EPA Data Summit

January 10, 2017

Virginia Tech
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Flint Hospital 2015 vs. 2016
What a difference a year makes.....

2015: Flint River without Corrosion Control

2016: Detroit Water with Enhanced Corrosion Control

Photographs: Zhu “Joyce” Ni, Min Tang, Pan Ji, Mariah Gnegy

1) Fourth round of lead in water testing
(led by Ms. LeeAnne Walters, Flint residents and funded by EPA)

2) A special study of Legionella and Shigella testing
(led by William Rhoads and funded by the State of Michigan)

3) Fourth round of disinfection by-product testing (led by Dr. Susan D. Richardson, a team at the University of South Carolina and funded by the EPA)

4) Flint Filter Fears

(Sloan Foundation Research from 2011-2013)

Flint resident sampling: August 2015 - November 2016

Min Tang, Kelsey Pieper
and Marc Edwards

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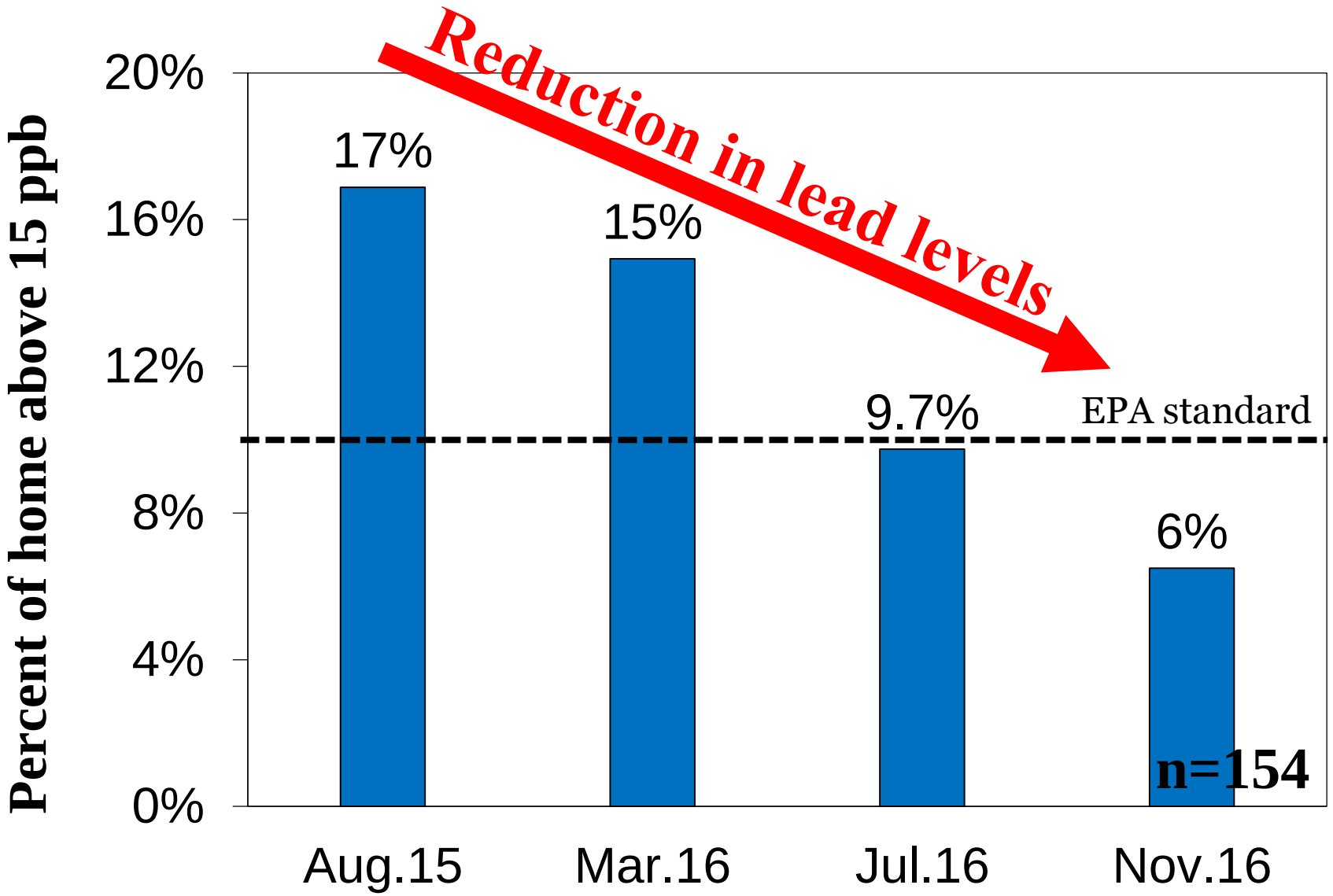
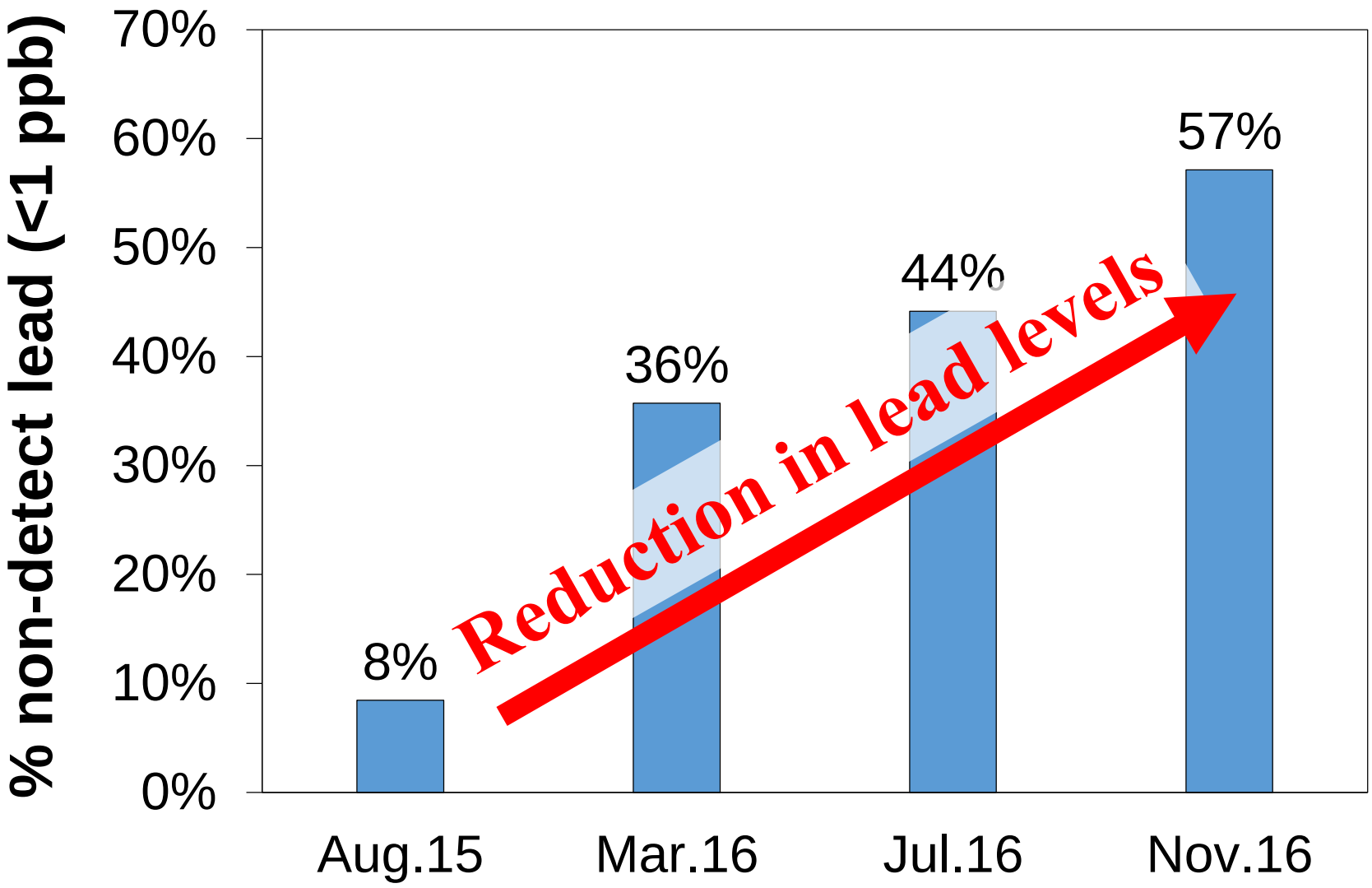
Sampling in November 2016

