

## Lead Pollution in Flint, Michigan, U.S.A. and Other Cities

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### ABSTRACT

Flint, Michigan was recently faced with lead contamination that affected 6,000-12,000 children. The contamination led to the death of 10 people as a result of Legionnaires' disease. Exposure to lead has long term health effects including neurological problems in children, kidney failure and cancer. The contamination in Flint, MI was due to the leaching of old lead pipes into the water supply system. The problem started when the authorities switched the water supply from the Detroit Water and Sewerage Department to the Karegnondi Water Authority. The river water required more chlorine as compared to the lake water and hence the cause of the lead leaching. The problem could have been solved earlier had the authorities responded timely to the concerns of the users about the changes in the water color and odor. Some officials were found to have falsified the tests and test results. The State and Federal governments finally intervened with promises to remove all the lead pipes. The US President approved the provision of funds and personally visited the city. Several law suits were filed but the nature of the legislation made it difficult for the top officials to be prosecuted. Four officials were, however, dismissed with one being prosecuted. The problem can be attributed to negligence. Other cities have also faced similar lead water pollutions including Washington DC, Durham NC, Greenville MS, Sebring OH and Columbia SC. The research methodology involved the use of secondary sources for data collection and analysis.

### KEYWORDS

Lead contamination, water quality, pollution level, drinking water, Flint

### ARTICLE HISTORY

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## Introduction

Water quality is an important aspect that determines if the water is portable. Pollution or contamination of drinking water can cause serious health effects to the users. In Flint Michigan, the residents were faced with serious challenges as a result of lead pollution. The water supply was polluted by lead, leading to negative health effects for the residents (Laidlaw et al., 2016). Lead is one of the heavy metals that have negative human health effects. Lead

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pollution changes the quality of water which leads to changes in the color, smell and taste of the water. One of the major sources of lead pollution of water is through the corrosion of the lead pipes. In many municipal water supplies including that of Flint, MI, lead pipes which had been installed for over a century were still in use. Lead pipes were used in water supplies because they were inexpensive. Proper treatment of water ensures that pollution is avoided as the corrosion is preventable. In Flint MI, the problem started in 2014 when the water source was changed from the Detroit Water and Sewerage Department to the Flint River (Markel, 2016). The water from the Detroit Water and Sewerage Department was mainly sourced from the Detroit River and Lake Huron.

Corrosion inhibitors were not applied in the water from the Flint River which led to the corrosion of the lead pipes. The water from the Flint River was corrosive and it caused lead from old pipes to leach into the water supply resulting in lead pollution of the water. The lead pollution affected about 12,000 children as a result of consuming and using the water (Laidlaw et al., 2016). It is estimated that the pollution led to an elevation of blood-lead levels among the children to 5%, a level that is above permissible limits and that causes serious health effects. The presence of such a high level of lead in blood affects the body organs such as the kidney and consequent poor health. The lead pollution problem in Flint MI caught the attention of former President Barack Obama who declared it a federal state of emergency (Markel, 2016). The president was also critical of the officials responsible for the problem through acts of negligence. Lead pollution is not limited to Michigan and has occurred in other cities in the USA as well as in different parts of the world. In some instances, it has caused a high number of deaths as well as serious health effects. This paper thus discusses lead pollution primarily in Flint, MI, USA and other cities as well as the measures taken by the government to correct and mitigate the problem.

## Literature Review

### *Lead pollution in Flint Michigan*

In Flint, MI, some of the pipes used to supply water to the residents were made of lead. Most of the lead pipes were installed over a century ago with no changes made. The lead pipes are usually inexpensive and durable which contributed to its large scale use in most of the water supplies in different parts of the USA. One of the main weaknesses of lead pipes is the ability of lead to leach into water in the presence of specific contaminants (Schnoor, 2016). In the water supply, the presence of lead as a result of leaching is not a problem as long as it is within the acceptable limit. In Flint, MI, the water was sourced since 1967 from the Detroit Water and Sewerage Department. The water from the Detroit Water and Sewerage Department was well treated which played an essential role in preventing the leaching of lead. The treatment of water ensures that contaminants are removed and hence preventing the chemical reactions that cause the leaching of lead. In Flint MI, there were about 3,500 lead lines which supplied water to thousands of people (Washington & Foster, 2016). The decision to switch water sources was made in 2013 after a vote of 7-1 by the Flint City Council. This was after the development of the Karegnondi Water Authority in 2011. The Authority sourced water from the Flint River and supplied water to Genesee, Flint, Lapeer and Sanilac Counties in Michigan.

