Bridging Epidemiologic Research and Community Action for Safe Drinking Water in Texas Border Communities

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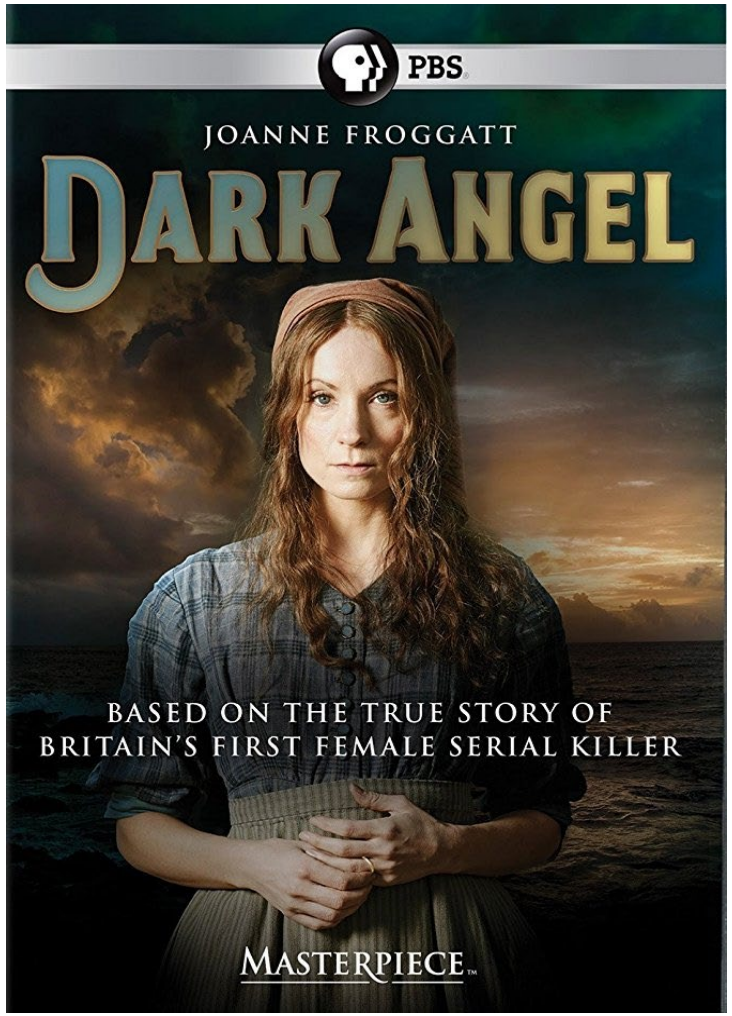
Arsenic – an Invisible Poison