Sampling organized by LeeAnne Walters and the Flint citizen science team

First draw lead in November 2016



Non-detectable first draw lead



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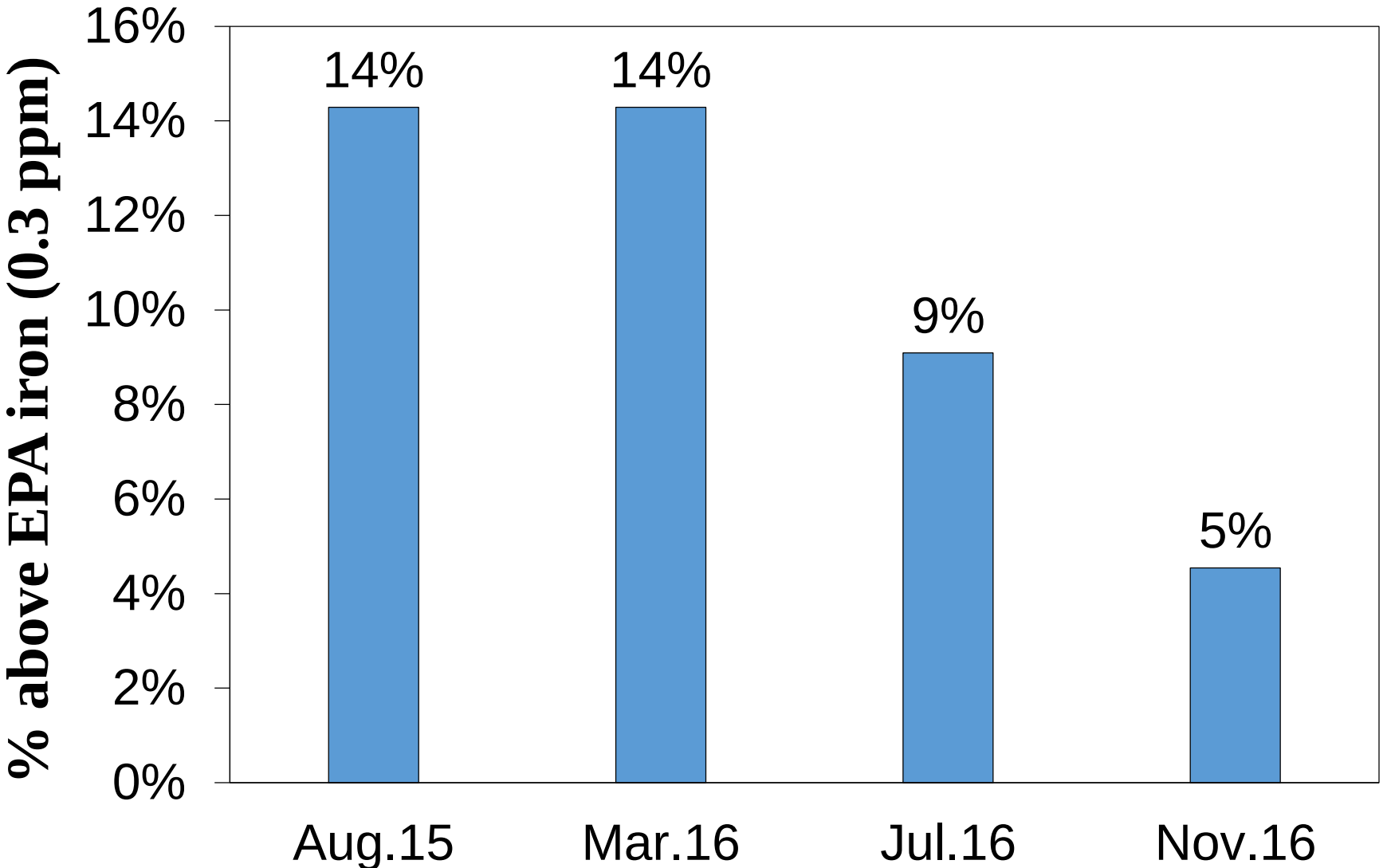
First draw iron concentrations



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Conclusions

1. It is likely that Flint is meeting the lead action level
   - However, this is not an approved LCR sampling pool

2. Lead and iron levels have continued to decrease since July 2016

3. Residents should use lead filters or bottled water until further notice from the State or EPA

Water Heater Study: Update

William Rhoads, Taylor Bradley,
Amy Pruden and Marc Edwards

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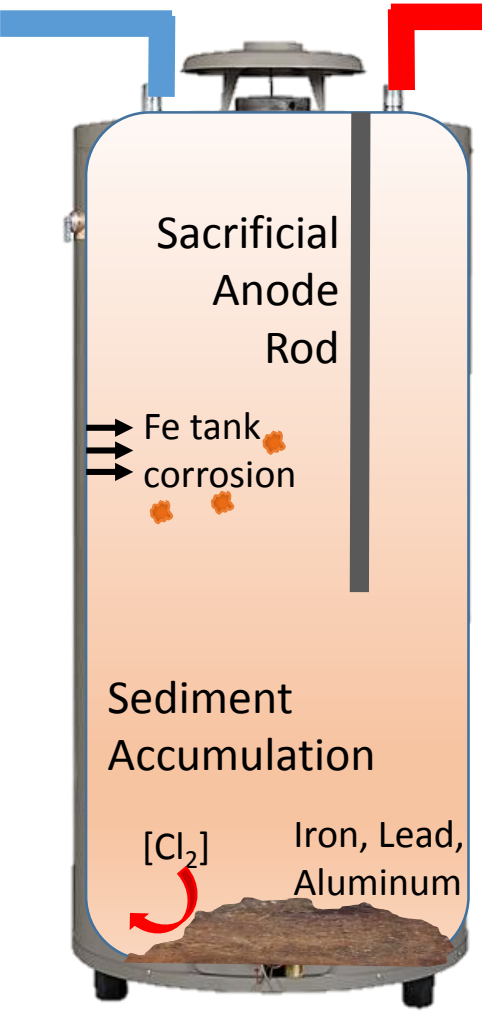

Water Quality Testing in Homes

June 2016 – 30 Homes

- Tested water
  - Metals (Pb, Fe, Al, Cu)
  - Chemistry (Cl_2, pH, temperature)
  - *Legionella*
- Extensive tank cleaning
  - Flush, drain, scour out sediment
- Re-tested water

Key Conclusions Regarding *Legionella*

- *Legionella* colonization rates were very low relative to levels of concern
  - 2 of 30 homes had culturable *L. pneumophila* serogroup 1, that was MAb 2 positive
- Chlorine levels reaching homes were relatively high

Follow-Up Sampling in One of the Homes

Culture *L. pneumophila* serogroup 1, MAb2 positive?