The Flint City County approved the purchase of 16 million gallons of water per day from the Authority. The political leadership was in support of the decision despite protest by the Detroit Water and Sewerage Department. The Department indicated through a press release that the decision would lead to water wars. The Detroit Water and Sewerage Department was accused of negotiating through the media and attempting to impose an agreement on one community at the expense of the other (Jones, 2016). The Department was thus forced to terminate its services to Flint. The final decision to switch the water supply was made in 2014 with an investment of \$ 4 million. However, shortly after the switch, the residents started complaining of the odor and color of the water (Fig. 1). Initially, the problem was not known and it was assumed to be a result of bacterial activity. This was after some bacteria were found in the water. Boiling water advisories were issued with the Michigan Department of Environmental Quality highlighting that the problem with the water could be the result of old pipes and cold weather (Binns & Wah, 2016). The other indicators of corrosion of the lead pipes started to emerge from different users of the water. General Motors was one of the companies that complained of the water quality as it was corroding some of their car parts. The employees of the Flint Public Library also declared the water undrinkable after the color of the water started to change. Initially the city officials kept insisting that the water was safe for drinking.



**Figure 1.** Water sample after the switch, source, <[www.motherjones.com/politics/2016/01/mother-exposed-flint-lead-contamination-water-crisis](http://www.motherjones.com/politics/2016/01/mother-exposed-flint-lead-contamination-water-crisis)>

Tests that were conducted indicated that the water had a high Trihalomethanes (THMS) content. THMS is a byproduct of chlorine which is commonly used as a disinfectant during the treatment of water. The byproduct was above the permissible limit which exposes the users to the risk of cancer. The tests were, however, conflicting with further tests by the city in January



2015 indicating the water met the set quality standards (Hopwood et al., 2016). The Emergency Manager for the City of Flint declined an offer to reconnect Flint to the Detroit Water and Sewerage Department. The officials advised Michigan Governor Rick Snyder that the water was safe and was not a threat to the members of the public. More complaints from the users followed despite insistence from the Authority that the water was safe. High blood-lead levels were however found in children 18 months after the water switch (Fig. 4). This led to concerns that the water could be responsible for the high levels of lead. Dr. Mozghan Savabieasfahani, an environmental toxicologist found that the river water had high chloride levels as compared to that of the lake that was the initial water source (Fig. 5). The high levels of chlorine caused the leaching of the old lead pipes resulting in the lead problem (Kirchhoff, 2016). Following these revelations, there appeared to be evidence of a cover up as the officials filed reports indicating that the tests did not show that the water had high lead levels. It was later discovered that the officials had disregarded the federal rules for water testing. Testing by other laboratories confirmed that the water had high lead levels.

The city had no choice but to switch back to the lake water supply from Lake Huron which was by then under a new water Authority. The investigations revealed that the officials mishandled the situation despite the concerns that had been raised by members of the public. The Flint Mayor was forced to declare the problem a public health emergency in December 2015. The county started distributing bottled water and water filters to the users. Different personnel were involved in dealing with the emergency including the Health Department, Homeland Security and the Police (Schlieber & Stacey, 2016). Michigan Governor Snyder declared the problem a state of emergency in 2016. President Obama also declared a federal emergency in January 2016. This was for the purpose of protecting the health, safety and welfare of the residents. Federal financial aid was provided for emergency assistance. Former President Obama authorized the provision of \$ 5 million in federal aid. The President was critical of the officials whose negligent acts contributed to the problem. The political class including the presidential candidates for the Democratic and Republican Parties condemned the officials. The President visited Flint in May 2016 to reassure the residents that the problem is under control and he even tasted the water for confirmation (Fig. 2) (Hanna-Attisha, et al., 2016). It was estimated that the replacement of the lead pipes as well as repairs would cost up to \$ 1.5 billion. Charity groups and different non-governmental organizations made contributions to assist the affected families.