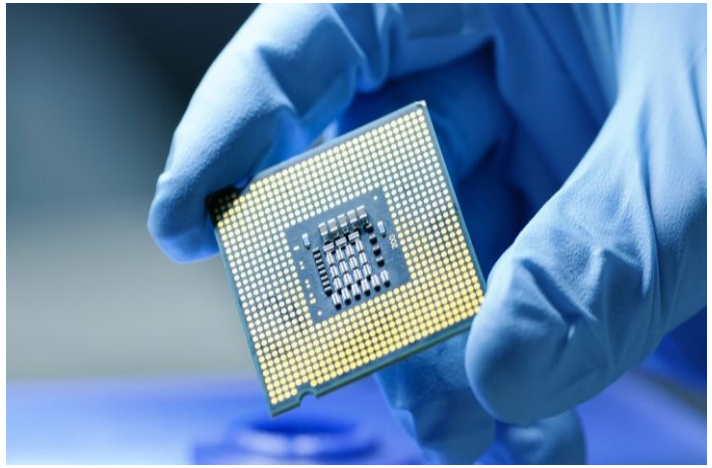


Poison of Kings

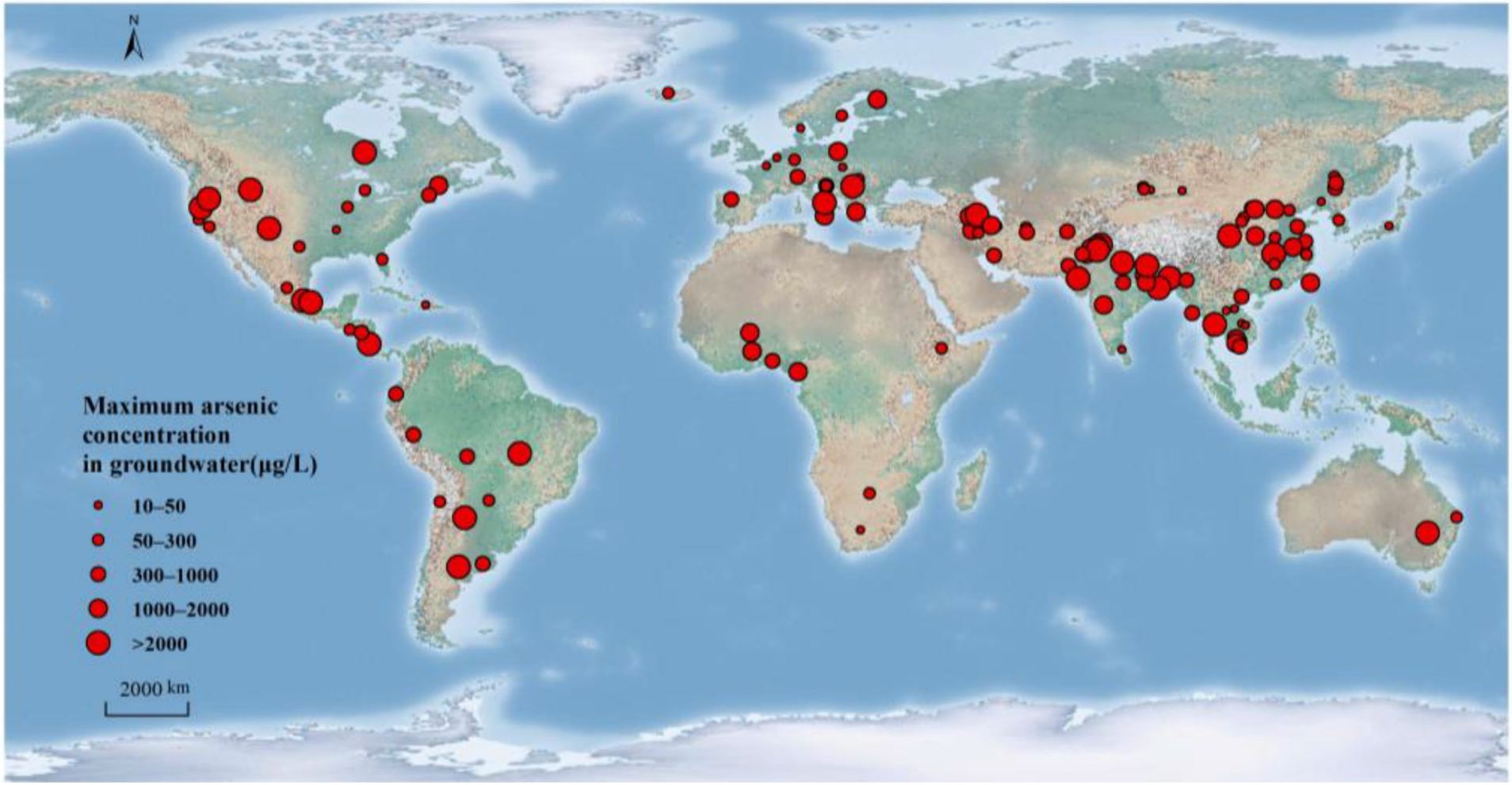
King of Poisons

Sources of Arsenic Exposure

- ❑ Ground Water
- ❑ Food
- ❑ Occupational
- ❑ Soil



Arsenic in Groundwater Worldwide



Smedley et al., 2005

Health Effects of Arsenic

Skin lesions

Cancers (skin, lung, bladder, larynx, kidney)

