

# Exposure to Arsenic

*Everything but the kitchen sink.*

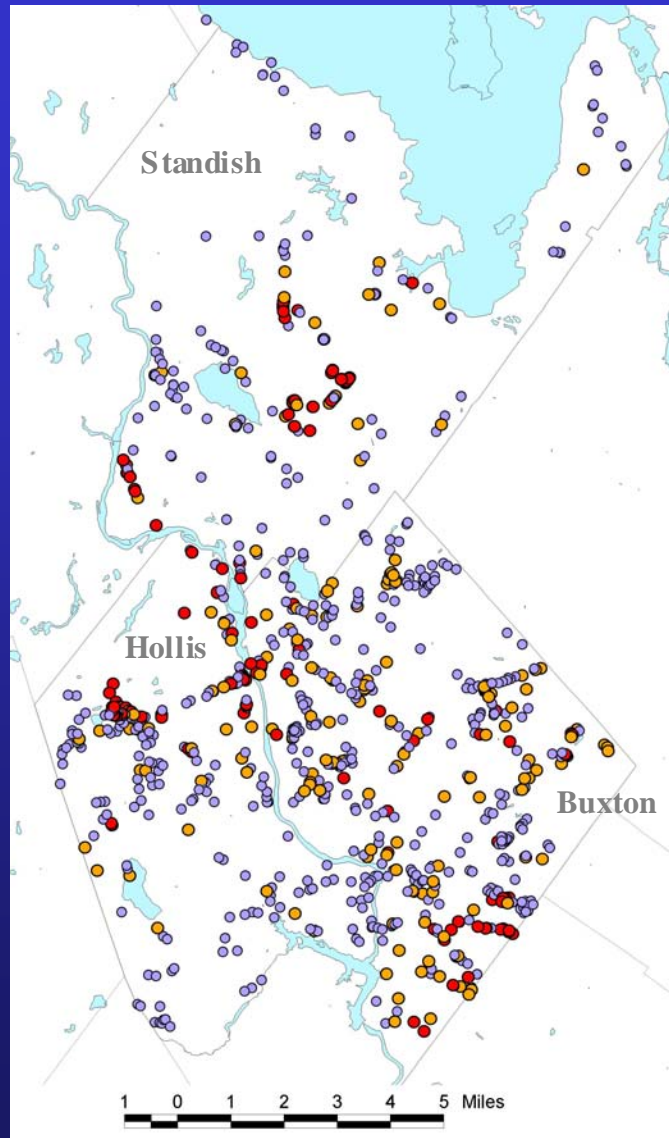
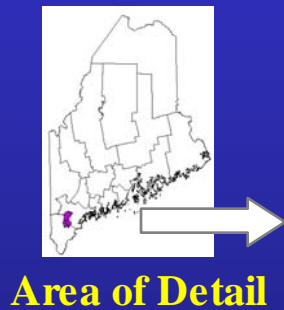


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Maine Center for Disease Control and Prevention

## Why We are Concern About Arsenic

- **Arsenic is a known human carcinogen (bladder, skin, lung)**
- **Arsenic may cause adverse reproductive outcomes (low birth weight, preterm births, spontaneous abortion, infant mortality)**
- **Arsenic may cause deficits in cognitive function (reduced IQ scores)**
- **Arsenic may be associated with increased risk of diabetes mellitus**