Kitchen Tap:	June	Nov.
Cold Water	Yes	
Hot Water	Yes	

***L. pneumophila* concentration (gene copies/mL)**

Kitchen Tap:	June	Nov.
Cold Water	BQL	
Hot Water	323	

BQL = “Below quantification limit” (i.e., present, but in very low concentration)
BD = “Below detection” (i.e., none detected)

Follow-Up Sampling in One of the Homes

Culture *L. pneumophila* serogroup 1, MAb2 positive?

Hose Bib:	June	Nov.
"Distribution System Water"	Yes	

***L. pneumophila* concentration (gene copies/mL)**

Hose Bib:	June	Nov.
"Distribution System Water"	1121	

BQL = "Below quantification limit" (i.e., present, but in very low concentration)
BD = "Below detection" (i.e., none detected)

Possible Explanations for Improved Water Quality with Respect to *Legionella*

- Amount of time back on Detroit water
  - Generally improved water quality stability
  - Chlorine residuals throughout system
  - Reduced iron
- Seasonality
  - Cooler weather = cooler water in mains
- Increased water heater temperature
  - Hot water temperature = 53.7 °C in August 2016

Reflects high quality distribution system operations overseen by EPA and MDEQ

The Saginaw & Genesee County *Shigella* Outbreak

Owen Strom, William Rhoads,
Emily Garner, Amy Pruden and
Marc Edwards

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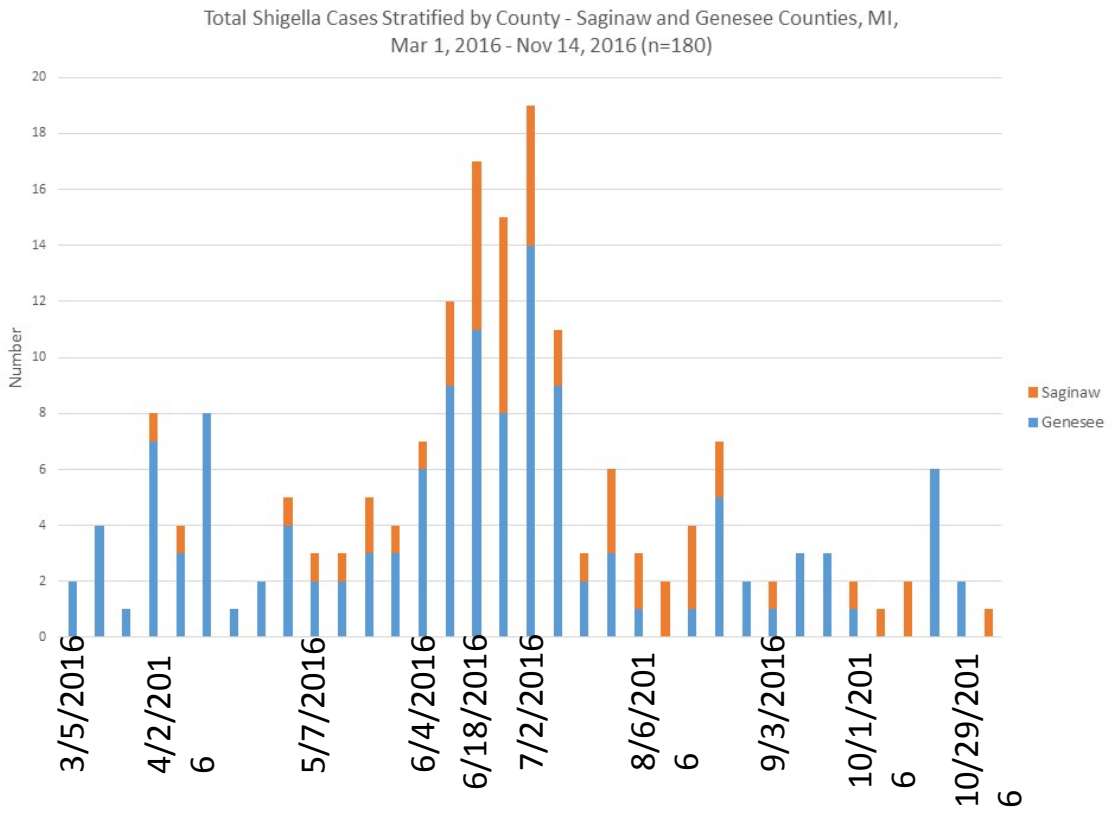
2016 Outbreak of *Shigella*

