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The Importance of Clinicians and Community Members Receiving Timely and Accurate Information about Waterborne Hazards

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Abstract

It is important for clinicians and community members to receive up-to-date information about the microbiological and elemental composition of local water supplies. Clinicians play an important role in helping their patients to interpret water quality data and understand the potential impact of water quality on their health. Expanding the medical school curriculum to include environmental health, public health, and health disparities—including disparities related to environmental quality and waterborne hazards—is key to clinicians' fulfilling this role.

Introduction

Physicians often use information from public health agencies to optimize care for their patients. For example, data about the prevalence of pathogenic and environmental exposures can influence a clinician's index of suspicion and inform decisions about which laboratory tests should be ordered to screen patients for a hazardous exposure or illness.

Although the US has one of the safest public drinking water supplies in the world, sources of drinking water can still become contaminated and lead to adverse health effects [1]. Water contamination can occur as a result of industrial effluents (e.g., from pulp and paper mills, steel plants, and food processing plants), municipal sewage treatment plant overflows, storm-water and sewage overflows, and agricultural runoff (e.g., pesticides, fertilizers, and pathogens) [2]. For example, in 2014, an industrial solvent contaminated West Virginia's Elk River and 15 percent of the state population's tap water [3]. Along the coast, toxic algae blooms (cyanobacteria) and bacterial contamination in shellfish occur each year in warmer months [4]. Moreover, water supplies and water distribution systems are potential targets for terrorist activity [2].

Ensuring water quality and safety in the US requires the participation of the medical community. However, the majority of health care professionals have received limited training in the recognition and evaluation of waterborne disease from intentional contamination of water [5] and in the adverse health effects of water pollution [1]. In this article, we consider the importance of clinicians and community members receiving up-to-date information about the microbiological and elemental composition of local

water supplies. We argue that clinicians have an important role to play in helping their patients to interpret water quality data and to understand the potential impact of water quality on their health.

Timely and Accurate Information about Waterborne Hazards and Why Physicians Need It

The Centers for Disease Control and Prevention (CDC) provides health alerts, health advisories, and updates through the Health Alert Network [6], which is designed for use by members of the public health and medical communities. Outbreak investigation reports appear in the *Morbidity and Mortality Weekly Report*, which is designed for the same communities and published with a rapid turnaround time, enabling tracking of new disease outbreaks [7]. Public health officials in the 50 states, the District of Columbia, and US territories voluntarily report outbreaks of recreational water-associated illnesses to the CDC. During the period 2011-2012, for example, 90 recreational water-associated outbreaks—resulting in at least 1,788 patients, 95 hospitalizations, and one death—were reported in the CDC's Waterborne Disease and Outbreak Surveillance System [8]. *Cryptosporidium* caused 52 percent of the outbreaks associated with treated recreational water venues (e.g., pools, hot tubs). *Escherichia coli* O157:H7 and O111 caused 33 percent of outbreaks associated with untreated recreational water (e.g., lakes, ocean beaches) [8]. During the period 2011-2012, 32 drinking water-associated outbreaks accounting for at least 431 cases of illness, 102 hospitalizations, and 14 deaths were reported to CDC, with *Legionella* being responsible for 66 percent of outbreaks and 26 percent of illnesses [9].

The medical and public health professions play important roles in helping community members to interpret information about water quality and to understand the data's potential impact on their health. Factors such as the time of year, chronological progression of cases, and constellation of symptoms and whether an occurrence is isolated or clustered with other cases can influence clinicians' index of suspicion. This information helps clinicians determine which laboratory tests and imaging studies should be ordered to rule in or out potential causes for a clinical presentation.

Ethical Implications of Clinicians and Community Members Not Receiving Timely and Accurate Information about Waterborne Hazards

According to the American Medical Association's Principles of Medical Ethics, physicians "shall … apply … scientific knowledge … [and] make relevant information available to patients … and the public" [10]. These professional obligations are hindered when clinicians and community members do not receive timely and accurate information about waterborne hazards. The ethical implications of physicians not receiving timely information about waterborne hazards and of government officials deliberately withholding such information are illustrated by the Flint, Michigan, water crisis. In 2014 Flint switched its municipal water supply from Lake Huron to highly corrosive Flint River

water and did not treat the water with an anticorrosive agent, causing lead from the pipes to leach into the water [11]. For 18 months, the people of Flint were drinking water contaminated with lead while government officials were downplaying the seriousness of the problem [12]. Lead exposure, especially in young children, can cause irreversible harm including brain and nervous system damage, slowed growth and development, and learning, behavioral, and speech problems [13]. Finally, after research revealed a significant incidence of elevated pediatric blood levels, Genesee County declared a public health emergency in Flint [13]. Taylor et al. [13] described urgent efforts to provide continuing professional education at Hurley Medical Center in Flint to ensure that clinicians were equipped to address the environmental health crisis. In such situations, the professional role of physicians includes ordering appropriate tests and interpreting information about waterborne environmental hazards for patients so that they can take steps to protect themselves. These professional obligations relate to the ethical obligation of physicians to minimize risks and potential harm to their patients. Thus serious ethical problems arise when physicians do not receive timely and accurate information about waterborne hazards because of the actions or inaction of government officials or when they do not have sufficient training to interpret information about waterborne environmental hazards.

