with a Waterborne Outbreak in Lake Erie, South Bass Island, Ohio

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BACKGROUND: A groundwater-associated outbreak affected approximately 1,450 residents and visitors of South Bass Island, Ohio, between July and September 2004.

OBJECTIVES: To examine the microbiological quality of groundwater wells located on South Bass Island, we sampled 16 wells that provide potable water to public water systems 15–21 September 2004.

METHODS: We tested groundwater wells for fecal indicators, enteric viruses and bacteria, and protozoa (*Cryptosporidium* and *Giardia*). The hydrodynamics of Lake Erie were examined to explore the possible surface water–groundwater interactions.

RESULTS: All wells were positive for both total coliform and *Escherichia coli*. Seven wells tested positive for enterococci and *Arcobacter* (an emerging bacterial pathogen), and F⁺-specific coliphage was present in four wells. Three wells were positive for all three bacterial indicators, coliphages, and *Arcobacter*; adenovirus DNA was recovered from two of these wells. We found a cluster of the most contaminated wells at the southeast side of the island.

CONCLUSIONS: Massive groundwater contamination on the island was likely caused by transport of microbiological contaminants from wastewater treatment facilities and septic tanks to the lake and the subsurface, after extreme precipitation events in May–July 2004. This likely raised the water table, saturated the subsurface, and along with very strong Lake Erie currents on 24 July, forced a surge in water levels and rapid surface water–groundwater interchange throughout the island. Landsat images showed massive influx of organic material and turbidity surrounding the island before the peak of the outbreak. These combinations of factors and information can be used to examine vulnerabilities in other coastal systems. Both wastewater and drinking water issues are now being addressed by the Ohio Environmental Protection Agency and the Ohio Department of Health.

KEY WORDS: *Arcobacter*, groundwater, microbiological contamination, outbreak, viruses, waterborne. *Environ Health Perspect* 115:856–864 (2007). doi:10.1289/ehp.9430 available via <http://dx.doi.org/> [Online 6 February 2007]

Contaminated groundwater is the most commonly reported source of waterborne disease in the United States, associated with 64% of the drinking water outbreaks between 1989 and 2002. In recent national figures (2001–2002), groundwater sources constituted 92% of the outbreaks, which often occurred in small communities (Blackburn et al. 2004). A large groundwater-associated outbreak in the Great Lakes basin occurred between June and September 2004 on South Bass Island, Ohio, affecting approximately 1,450 individuals (both residents and visitors) [Ohio Environmental Protection Agency (EPA) 2005]. The present study was undertaken to investigate the groundwater quality on the island and the factors associated with the contamination event.

South Bass Island is located in Ottawa County, Ohio, off the southern coast of Lake Erie, and approximately 5 mi from the Canadian border (Figure 1). South Bass Island is one of the main tourist destinations in the Midwest and has the nickname “Key West of the Midwest.” Most bars and restaurants on the island are located in the village of Put-in-Bay,

which is the largest community on the island; Put-in-Bay has a permanent population of 350 and up to 25,000 visitors/day during the tourist season. Potable water on the island is provided through a number of public and private water systems. A public water system was defined by the Ohio EPA (2005) as a system that has at least 15 service connections or regularly serves an average of at least 25 individuals daily at least 60 days of the year.

The village of Put-in-Bay is served by a municipal public water system that uses primarily treated surface water from Lake Erie. However, many businesses and the majority of residents on the island use untreated groundwater pumped from wells on their premises as their primary source of potable water. There are approximately 13 transient noncommunity public water systems and small businesses on the island that use wells to meet their water needs. According to the Ohio EPA (2005), transient noncommunity public water systems are water systems that do not regularly serve at least 25 of the same persons over 6 months of the year (e.g., restaurants, campgrounds, gas stations).

During the time of the outbreak, South Bass Island used three main types of wastewater disposal systems: a) the village of Put-in-Bay operated a publicly owned treatment works (POTW) that served the village; b) some of the businesses on the island were served by small package wastewater treatment works with aeration; and c) on-site wastewater treatment works, such as septic tanks, mound systems, subsurface sand filters, and holding tanks served most of the unincorporated areas of the island. The small package (or semipublic) wastewater treatment plants (WWTPs) are privately owned facilities that are regulated the same as POTWs by the Ohio EPA. All POTWs on South Bass Island discharge treated effluent to Lake Erie and are regulated by the Ohio EPA under a National Pollutant Discharge Elimination System (NPDES) permit. Under Ohio NPDES permits (Ohio EPA 2005), sanitary sewage treatment systems are allowed to discharge with a daily fecal coliform bacteria limit of 2,000 colony-forming units (CFU)/100 mL with a design flow of < 5,000 gal/day if they do not discharge directly into an Ohio river.

Description of the outbreak. On 2 August 2004, the Ottawa County Health Department (OCHD) in Ohio received several telephone calls from persons reporting gastrointestinal illness after visiting South Bass Island. A foodborne disease outbreak investigation was initiated by the OCHD and the Ohio Department of Health (ODH). On 12 August 2004 the Ohio EPA was informed about a possible waterborne outbreak and began an

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The authors declare they have no competing financial interests.

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