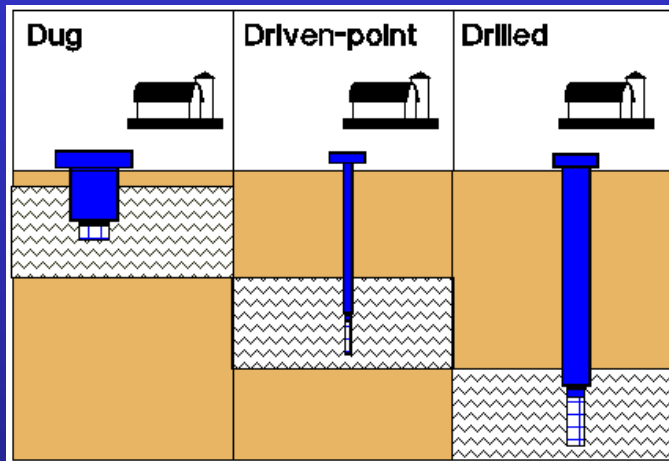
## Arsenic in Maine Well Water



- Statewide, ~10% wells have arsenic levels above 10 ppb
- Some areas may approach 20 – 30%.
- Highest value detected in Maine was 5000 ppb. Levels > 100 ppb occur with a frequency of less than 1 per 100.
- High levels can cluster together.

# Arsenic In Domestic Well Water

## *Public Health Considerations*



- About half of Maine's households obtain drinking water from private wells (~260,000 households)
- Elevated arsenic more likely to be found in bedrock wells, and can be found in wells all over Maine
- Private household wells are not regulated
- Arsenic is not always included in standard water tests
- Significant potential cancer risk even at 10 ppb.

# Arsenic in Domestic Well Water

## Public Health Response



- Increased testing by adding arsenic to standard water test
- Survey to estimate percent of private wells that have tested for arsenic ... about 40 %.

Q. Can I use my water for bathing if it has high arsenic?  
Answer: Studies have shown that little arsenic gets into adults from bathing. But we do not have studies on young kids. Kids might get more arsenic in them while bathing because of their play habits. We have a study underway to check this. If you would like to know about our study of kids exposure from bathing, call us toll-free at 866-292-3474.

How do I get more information about arsenic in private well water?  
For more information on the health effects of arsenic, contact:  
Andrey E. Smith, SM, ScD.  
State Toxicologist  
Environmental Toxicology Program  
Bureau of Health  
11 State House Station

**HAVE YOU TESTED YOUR WELL WATER FOR ARSENIC?**

Health Information for Private Well Users

**Well Testing Schedule**

**How to Read the Safe Limits** Compare the numbers and letters on your test results with the numbers and letters under the safe limits. Make sure the letters match and the year test results are at or below the limits.

Well Problem	Can Cause	Safe Limit
<b>Test Every Year</b>		
• Bacteria	Diarrhea and Vomiting	0
<b>Test Every 3 to 5 Years</b>		
• Arsenic	Cancer	10 mg/L or less
• Radon	Cancer	20,000 pCi/L or less
• Uranium	Kidney Problems	20 mg/L or less
• Lead - First Draw Test	Brain Damage	10 mg/L or less if plumbing a baby program or have a child under age 6
• Fluoride	Too little - increased chance of tooth decay Too much - stained teeth	Between 0.6 mg/L and 1.7 mg/L

**Other Times to Test Your Well:**

- You're expecting a baby.
- Your water changes in smell, taste, or color. Drink bottled water. Call us to learn which tests to do.
- You put in new parts to the system, like a new pump or new pipes or water softener. Test for bacteria.
- The well runs dry and comes back. Test for bacteria.
- You put in a water treatment system to fix a problem. Test the treated water each year for that problem.

If you're not 100% sure you understand your water test results, call us.  
Bureau of Health Toll Free in Maine: 866-292-3474 or [www.maine-wellwater.org](http://www.maine-wellwater.org)