Heart and vascular diseases

Respiratory disease

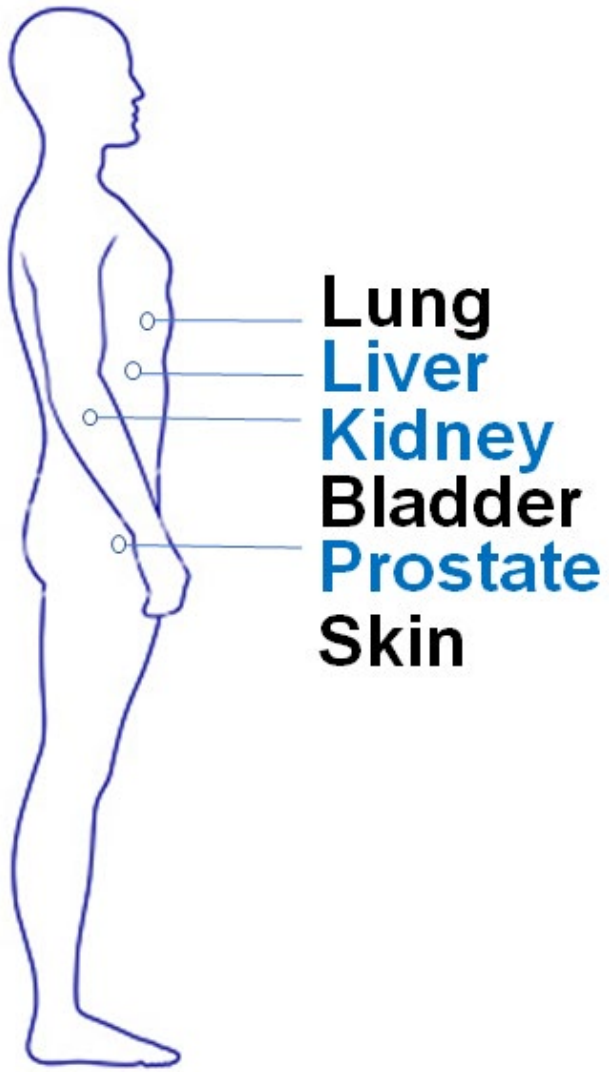
Chronic kidney diseases

Reproductive/developmental effects

Diabetes

Other

Health Effects of Arsenic

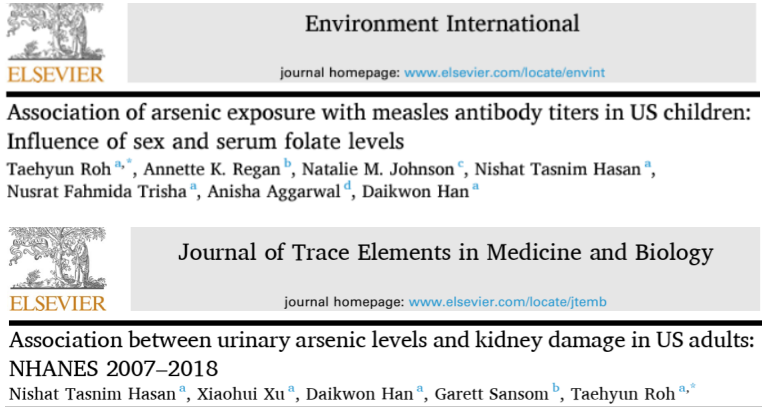


“Group1 Carcinogen”

“There is sufficient evidence that arsenic causes cancers of the urinary bladder, lung and skin. Positive associations with cancer of kidney, liver, and prostate has been observed.”
(IARC, 2004)

Previous Studies

- Arsenic exposure from drinking water increases the risk of various diseases.
- Increased risks of diseases from arsenic exposure continues even 40 years after exposure has been reduced
- Arsenic exposure during early life showed marked increase in diseases in later life.
- Low-level arsenic still increases the risk of diseases.