Delays in receipt of timely and accurate information also raised ethical concerns in the Freedom Industries chemical spill in West Virginia. In January 2014, coal-cleaning chemicals, such as 4-methylcyclohexane methanol (MCHM) leaked from Freedom Industries in Charleston, West Virginia, and flowed into West Virginia American Water's intake in the Elk River [14]. Shortly before noon on January 9th, state Department of Environmental Protection inspectors alerted West Virginia American about the spill. But the information flow was confusing and contradictory, according to a US Chemical Safety Board report [15]. Initially, the water company was told the material that spilled was a flocculant, or a coagulant, and that only 1,000 gallons, a relatively small amount, had been released into the river. West Virginia American thought its plant could easily treat the chemical it was told Freedom had spilled [15]. The water company soon learned that the leak was of a "frothing agent," something that Freedom sold to the coal industry to help it separate coal from rock. Shortly after, the water company began receiving revised estimates of the size of the spill and later noted its impact.

> The DEP [state Department of Environmental Protection] provided a new estimate that showed the leak could have been of more than 5,000 gallons. Still later, that estimate would grow to 10,000 gallons—and the public would learn that chemicals other than MCHM were involved.… "Shortly before 4 p.m., the water company determined that the filters did not fully remove the chemical," the CSB [Chemical Safety Board] reported. The water company told the state Bureau for Public Health and Gov. Earl Ray Tomblin's office that the chemical "was detected in the

> water beyond the filters and that the water distribution system might be contaminated." At about 6 p.m., residents were advised to not drink their tap water or use it for cooking or bathing [15].

Tap water use was banned for days across nine counties. The ensuing state of emergency closed schools and businesses. Hundreds of people went to emergency rooms for nausea, vomiting, rashes, and similar issues after breathing near, bathing in, or drinking contaminated water [16], illustrating the importance of physicians being trained in how best to respond to public health emergencies related to environmental disasters and waterborne hazards.

In the Freedom Industries chemical spill as in the Flint water crisis, a lack of accurate and timely information about health hazards during an environmental disaster impaired the ability of physicians to minimize risks and potential harm to their patients. Such problems can lead to the erosion of community member trust in company representatives, physicians, and government officials.

Improving Public Health and Health Disparities Education in Medical School Curricula

Although physicians can play an important role in interpreting water quality data and helping their patients understand the potential impact of water quality on their health, many physicians do not have sufficient public training to enable them to respond to illnesses related to water contamination. One solution is expanding the medical school curriculum to include training in how best to respond to public health emergencies and about the root causes of health disparities, including disparities related to environmental quality and waterborne hazards [17, 18]. Such training could provide physicians with an improved understanding of social and environmental causes of diseases and with strategies for identifying and ameliorating waterborne hazards. For physicians, the link between the public health community and the medical community should be forged during medical school [17]. However, epidemiology and population health only comprise 1-5 percent of the United States Medical Licensing Examination® (USMLE®) Step 2 Clinical Knowledge exam [19]. Instead, much of the focus of the medical school curriculum is on disease pathophysiology, diagnosis, and treatment [17]. This emphasis is also reflected in the first and second parts of the USMLE, which focus on organ systems, normal and abnormal processes, and therapies. Yet, as exemplified by the case studies included in this article, the causes of health disparities extend beyond disease pathophysiology to include social determinants of disease at multiple levels (e.g., individual, neighborhood, community, health care system, public policy). Thus a greater emphasis is needed on social determinants of disease in medical education as well as on epidemiologic and public health knowledge and insights pertaining to emergency response to environmental disasters and waterborne hazards. As noted by Finkel, "Disparities based on race/ethnicity, socioeconomic status, geography, and other factors continue at unacceptably high levels" [20]. Disparities based on environmental quality, such as

waterborne hazards, have a great impact on health. Indeed, poor environmental quality has the greatest impact on the health of those who are already at risk [21].

Medical schools have begun to address disparities based on environmental quality in several ways. Incorporation of screening techniques, receiving basic public health training, and partnership with accredited programs have all been suggested [18]. In the case of waterborne hazards, physicians with public health knowledge would be better equipped to look for timely and accurate information and to adjust their practice based on the most recent evidence.

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