**Figure 2.** Former President Obama sipping the filtered water in Flint to reassure residents, Source, SkyNews

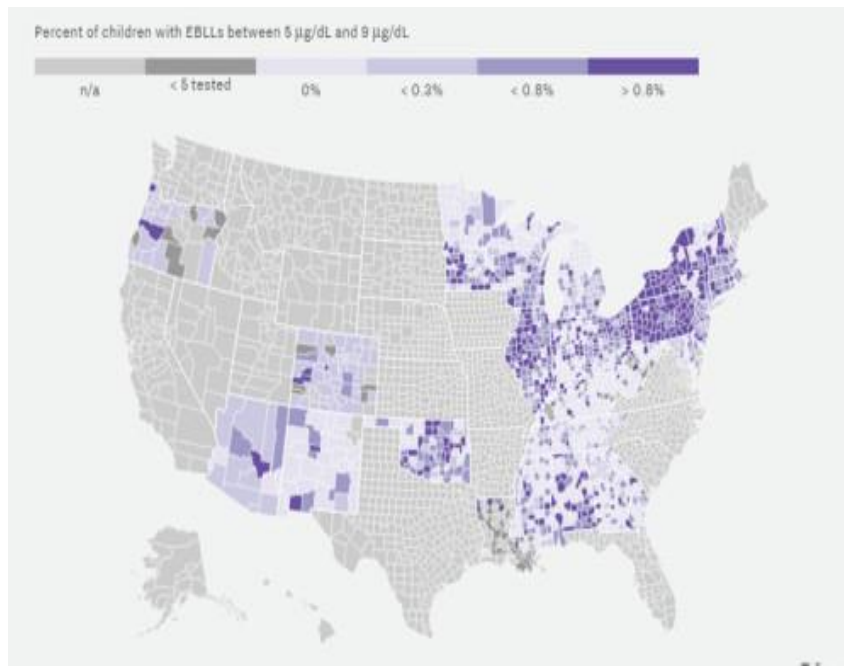
Estimated 6000-12000 children were exposed to lead as a result of the problem. The exposure to high levels of lead usually results in serious health problems including increased risk of cancer. There was an outbreak of Legionnaires' disease which was blamed on the lead polluted water. The disease resulted in the death of 10 people with 77 others being affected (Mielke, 2016). Four government officials resigned as a result of the crisis. One member of the Michigan Department of Environmental Quality was fired for mishandling the crisis. Another member of the Department has a termination hearing pending before the court. The Governor was forced to apologize over the incident with promises of immediately solving the problem. Criminal charges were filed against three officials for various offences (Ryder, 2016). The officials were charged for misconduct, violation of the Safe Drinking Water Act, negligence and conspiracy to tamper with evidence. One of the officials accepted a plea deal and admitted to filing false information about the lead levels. Several law suits have been filed by different groups including the families of the affected children. The effects of exposure to high levels of lead have resulted in problems such as autoimmune disorders, skin lesions and brain fog among exposed persons. Damages to the kidney and liver are among the major effects of exposure to high lead levels. The serious health effects of lead poisoning contribute to early death.

### ***Lead poisoning in other cities***

Lead pollution of water supply is not a new problem in the USA. Other cities have faced similar problems in the past (Fig. 3). Lead contamination of drinking water was discovered in Washington D.C in 2001. It was blamed on the use of chloramines in public drinking water which contributed to the leaching of lead into the water to levels that were 83 times higher than permissible limits (Ryder, 2016). The decision by the authorities to change from the use of chlorine to chloramines was responsible for the problem. Investigations indicated that there was misreporting of the lead levels in the drinking water. The lead contamination left thousands of children with health risks. It was found that



lead has the ability to disrupt the development of fetuses, mental and physical development of children as well as high blood pressure among the children. In 2005, Columbia, the largest city in the State of South Carolina was also faced with lead problem that affected thousands of children (Hanna-Attisha et al., 2016). The problem of lead in the cities can be attributed to old pipes and the chemicals that are used in water treatment. Although the problem mainly affects the children who consume lead polluted water, the authorities are usually reluctant to admit to the problem for fear of being forced to take responsibility. This is a trend that was noted in Columbia, SC just like in other cities such Washington DC and Flint MI.



**Figure 3.** Map of lead exposure in different states, Source, [www.wbur.org/onpoint/2016/01/18/flint-water-crisis--lead-poisoning-nationwide](http://www.wbur.org/onpoint/2016/01/18/flint-water-crisis--lead-poisoning-nationwide)

Tap water was found to be the source of lead in Durham, North Carolina in 2006 after 800 ppb of lead was found in tap water that led to the poisoning of a child. This was attributed to a corroded solder in the tap as there was no other sources of lead in the child's home. However, unlike in the other cities, there were no lead pipes in Durham and Greenville. The lead pollution was attributed to the change in coagulant chemicals used in the treatment of water to clear the natural turbidity (Gostin, 2016). The authorities had changed the chemicals from alum to ferric chloride. This altered the sulfate ratio leading to corrosion. The children are the main victims in cases of lead poisoning. In 2015, Jackson Mississippi and Sebring Ohio also reported cases of lead poisoning. In Jackson MS, the authorities were blamed for poorly handling the crisis. The members of the public were informed not to drink the water six months after the crisis. This is an indication that the authorities are usually reluctant to disclose the problem

despite the negative health effects for the water consumers. In Sebring Ohio, the problem was witnessed after the authorities reportedly stopped adding corrosion curbing chemicals to the water (Kausahal, 2016). The residents continued to consume the lead polluted water for about five months before the problem was solved. During the period, a high number of children and pregnant women consumed the water leading to negative health effects.