Environment International

journal homepage: www.elsevier.com/locate/envint

Association of arsenic exposure with measles antibody titers in US children: Influence of sex and serum folate levels

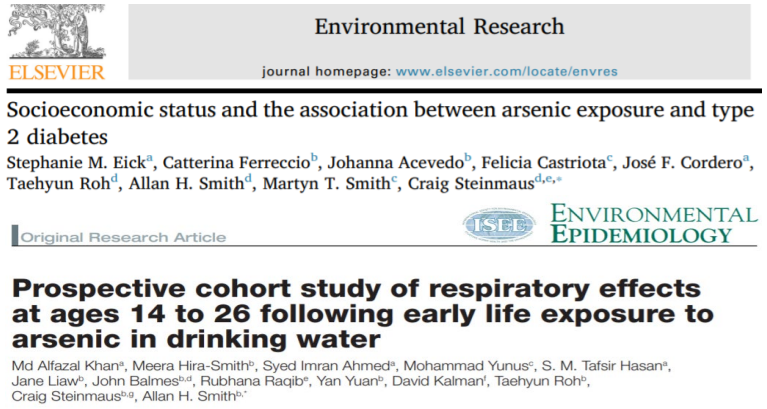
Taehyun Roh [a,*], Annette K. Regan [b], Natalie M. Johnson [c], Nishat Tasnim Hasan [a], Nusrat Fahmida Trisha [a], Anisha Aggarwal [d], Daikwon Han [a]

Journal of Trace Elements in Medicine and Biology

journal homepage: www.elsevier.com/locate/jtemb

Association between urinary arsenic levels and kidney damage in US adults: NHANES 2007–2018

Nishat Tasnim Hasan [a], Xiaohui Xu [a], Daikwon Han [a], Garett Sansom [b], Taehyun Roh [a,*]



Environmental Research

journal homepage: www.elsevier.com/locate/envres

Socioeconomic status and the association between arsenic exposure and type 2 diabetes

Stephanie M. Eick[a], Catterina Ferreccio[b], Johanna Acevedo[b], Felicia Castriota[c], José F. Cordero[a], Taehyun Roh[d], Allan H. Smith[d], Martyn T. Smith[c], Craig Steinmaus[d,e,*]

Original Research Article

ISEE ENVIRONMENTAL EPIDEMIOLOGY

Prospective cohort study of respiratory effects at ages 14 to 26 following early life exposure to arsenic in drinking water

Md Alfazal Khan[a], Meera Hira-Smith[b], Syed Imran Ahmed[a], Mohammad Yunus[c], S. M. Tafsir Hasan[a], Jane Liaw[b], John Balmes[b,d], Rubhana Raqib[e], Yan Yuan[b], David Kalman[f], Taehyun Roh[b], Craig Steinmaus[b,g], Allan H. Smith[b,*]

American Journal of Epidemiology
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Age at Exposure to Arsenic in Water and Mortality 30–40 Years After Exposure Cessation

Taehyun Roh, Craig Steinmaus, Guillermo Marshall, Catterina Ferreccio, Jane Liaw, and Allan H. Smith*

Environmental Research

journal homepage: www.elsevier.com/locate/envres

Low-level arsenic exposure from drinking water is associated with prostate cancer in Iowa

Taehyun Roh[a], Charles F. Lynch[b], Peter Weyer[c], Kai Wang[d], Kevin M. Kelly[e], Gabriele Ludewig[a,e,*]

JNCI J Natl Cancer Inst (2018) 110(3): djx201

doi: 10.1093/jnci/djx201
First published online October 24, 2017
Article

Lung, Bladder, and Kidney Cancer Mortality 40 Years After Arsenic Exposure Reduction

Allan H. Smith, Guillermo Marshall, Taehyun Roh, Catterina Ferreccio, Jane Liaw, Craig Steinmaus

Environmental Research and Public Health

Characterization of Arsenic and Atrazine Contaminations in Drinking Water in Iowa: A Public Health Concern

Taehyun Roh [1,*], Peter S. K. Knappett [2], Daikwon Han [1], Gabriele Ludewig [3,4], Kevin M. Kelly [4], Kai Wang [5] and Peter J. Weyer [6]

Environmental Health Perspectives

Estimating the Occurrence of Arsenic in Residential Drinking Water and Population with Potential High Arsenic Exposure in Texas