**Arsenic in Well Water**

Maine Bureau of Health

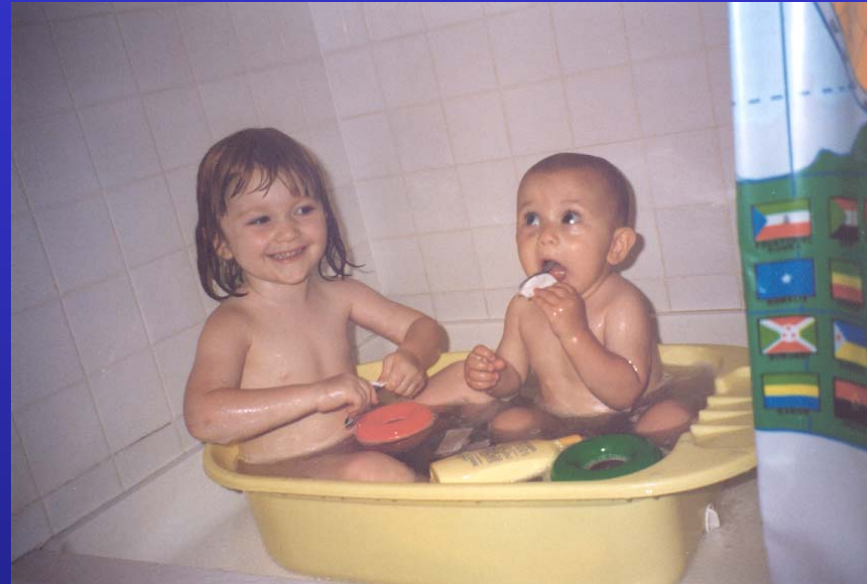


- Develop and disseminate public education materials
- Cluster Response

- Bottled water as short-term strategy to reduce exposure
- Point-of-Use (POU) treatment systems for long-term use.

## What About Bathing?

- Play related behavior?
- Dermal absorption?
- Non-compliance?
- Evidence that direct ingestion is clearly the major route of exposure (Harrington et al., 1978)
- Studies with rhesus monkeys indicated dermal absorption rates of 1 to 6% of applied dose (Wester et al. 1993, 2004)



## Household Water Arsenic Exposure Study

- Objective was to assess potential for significant residual arsenic exposure after POU treatment.
- Recruited 250 households for total of 425 study participants with 172 kids < 10 years of age.
- Obtained first morning void urine and toe nail samples, water samples, food & bathing diaries, and surveys.
- Urine samples speciated for arsenic: (As+3, As+5, AsB, AsC, MMA, DMA)