- Saginaw & Genesee counties
- Starting March 1, 2016
- 180 cases as of November 14th
- Public concern that drinking water could be the source of the outbreak.
- MDHHS and CDC investigating



http://www.michigan.gov/images/mdhhs/ShigellaOutbreakGraph_541917_7.jpg

Shigella

- Bacteria
- Symptoms
  - Severe Diarrhea
  - Abdominal pain
  - Fever

http://www.cdc.gov/shigella/index.html

Detection in Water

- 30 Homes sampled June 2016

2016 Outbreak of *Shigella*

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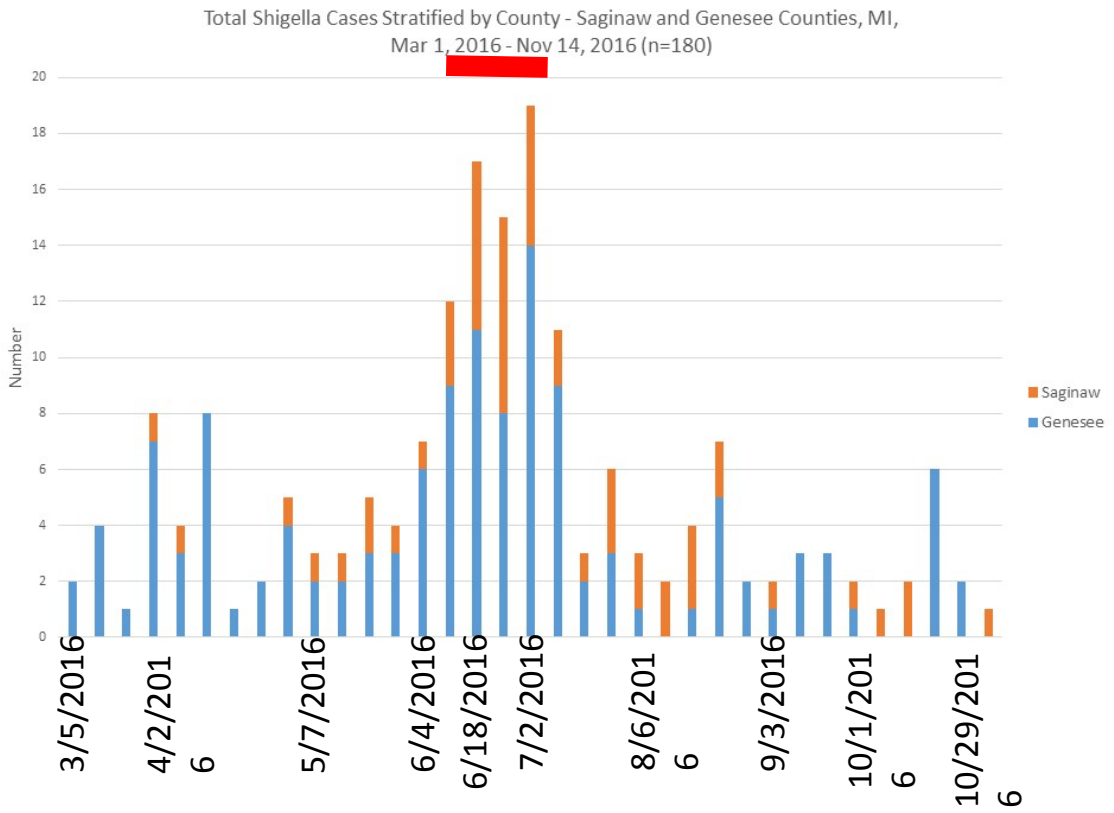


http://www.michigan.gov/images/mdhhs/ShigellaOutbreakGraph_541917_7.jpg

Detection in Water

- Samples from June 2016

- 5 types of samples
  - 1 Liter
  - Hot, cold, stagnant, flushed, main
- Kitchen faucet, shower head, and hose bib
- Total of 150 samples tested

Results

- Tested Presence/Absence of DNA from common pathogenic *Shigella*
- Endpoint polymerase chain reaction (PCR)
  - Identifies DNA from once living or dead *Shigella*
  - Sensitive to the four pathogenic *Shigella* species
- All 150 samples negative

CDC and MDHHS Investigation

- Initial Conclusion 1
  - "*Shigella* does NOT appear to be spreading through a drinking water system"
- Initial Conclusion 2
  - "*Shigella* bacteria appear to be spreading in the community from person to person"
- Initial Conclusion 3
  - "The Outbreak is slowing down"

"Update on the Shigella outbreak Investigation in Saginaw & Genesee Counties November 17, 2016"

The 2nd "fourth party" study funded by EPA

Is There a Disinfection By-Product Problem in Flint?