Taehyun Roh, Daikwon Han, Tong Wang, Peter Knappett, and John Tracy

Toxicology and Applied Pharmacology

journal homepage: www.elsevier.com/locate/taap

Association of arsenic exposure with PDGF-BB in vitro and in a South Texas population exposed through drinking water

Alexandra E. Svetlik[a,b], Nishat Tasnim Hasan[c], Nusrat Fahmida Trisha[c], Daniel W. White[d], Raj Satkunasivam[e], Natalie M. Johnson[a,b], Taehyun Roh[a,c,*]

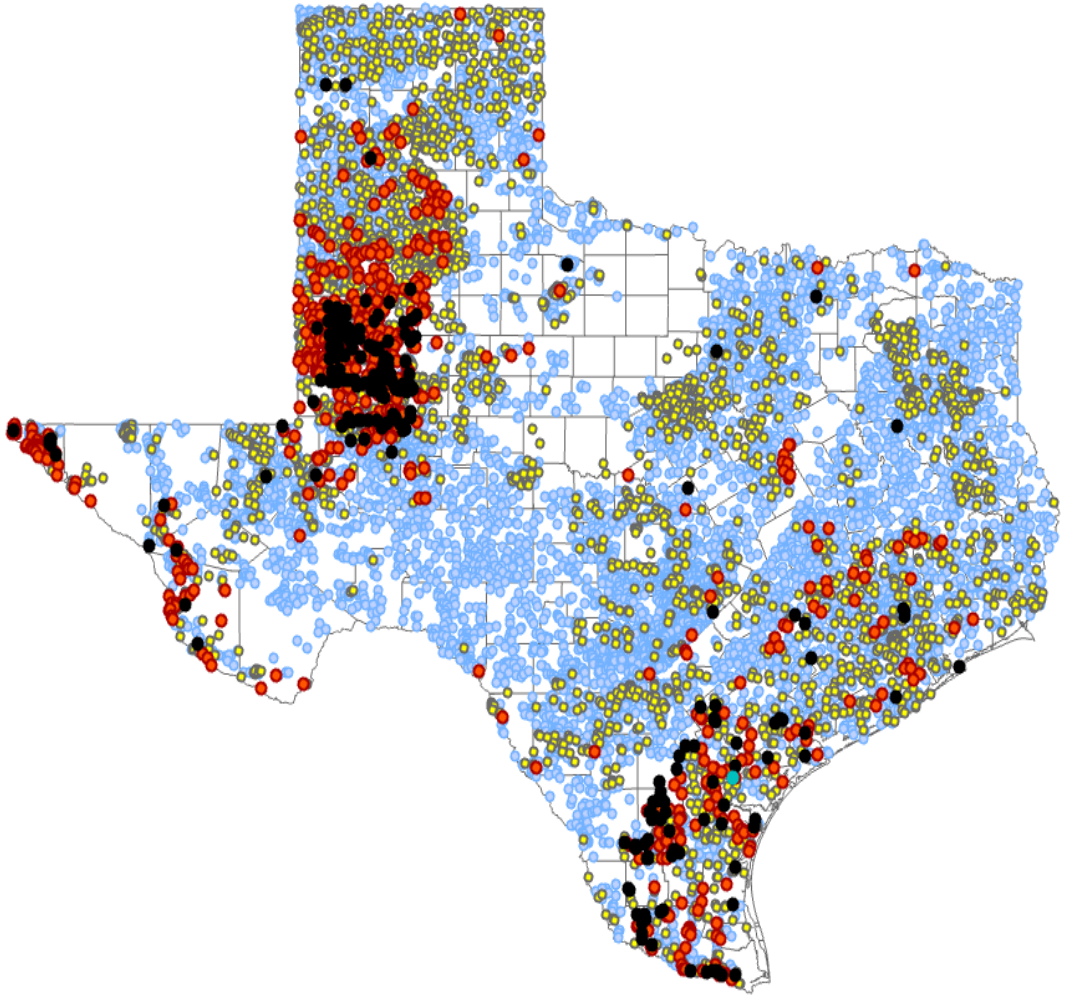
International Journal of Environmental Research and Public Health

