

# How ZIP codes nearly masked the lead problem in Flint

September 20 2016, by Richard Casey Sadler

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I write this as we approach the first anniversary of my involvement in the [Flint Water Crisis](#), an ongoing catastrophe and basic failure of government accountability that will soon approach three years.

On Sept. 25, 2015, I received a call from my colleague – the now-renowned [Dr. Mona Hanna-Attisha](#) – asking if I could run some basic [spatial analysis](#) of [blood lead](#) data collected from area pediatric clinics. I had heard rumblings that [blood lead levels were on the rise](#) in Flint but that [state officials were pushing back](#) against her findings.

My job was to examine blood lead data from our local [Hurley Children's Hospital](#) in Flint for spatial patterns, or neighborhood-level clusters of elevated levels, so we could quash the doubts of state officials and confirm our concerns. Unbeknownst to me, this [research project](#) would ultimately help blow the lid off the water crisis, vindicating months of activism and outcry by dedicated Flint residents.

As I ran the addresses through a precise parcel-level [geocoding](#) process and visually inspected individual blood lead levels, I was immediately struck by the disparity in the spatial pattern. It was obvious Flint children had become far more likely than out-county children to experience elevated blood lead when compared to two years prior.

How had the state so blatantly and callously disregarded such information? To me – a [geographer](#) trained extensively in geographic information science, or computer mapping – the answer was obvious

upon hearing their unit of analysis: the ZIP code.

Their ZIP code data included people who appeared to live in Flint and receive Flint water but actually didn't, making the data much less accurate than it appeared.

ZIP codes – the bane of my existence as a geographer. They confused my childhood friends into believing they lived in an entirely different city. They add cachet to parts of our communities (think 90210) while generating skepticism toward others relegated to less sexy ZIP codes.

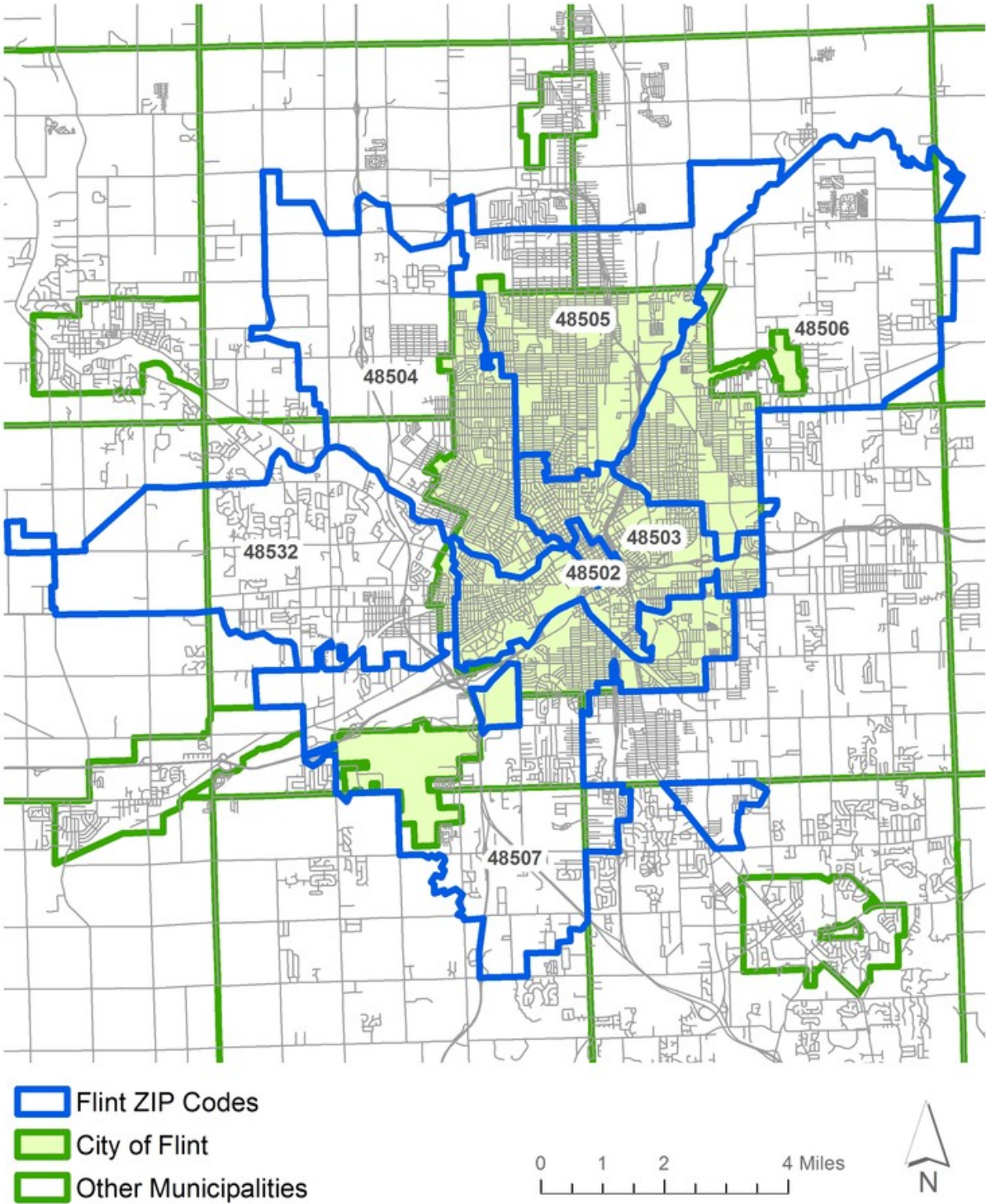
Dr. Tony Grubestic, an Arizona State University professor, has called them "one of the [quirkier 'geographies'](#) in the world." Dr. Nancy Krieger, a Harvard University professor, and colleagues have called out their [unacceptability](#) for small-area analyses.