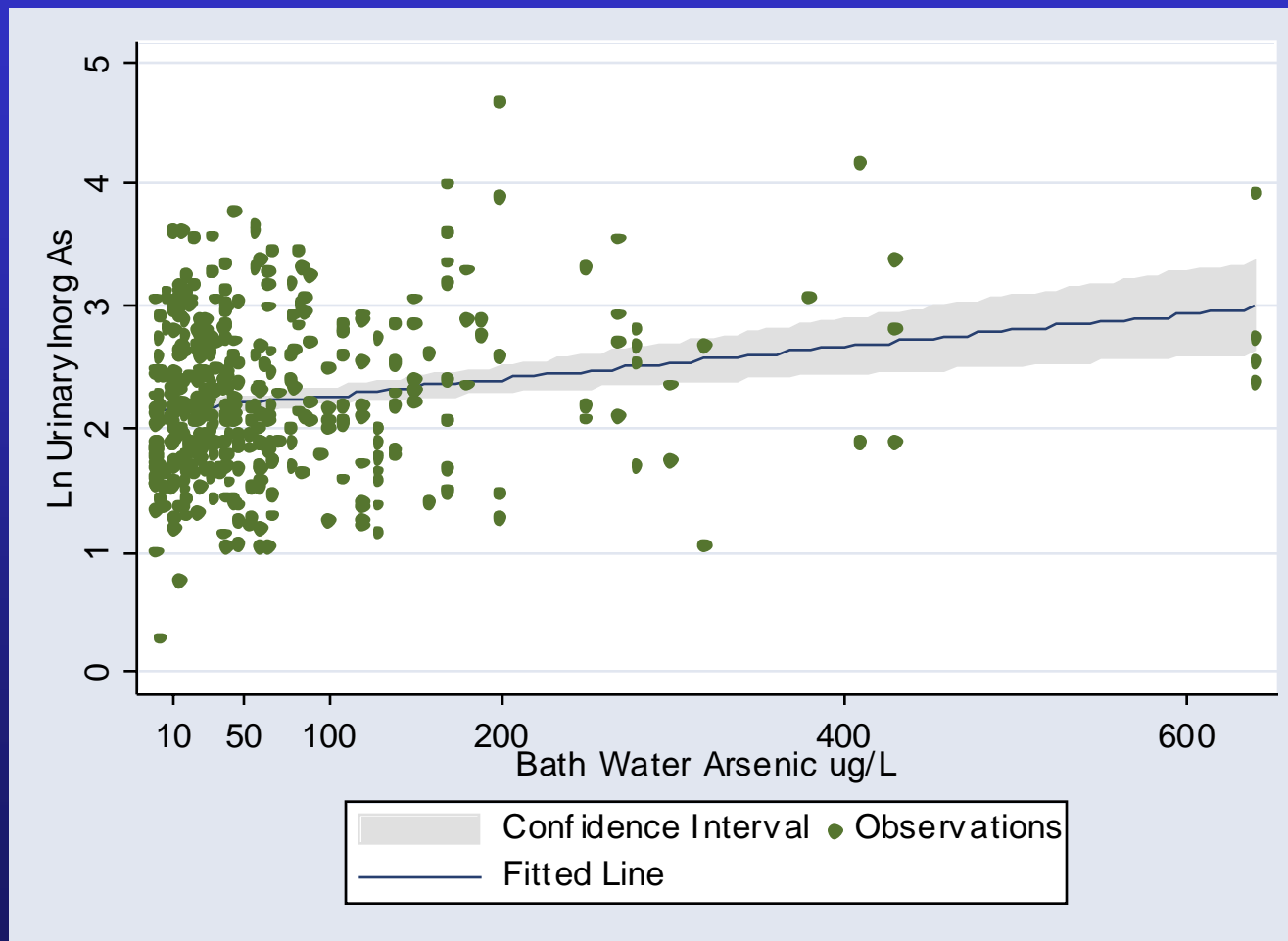
## Preliminary Analyses

### *Choice of Exposure Measure*

	ln_urine~s	ln_urine~c	ln_urine~i	ln_urine~2	ln_urine~t	bath_as	dw_as
ln_urine_as	1.0000						
ln_urine_a~c	0.7269	1.0000					
ln_urine_a~i	-0.2059	0.4466	1.0000				
ln_urine_a~2	0.2665	0.7195	0.7400	1.0000			
ln_urine_a~t	0.3351	0.6138	0.2900	0.2097	1.0000		
bath_as	0.2395	0.1836	0.0708	0.2002	-0.0026	1.0000	
dw_as	0.0726	0.0742	0.0192	0.0274	0.0527	0.0434	1.0000