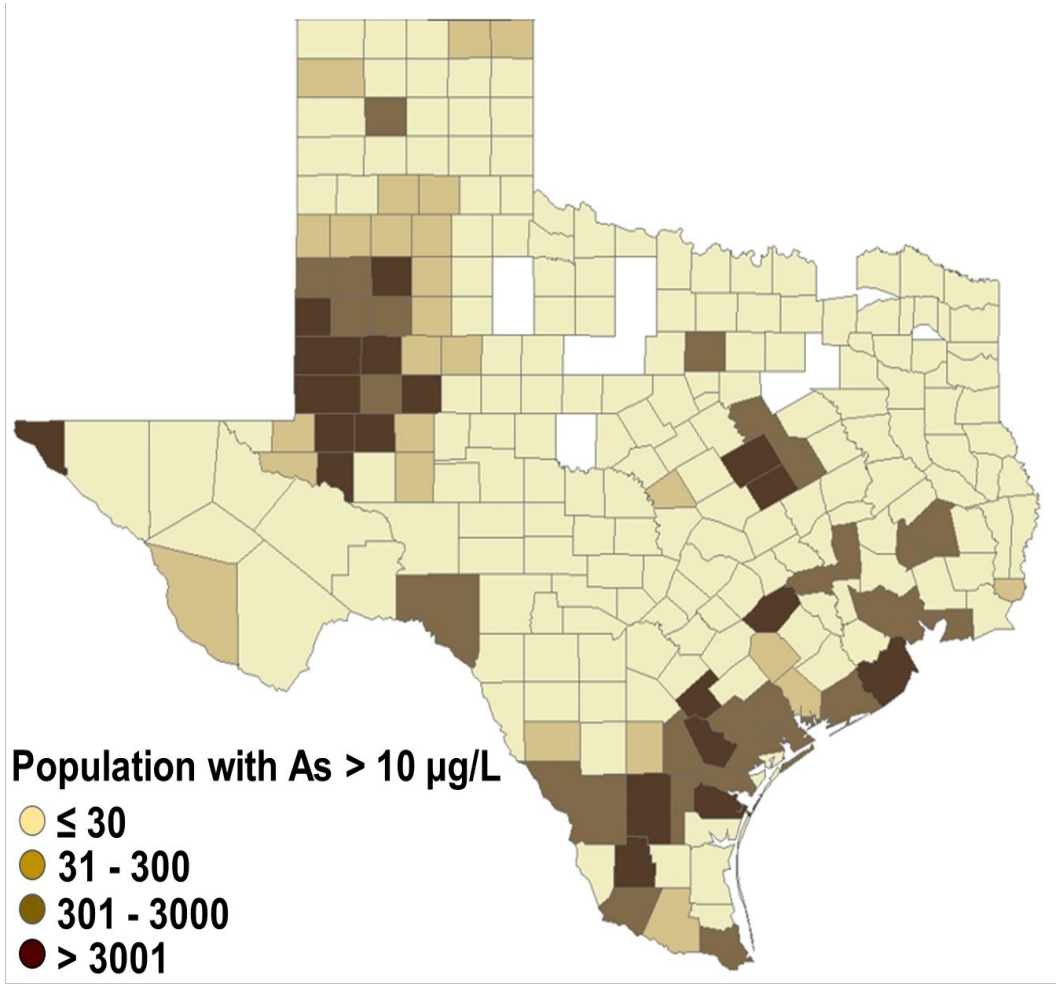
Comparative Biomonitoring of Arsenic Exposure in Mothers and Their Neonates in Comarca Lagunera, Mexico

José Javier García Salcedo [1], Taehyun Roh [2], Lydia Enith Nava Rivera [3], Nadia Denys Betancourt Martínez [3], Pilar Carranza Rosales [4], María Francisco San Miguel Salazar [1], Mario Alberto Rivera Guillén [1],