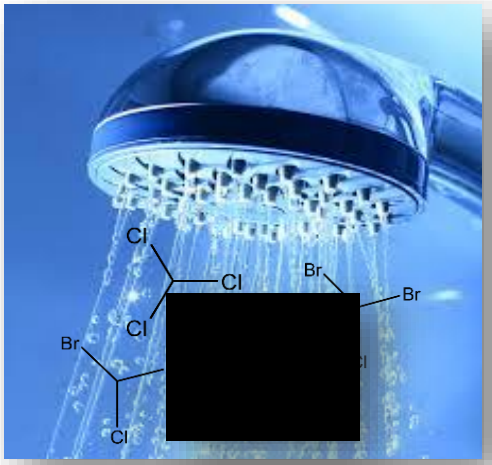
Joshua M. Allen

Amy A. Cuthbertson, Susana Y. Kimura, Hannah K. Liberatore,

Meghan E. Franco, Susan D. Richardson

UNIVERSITY OF SOUTH CAROLINA

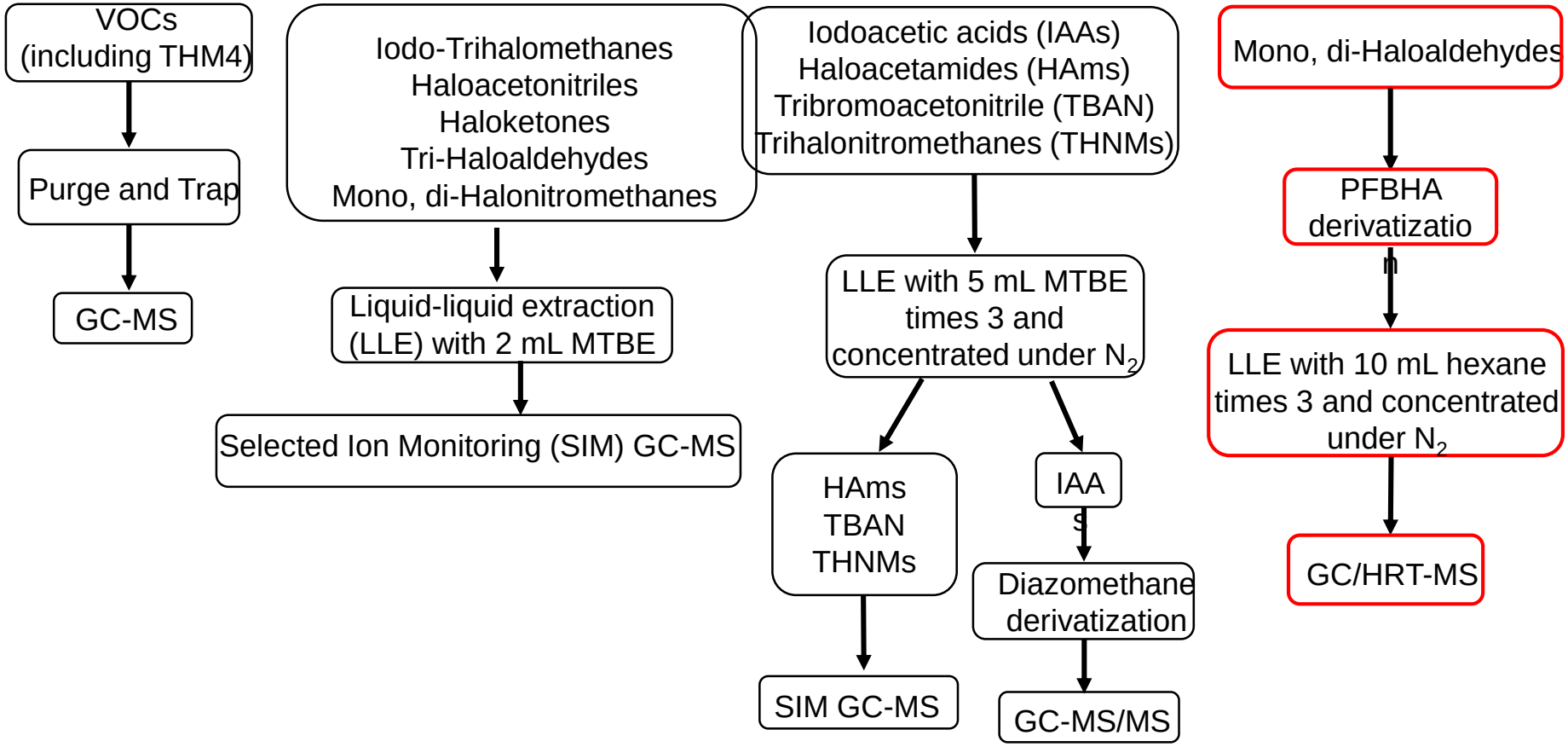
Key Question: Are there chemicals/DBPs present at unusual levels?



