

Lessons Learned From the Crisis in Flint, Michigan Regarding the Effects of Contaminated Water on Maternal and Child Health

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ABSTRACT

The Flint, Michigan water crisis raised awareness about the dangers of lead-tainted drinking water and the role of the nurse in addressing such a crisis. Although lead exposure is dangerous for all people, research indicates that pregnant and nursing women and their infants are especially vulnerable to prenatal and postnatal lead exposure. This information is of national importance because of the aging infrastructure of American cities and the likelihood of similar problems in other locations.

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In 2016, the media spotlight on Flint, Michigan revealed an American tragedy that soon could be repeated in other cities across the nation as the crumbling water treatment and filtration systems and aging pipes that comprise the water infrastructure decline. Government hearings are being held to identify the root cause(s) and determine those individuals and agencies responsible for the contamination of the water supply of the nearly 100,000 people who live in the heart of the economically declining Midwestern rust belt. Social economists reported on Flint's demographics and its failing postindustrial economy (with 40% of the population at the poverty level) and proposed solutions to the problems uncovered. Regardless of the results of these hearings, Flint's citizens will continue to be harmed by lead toxicity for decades to come.

The Tragedy in Flint

On April 25, 2014, the residents of the city of Flint, Michigan began to use water from the Flint River to save money by terminating a contract with Detroit to use treated and filtered water from Lake Huron. Complaints about the quality of the water began the next month. A stay-at-home mother of

four children was especially vocal about the decline in Flint's water quality and reported to her pediatrician that her children developed skin rashes and experienced hair loss after using Flint River water (Guyette, 2015). Other Flint residents and business owners also voiced concerns about the water, and after months of requests from citizens, local physicians, nurses, and other health professionals, the U.S. Environmental Protection Agency (EPA) finally tested Flint's water and found dangerously high lead levels that put the health of pregnant women and children at risk for short- and long-term health problems. When an independent expert on clean drinking water tested the water in Flint, he reported a lead level of 13,200 ppb, more than twice the amount at which the EPA classifies water as hazardous waste (Guyette, 2015).

When high levels of lead were discovered in Flint tap water, a Flint pediatrician and her research team conducted a review of blood lead levels (BLLs) for children younger than 5 years before 2013 and after the 2015 water source change. Incidences of elevated BLLs increased from 2.4% to 4.9% after the water source change, and some neighborhoods had increases in BLLs as

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The American College of Obstetricians and Gynecologists acknowledged that adverse effects of lead exposure in children and adults are being identified at lower levels.

high as 6.6% (Hanna-Attisha, LaChance, Sadler, & Champney Schnepf, 2016). Hanna-Attisha et al. (2016) concluded that the percentage of children with elevated BLLs increased after the water source change, particularly in socioeconomically disadvantaged neighborhoods. Although these researchers were told by state and government officials that their findings were incorrect and that the water was safe, the gravity of the environmental threats ultimately was recognized. On October 16, 2015, the governor of Michigan allowed Flint to switch back to its use of water from Detroit and announced a state of emergency. Shortly thereafter a federal emergency was declared by President Barack Obama.

Currently, bottled water is abundant because of donations from churches, celebrities, professional nursing service organizations such as Chi Eta Phi Sorority, Inc., relief agencies, and local and national charities. However, many childbearing women, teens, and children are being tested for lead toxicity, kidney disease, Legionella, skin conditions, and other health problems associated with exposure to the contaminated water. Unfortunately, because of the nature of lead storage in the body, Flint's residents will face the effects of the water crisis for years to come.

The Dangers of Lead Exposure

Lead is a dangerous toxin. According to the Agency for Toxic Substances & Disease Registry (2007), the main target for lead toxicity is the nervous system in adults and children. Elevated levels of lead (≥ 10 $\mu\text{g}/\text{dl}$) pose detrimental health effects that include delirium, seizures, stupor, coma, or death. Signs and symptoms of lead toxicity may manifest as hypertension, behavioral changes, decreased concentration, peripheral neuropathy, ataxia, tremor, headache, loss of appetite, weight loss, fatigue, muscle and joint aches, gout nephropathy lead colic, and anemia. In addition, symptoms of chronic low lead levels in adults include cognitive decline, hypertension, cardiovascular effects, decline in renal function, and unfavorable reproductive outcomes. The nervous systems of children and developing fetuses are most susceptible to the damaging effects of this neurotoxin (American College of

Obstetricians and Gynecologists, 2012). For laboratory values and symptoms of acute and chronic lead poisoning, see Table 1.

Vulnerable Populations

Although the damaging effects of lead exposure are well known, research shows that the way lead is stored in the body makes prenatal and postnatal lead exposure especially dangerous for pregnant women, fetuses, lactating mothers, and nursing infants. Lead exposure during pregnancy and breastfeeding can have lasting adverse maternal and infant health effects that are distinct from exposure during other life stages, including the ability to become pregnant, to maintain a healthy pregnancy, and to have a healthy infant (Centers for Disease Control and Prevention [CDC], 2010).

Approximately 99% of the lead taken into an adult's body will be excreted in waste within a couple of weeks compared with only about 32% of the lead taken into a child's body (Agency for Toxic Substances & Disease Registry, 2007). Additionally, childhood lead exposure can later affect women in their childbearing years because lead stored in the bones during prior exposure is mobilized in pregnancy and lactation and can be released into maternal blood and breast milk and adversely affect the fetus and infant (CDC, 2010). Nicholson and Cleeton (2016) reported that great strides have been made to reduce the prevalence of childhood lead exposure. Policy changes reflect a continuous reduction in the identified BLL that requires public health initiatives to reduce and monitor a child's lead level exposure. In the 1960s the public health initiatives were not initiated unless a child's BLL was 60 $\mu\text{g}/\text{dl}$; that changed to 30 $\mu\text{g}/\text{dl}$ in 1975, 25 $\mu\text{g}/\text{dl}$ in 1985, and 10 $\mu\text{g}/\text{dl}$ in 1991. The Advisory Committee on Childhood Lead Poisoning Prevention recommendation in 2012 was 5 μg or more of lead per deciliter of blood as an unhealthy exposure. Presently, the CDC reference value (>5 $\mu\text{g}/\text{dl}$) is the standard for identification of children with elevated BLL. Children who live in housing built before 1978 in poverty-stricken areas are at an additional risk because of the existence of lead-based wall paint.

The American College of Obstetricians and Gynecologists (ACOG, 2012) stated that prenatal lead exposure has known adverse effects on maternal health and infant outcomes across a wide range of maternal BLLs. ACOG

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