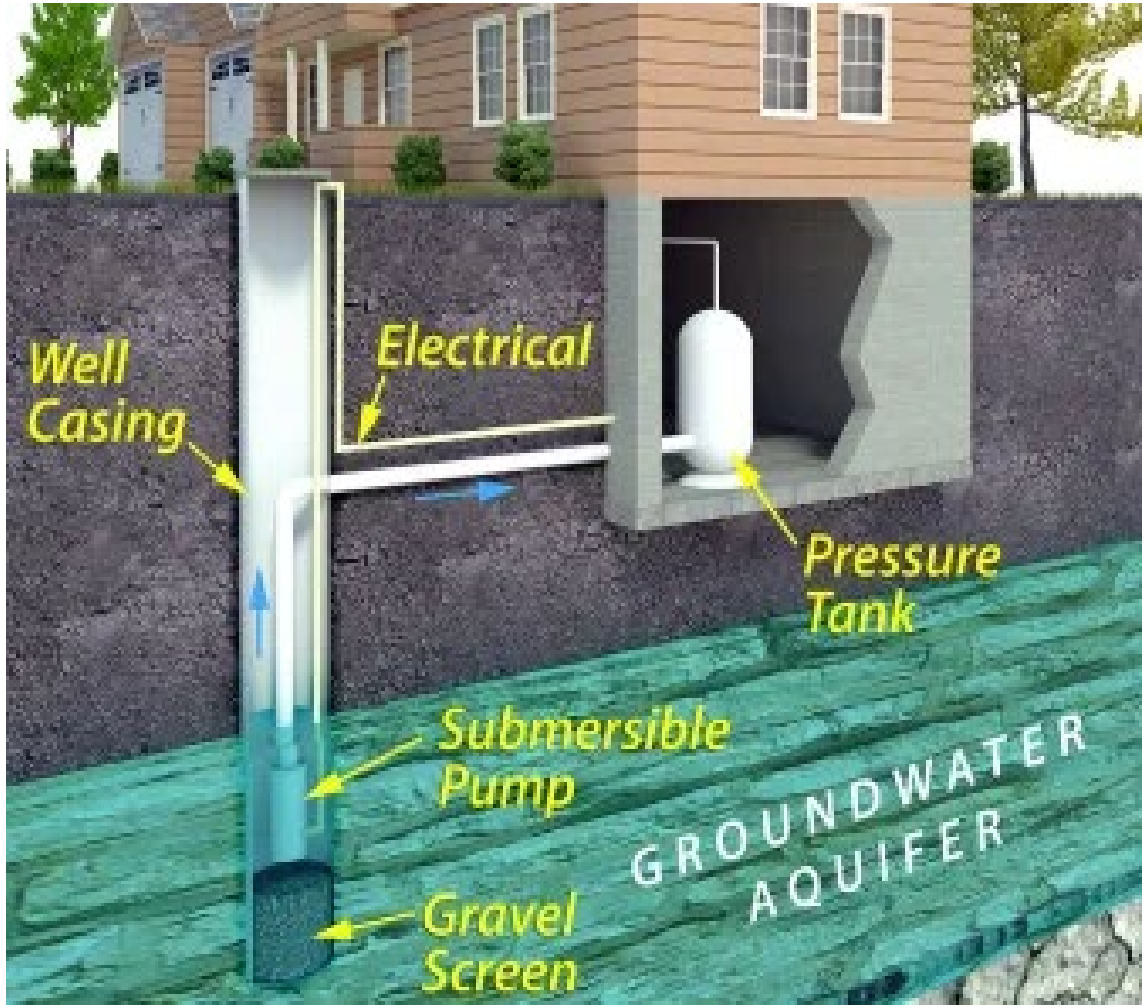
What is the next step?