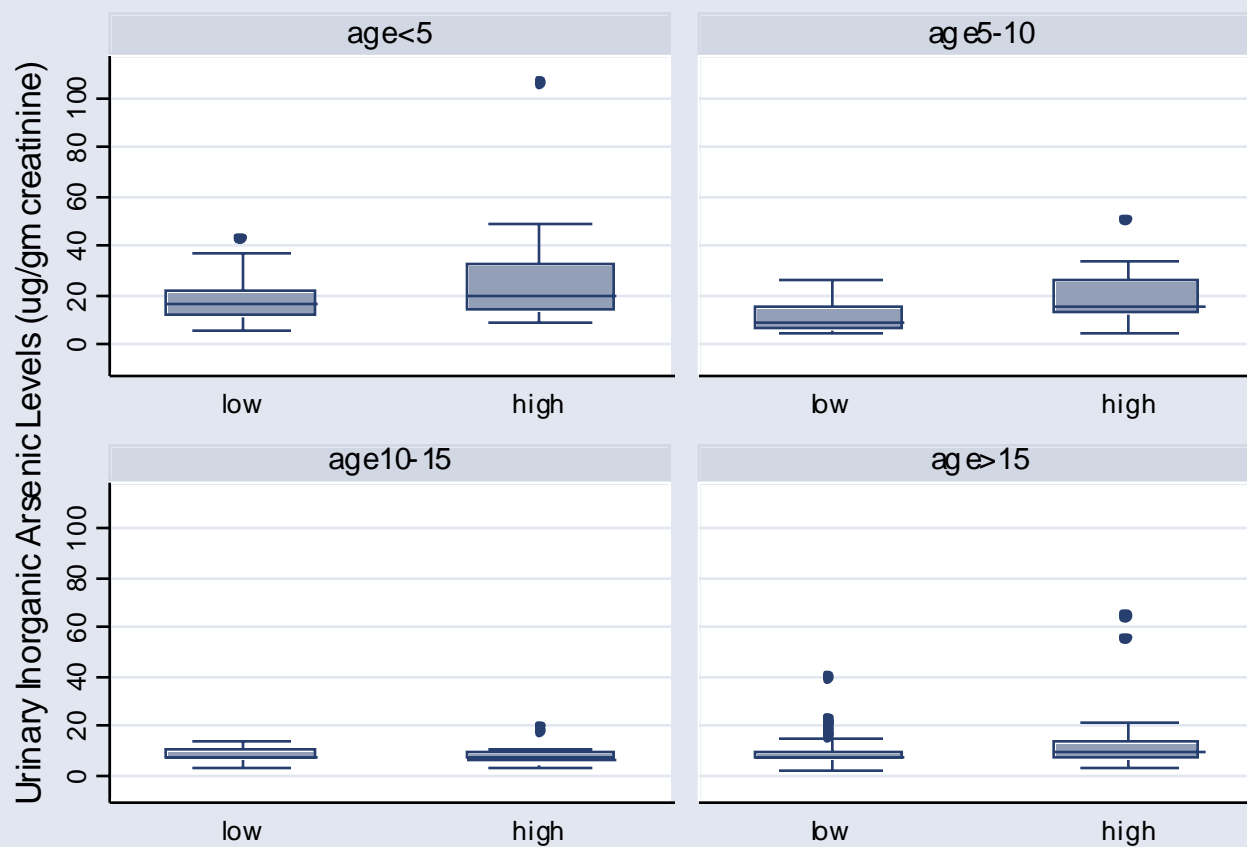
# Preliminary Analyses

## *All Subjects*



# Preliminary Analyses

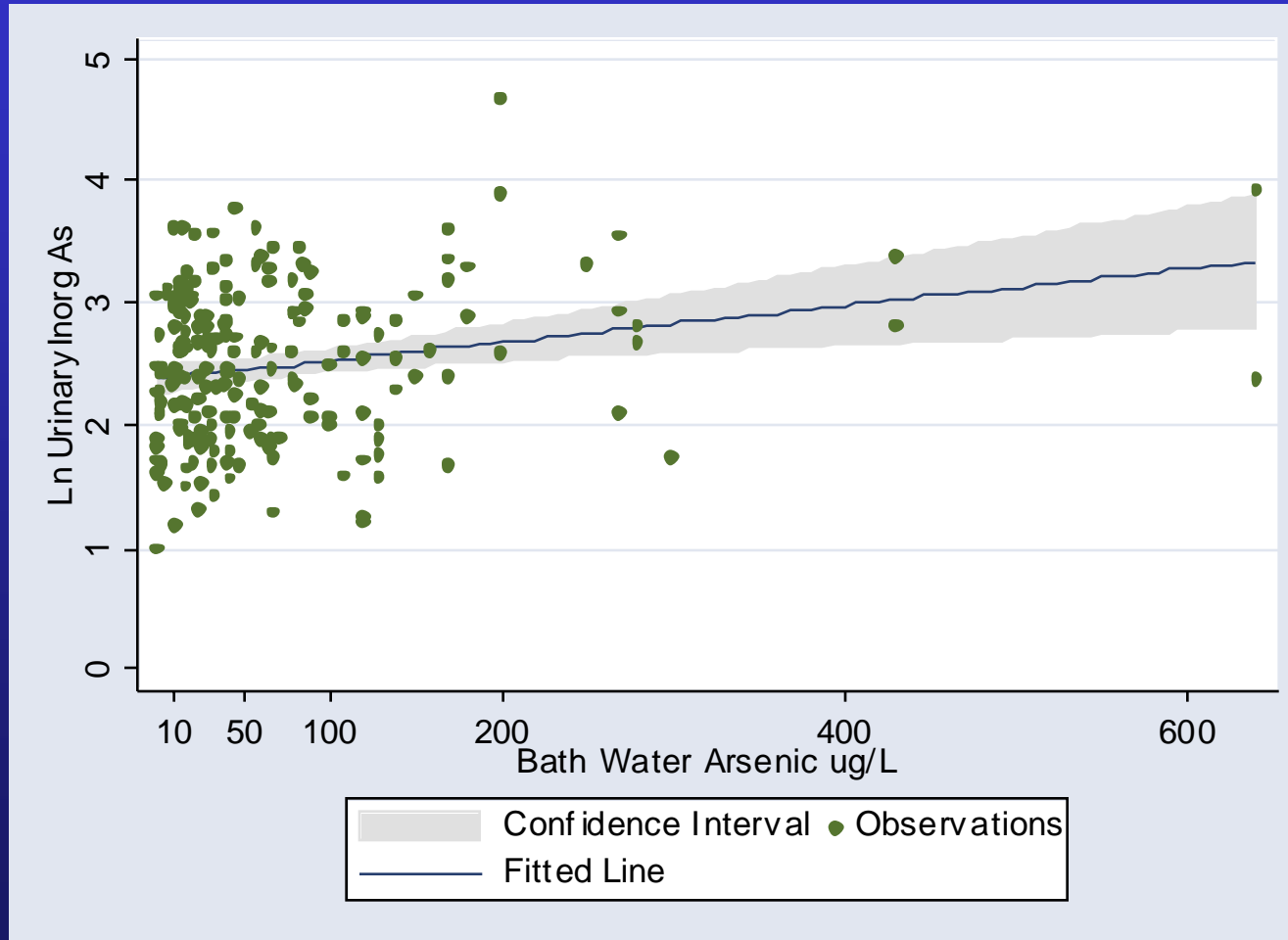
## *Subjects by Age Category*



Graphs by RECODE of age

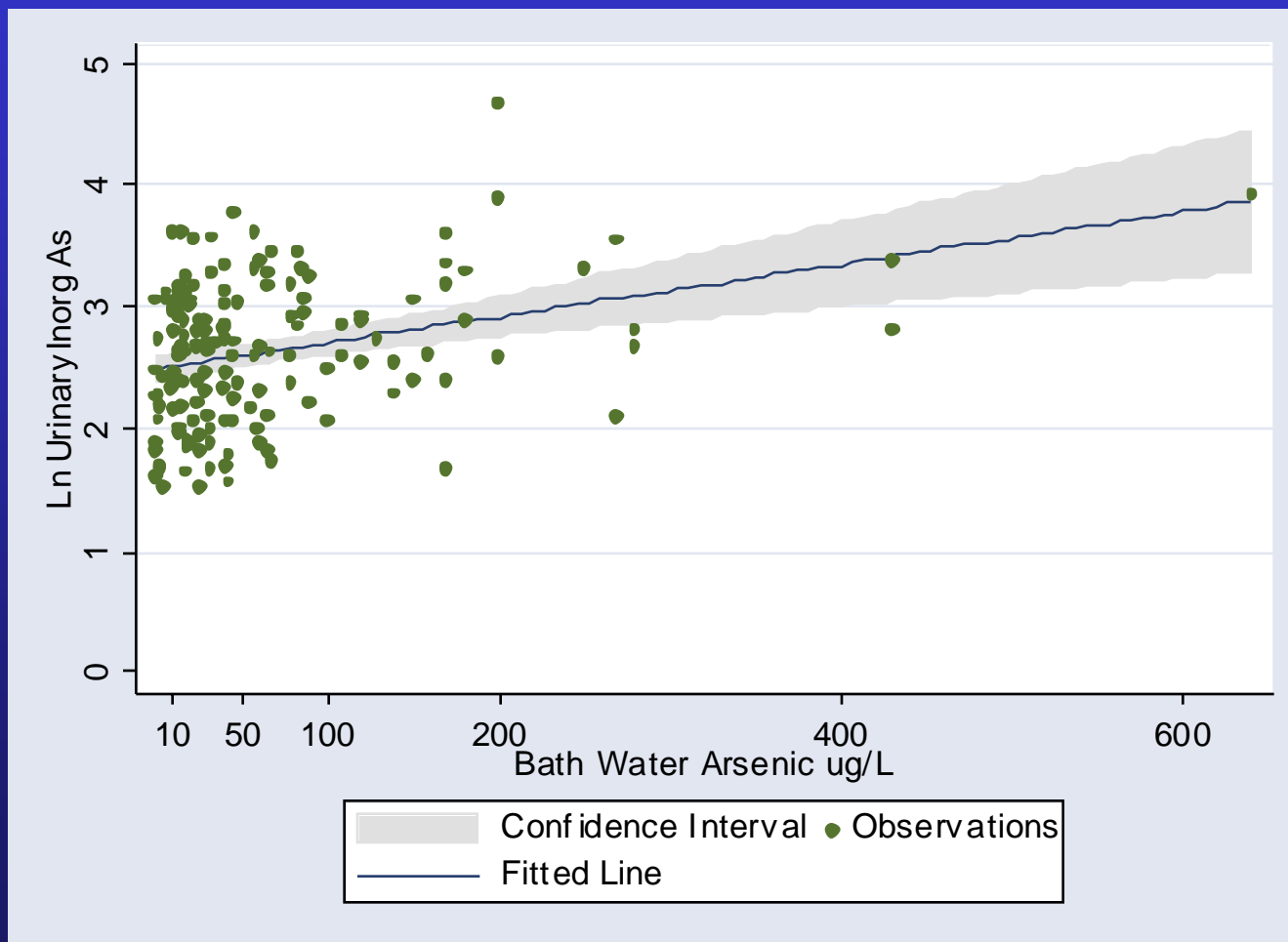
# Preliminary Analyses

*Subjects < 15 years old*



# Preliminary Analyses

*Subjects < 10 years old*



# Preliminary Analyses

## *Subjects < 15 years old*

```
. regress ln_urine_as_i2 bath_as dw_as age gender if age < 15
```

Source	SS	df	MS	Number of obs =	200
Model	38.4677442	4	9.61693604	F( 4, 195) =	45.41
Residual	41.3006463	195	.211798186	Prob > F =	0.0000
				R-squared =	0.4822
				Adj R-squared =	0.4716