### ***Efforts by the government to correct the situation***

The response by the state and federal governments was slow in addressing the problem in Flint MI. The Flint Mayor estimated that fixing the infrastructure will require up to \$ 1.5 billion. The Michigan Governor asked the legislature to provide Flint an additional \$28 million for purchasing filters and replacing filter cartridges. President Obama approved \$80 million loan to Michigan for the purpose of repairing the infrastructure to correct the situation. US congressional legislation to provide \$ 400 million from the appropriation fund, however, failed in the US Senate. The Flint Mayor indicated that 15,000 water services lines containing lead pipes would be removed (Gostin, 2016). The Lansing Board of Water and Light which had carried out a similar activity in Lansing, MI was appointed to provide technical advice. Rowe Professional Services was hired to locate, remove and replace lead pipes in the high risk areas in Flint. A grant of \$ 2 million was provided by the State of Michigan to enhance the process of replacing the lead service lines. A Michigan Legislative representative sponsored legislation to ensure compliance and improved awareness regarding the water quality. Legislation that will see officials who intentionally falsify or manipulate information to face up to five-year imprisonment and \$ 5,000 fine was proposed (Markel, 2016). This was because the existing laws shielded the officials from prosecution and in the case of Flint there was intentional manipulation of the results. The authorities reversed their earlier decision to use the water from the Flint River and switched back to water from Lake Huron.

### **Research Methods and Methodology**

The collection of data used in the paper was carried out through the use of secondary sources. Secondary sources of data collection involve the use of existing sources (Baskarada, 2014). This may include books, journals as well as the internet. However, only credible journals and reliable internet sites were used in the collection of data for this paper. The validity of the information is useful for research. In order to achieve validity and reliability, only recent articles that were published no more than 5 years ago were used during the collection of the data. The journals that were used in the data collection involved qualitative and quantitative research articles. The qualitative articles were mainly used for obtaining the statistical information while the quantitative ones mainly provided explanations regarding the problem and its extent. High levels of ethics were maintained during the process of collecting the information. This was for the purpose of ensuring that the collected data are reliable and credible. The presentation of the data was carried out through the use of figures, charts and table in order to clarify the statistical information. The data collection was however, limited to certain cities in the USA with much focus placed primarily on Flint, MI.



## Results and Discussion

The lead pollution in Flint MI has negative health outcome on 6,000-12,000 children. The pollution was directly linked to the political decision to switch the water supply from the Detroit Water and Sewerage Department to the Flint River. The river water required the use of a high amount of chlorine for treatment. It is the use of the chemicals that led to the corrosion of the old lead pipes leading to the lead contamination of the water. The action of the Authority can be labeled as negligent as they failed to act despite the overwhelming evidence of lead pollution. The use of lead pipes had been banned in the USA about 30 years ago but its use continued (Laidlaw et al., 2016). The negligent action of the authorities led to the prolongation of the problem. Although some officials were fired and one was charged, the political leadership was also to blame for the decision. The pollution led to the outbreak of Legionnaires' disease that killed 10 people and affected an additional 77 individuals. The problem of lead pollution has been experienced in other cities in the USA. The use of certain chemicals as well as the failure to use the appropriate chemicals contributed to the problem. Although there were lawsuits against the officials and the political leaders, there was no financial compensation of the affected persons due to the nature of the law. Legislations were put in place as well as control measures to mitigate future occurrences.