Strategy

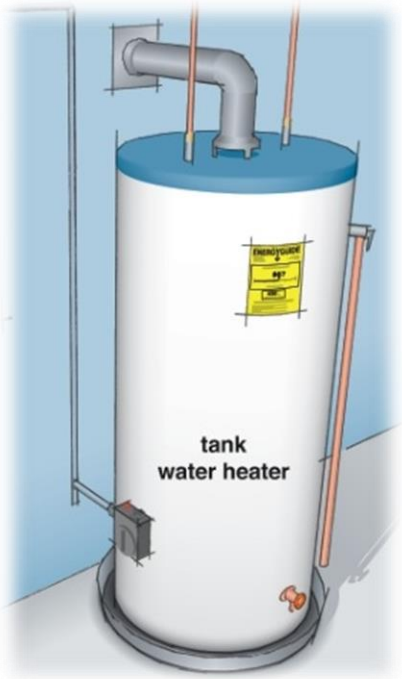
- Compare Flint hot and cold water to water of other cities → Anything unusual?
- **Other cities:**
  - Detroit (uses chlorine and same source water [Lake Huron] as Flint)
  - Grovetown, GA (surface water system using chlorine)
  - Lyons, GA (groundwater system using chlorine)

Quantitative Methods



Conclusions

Flint appears to have no DBP issues when compared to other cities



= ↑ THMs

- Increased THM levels from cold to hot water seen in all cases, but below the 80 µg/L regulatory limit.
- Unregulated DBPs detected were found at low to trace levels.
- Comprehensive analyses results showed Detroit and Flint water is very similar in composition.
- Preliminary data shows all iodo-acids to be < 10 ng/L in Flint and Detroit.

Much of Flint No Longer Believes Filtered Water is Safe

Two dinners with Flint residents 12/15/2017

Water filters could increase bacteria in Flint water, researchers say

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Water Study Update and Open House, Dec. 14
The Flint Journal

December 14, 2016

“ …. it's important to let water run through the filter for at least one minute to let the bacteria that has built up in the activated carbon filter disperse. Other tactics for clearing the bacteria from the water include boiling water or using a UV disinfection lamp.”

From: XXXXXXXXX [mailto:XXXXXX@hotmail.com]
Sent: Monday, January 9, 2017 3:20 PM
To: Marc Edwards <edwardsm@vt.edu>
Subject: Re: That commercial is coming out of the governor's office.

I located my letter from the Wayne State research team. The name of the bacteria is the Enterobacteriaceae family DNA. The presence of this type of bacteria is what I am also concerned about.

Enterobacteriaceae?

Impact of Water Chemistry, Pipe Material and Stagnation on the Building Plumbing Microbiome