Total	79.7683905	199	.400846183	Root MSE =	.46022

ln_urine_a~2	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
bath_as	.0020121	.0003554	5.66	0.000	.0013111	.002713
dw_as	.0122869	.0116295	1.06	0.292	-.0106488	.0352225
age	-.1249739	.0098175	-12.73	0.000	-.1443359	-.1056118
gender	-.0098075	.0657608	-0.15	0.882	-.1395012	.1198861
_cons	3.176272	.082591	38.46	0.000	3.013386	3.339159

# Preliminary Analyses

## *Subjects > 15 years old*

```
. regress ln_urine_as_i2 bath_as dw_as age gender if age > 15
```

Source	SS	df	MS	Number of obs =	208
Model	8.99983832	4	2.24995958	F( 4, 203) =	8.68
Residual	52.6160606	203	.259192417	Prob > F =	0.0000
Total	61.6158989	207	.297661348	R-squared =	0.1461
				Adj R-squared =	0.1292
				Root MSE =	.50911

ln_urine_a~2	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
bath_as	.0012346	.0003609	3.42	0.001	.0005231	.0019462
dw_as	.0236406	.0125011	1.89	0.060	-.0010081	.0482892
age	.0107555	.0026906	4.00	0.000	.0054503	.0160607
gender	-.1921196	.0840101	-2.29	0.023	-.3577639	-.0264753
_cons	1.458766	.1246181	11.71	0.000	1.213055	1.704478

# Preliminary Analyses

## *Next Steps*

- **Need to look at bathing related variables**
  - ✓ bath versus shower
  - ✓ bathing duration
- **Need to look at non-linear (threshold) models**
- **Need to use results to formalize position on when to recommend POE treatment systems**