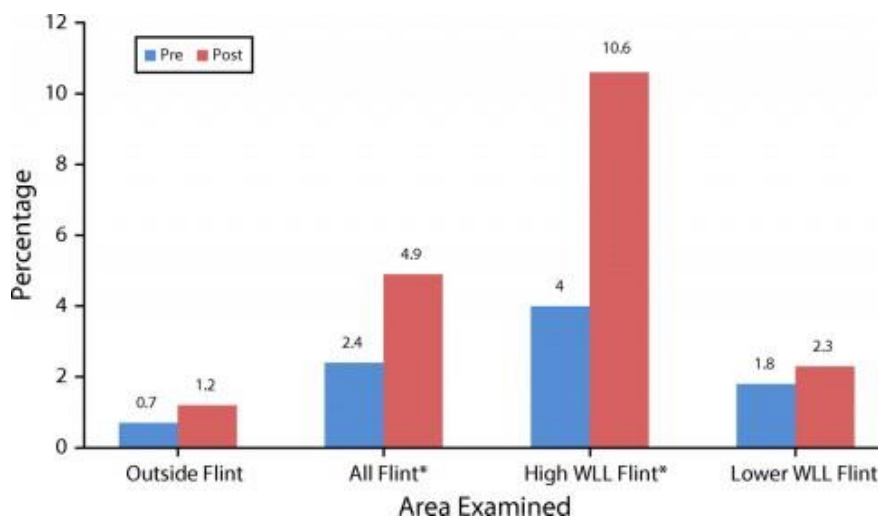


Figure 4. Lead levels in Flint before and after the switch, Sources, Science-Based Medicine

The problem attracted condemnation from various members of the society including the President and other political leaders (Ryder, 2016). The Flint problem indicated that lead pollution is a major threat to the health and safety of the consumers. It highlights how negligent the authorities can be when providing vital products and services to the residents. The reaction from the state as well as the federal government, however, indicated that there was a lot of public concern about the issue. The problem could have been easily avoided if the officials had listened to the concerns of the residents as well as other

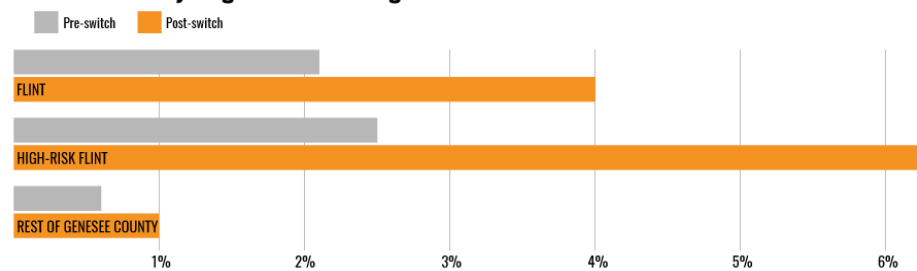


experts. The water users are the main victims of lead poisoning despite playing no role in the decision making process. The measures that were put in place were long overdue as the lead pipes had already been banned. Additional legislation is required to promote accountability by officials who act in negligent manners that jeopardize public health and well-being.

**One in six Flint homes has lead levels above the EPA's action level...**



**...and the rate of young children with high blood lead levels has soared.**



**Figure 5.** Comparison of lead-blood levels in Flint and Detroit water, Source, <[www.flintwaterstudy.org](http://www.flintwaterstudy.org)>

Since the Flint lead problem was not the first in USA, the authorities could have been more proactive in their decisions to prevent the occurrence of the same. This however did not happen and it appears the authorities were afraid of admitting the problem. The children who consumed the contaminated water are likely to suffer for a long period of time which is an indication of the severity of the problem (Ryder, 2016). It is only prudent for the authorities to offer free treatment as well as compensation to the affected individuals. The personnel who acted negligently including the political leaders should be held accountable. Maintaining and determining the water quality at both the point of treatment and consumption can be useful in the early detection of such a problem. It is also important that all lead pipes be replaced and more funds be provided by the state and federal governments to resolve the problem and to ensure the long-term health monitoring of the affected children.

## Conclusion

In conclusion, it is evident that lead contamination poses a serious health problem to children and pregnant women. The consumption of polluted water contributes to long term health problems. It led to the death of 10 people due to the outbreak of Legionnaires' disease. The Flint lead problem was a result of negligence by those in position of authority. The pollution could have been avoided if safety standards were adhered to. The early replacement of the century old lead pipes could have avoided the problem and its hazardous outcomes. The refusal by the authority to admit to the issues as well as the falsification of the results massively contributed to prolonging the problem. It is



evident that other cities in the USA have had lead pollution of their drinking water. The use of some of the chemicals contributes to the corrosion of pipes leading to leaching of lead into the water. The actions of the authorities were reactive as opposed to being proactive. However, it is evident that the problem caught the attention of the US President who visited the city and provided some federal funds to support the process of managing the problem. It is evident that the existing legislations, however, shield high ranking government officials from persecution for negligence. It is evident that the replacement of the lead pipes could prevent a similar problem in future. The proposed legislations, if enacted, may force those in positions of authorities to act more responsibly as they can be held accountable for their actions or inactions.

### Disclosure statement

No potential conflict of interest was reported by the authors.

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