Pan Ji, Jeffrey Parks, Marc A. Edwards, Amy Pruden
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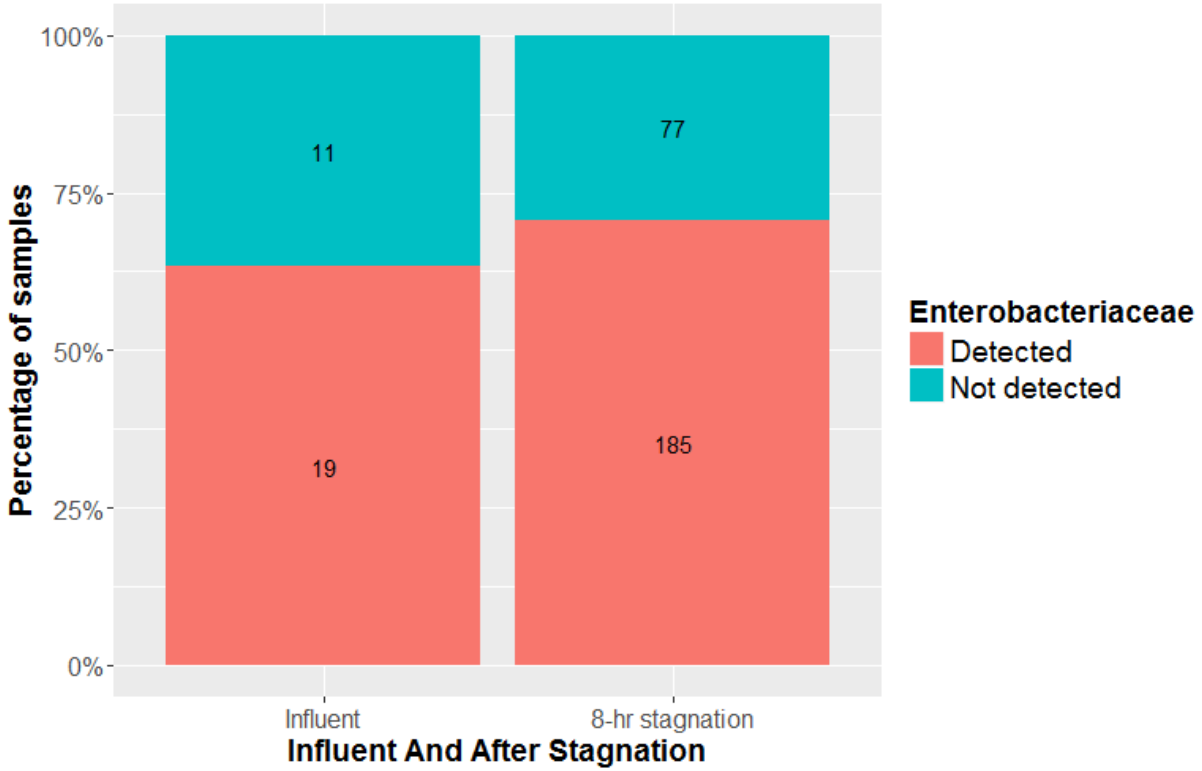
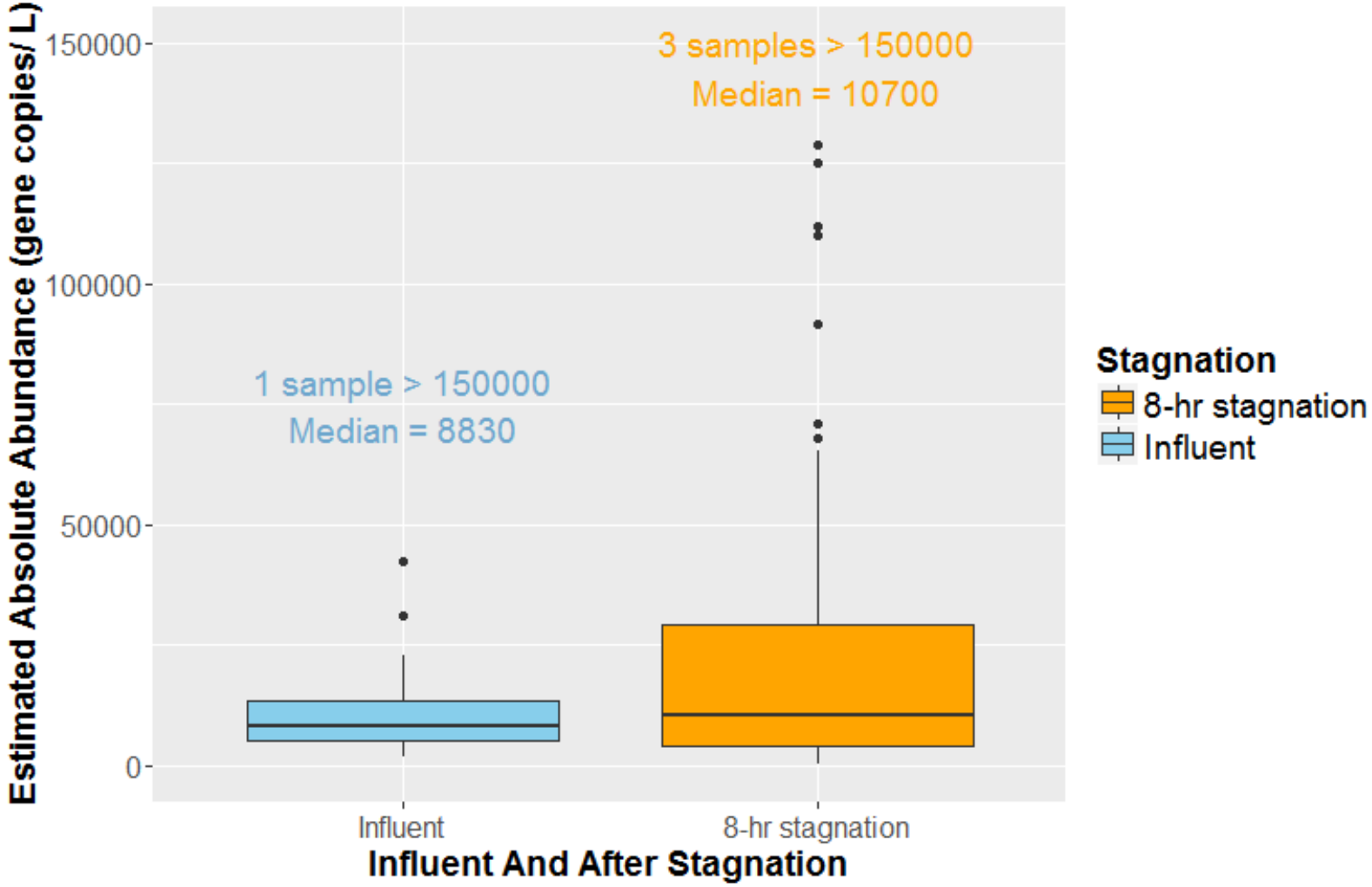
Over 62% water samples in our survey (not Michigan) were *Enterobacteriaceae* positive.



Pan Ji. Field drinking water survey at 5 water utilities across U.S.
16S rRNA amplicon sequencing data and 16S qPCR data

Estimated absolute abundance of *Enterobacteriaceae* family in the positive samples.



Pan Ji. Field drinking water survey at 5 water utilities across U.S.
16S rRNA amplicon sequencing data and 16S qPCR data

Numbers related to the positive detects box plot (gene copies/L)

	Min	25%	Median	Mean	75%	Max
Influent	1670	5690	8830	27930	14150	316000
8-hr stagnation	192	3930	10700	28170	29700	1050000

“Normal” = 0 to 1,000,000 gene copies/L