If I were to have simply summarized blood lead statistics by ZIP code, the pattern would not have been striking. The state, having done just this, incorrectly concluded that the change in water source had no discernible effect on Flint children.

Why exactly were ZIP codes so poorly suited to analyzing the Flint water crisis? I will share some reasons and argue that public health researchers should move away from a sole reliance on ZIP codes, or at least admit the shortcomings of ZIP code analysis.

## **When the boundaries don't line up**

### Misalignment between Flint ZIP Codes and City of Flint



ZIP codes and city boundaries of Flint do not align.

In Flint's case, the state's error was introduced because "Flint ZIP codes" do not align well with the city of Flint or its water system. The city and water system are almost 100 percent coterminous – that is, they share the same boundaries.

One-third of all homes with a Flint ZIP code lie outside the city. Thus, the state's numbers for Flint were watered down by an additional 50 percent of addresses that weren't in the city and weren't using Flint water. This is referred to in geography as the [modifiable areal unit problem](#).

Of the residential ZIP codes with Flint mailing addresses, only 48502 and 48503 lie completely within the city. ZIPs 48504, 48505, 48506 and 48507 are split between the city of Flint and outlying municipalities. ZIP 48532 contains very few homes actually in the city of Flint. In total, Flint ZIP codes used in the state's analysis blanket parts of eight different municipalities (seven townships and one city) surrounding Flint.

That the solution to this error was as simple as pinpointing patient addresses rather than relying on ZIP codes is both frightening and appalling. It reflects a fundamental ignorance of geography and a tendency to uncritically accept numbers at face value. While analysis by ZIP code tends to be the default analysis when public health professionals and researchers make a foray into mapping, more and more research in the past two decades has suggested that the reliance on ZIPs may be misplaced.

**Why are ZIP codes insufficient measures for**

## geographically specific phenomena?

The folly reflects an all-too-common reliance on arbitrary boundaries for defining public health issues. ZIP codes have recently garnered attention as being a [key determinant of health](#), curbing the old idea that biology was the primary director of one's health.

The idea behind "why ZIP codes matter" is that where you live influences your opportunities to conduct a healthy lifestyle. While this emphasis on neighborhood-specific effects is important (and has been the focus of urban planning and geographical inquiry for decades), the use of ZIP codes can mask more local issues.

To be truly useful as units of analysis for defining neighborhood effects on health, any geographic area should be relatively homogeneous in terms of its social and built environmental characteristics. But unlike postal codes in other countries which represent small areas suitable for in-depth geographic inquiry (Google "N6C 2B5" for a Canadian example), ZIP codes are woefully unqualified as units of analysis.

## Created for mail, not health care, delivery

The ZIP – or Zone Improvement Plan – code was designed by the [U.S. Postal Service in 1963](#) as a logistical solution to sorting the mail in growing cities. Thus, ZIP code designations were based on the area that a collection of mail carriers could reasonably cover each day; they had little to do with geography or municipal boundaries.

ZIP codes were arbitrarily delineated and covered a range of neighborhood types; in most small and midsized cities, one ZIP code can cover urban, suburban and rural neighborhoods with highly variable socioeconomic characteristics.



The public health field is now learning that their heterogeneity actually makes them very poor representations for understanding exposure or health disparities. ZIP codes aren't even contiguous areas – they are actually just linear features along roads. Yet they influence many aspects of our lives, including car insurance rates, sales tax assignment and home appraisal values, to name a few.

The reality is that very few tangible urban amenities – including school attendance zones, city boundaries, water systems and voting districts – are coterminous with ZIP code boundaries.

More useful are units such as census block groups, wards, planning districts or municipal designations for neighborhoods within a city. Each of these adhere to some temporally consistent, spatially bounded definition, and can more appropriately be used to understand how one neighborhood varies compared to another.

The use of ZIP codes by the public health and medical fields as a primary way to understand health statistics is thus concerning because heterogeneous populations can mask inequalities. As well, program deployment based on ZIP code inquiries is often not well aligned geographically with populations that need assistance.

## **Where do we go from here?**

Still, we should be careful not to remove ZIP codes from consideration entirely. They can still be useful for characterizing phenomena that manifest disparities at a large scale, such as rates of chronic disease, exposure to non-point source pollution, regional employment trends and so on. But we must be more critical toward unusual geographies, particularly when our topic of interest is more local.

A solution to the ZIP code problem could come from either side. For

example, a U.S. Postal Service-led redesign of ZIP codes into something more coherent as a planning tool would enable their continued use in public health with greater integrity. Conversely, a more critical eye toward ZIP codes by the public health profession would open the field to better spatial measures for exposure.

Either way, the current arrangement is clearly not working. If we are content with using ZIP code-level data, we leave open the possibility that further health issues could be masked by these quirky geographies.

The Flint water crisis is not the only example of ZIP codes hiding a public health problem; it is just one of the more apparent. When the ZIP code is the final arbiter of health statistics, we risk assuming that all [public health](#) issues can be packaged neatly into the same box.

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