Private Wells with Arsenic >10 in Texas



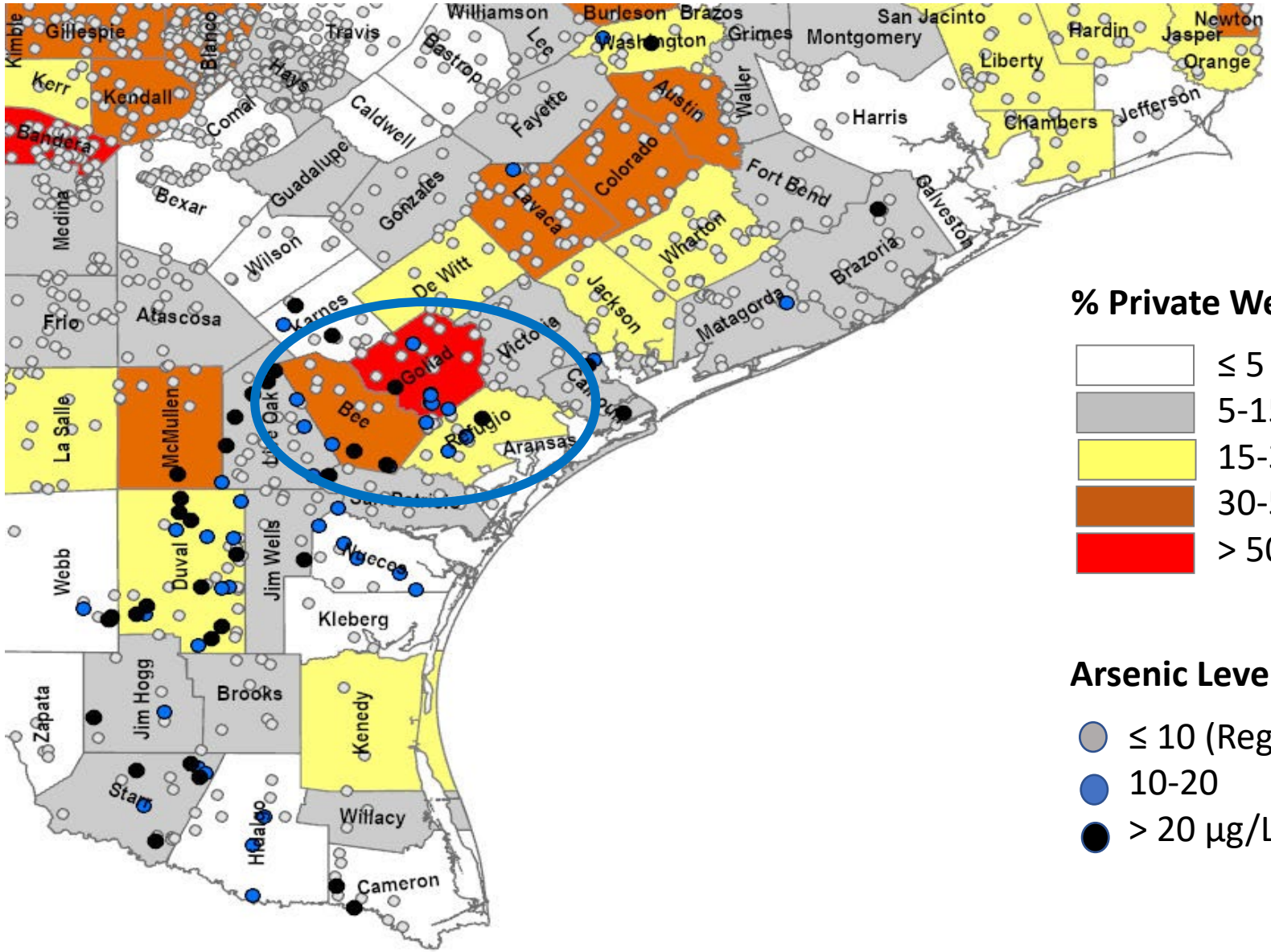


Domestic Wells



South Texas Domestic Arsenic Study

South Texas Domestic Well Arsenic Study



% Private Well Users

- ≤ 5
- 5-15
- 15-30
- 30-50
- > 50 %

Arsenic Level in Private Wells

- ≤ 10 (Regulatory Level)
- 10-20
- > 20 µg/L

Approach

Aim 1: Assess arsenic levels in private well drinking water

❑ Collect and analyze water samples from households using private wells

Aim 2: Estimate burden of arsenic exposure through biomonitoring

❑ Urine samples for recent exposure to arsenic

❑ Toenail samples for long-term exposure to arsenic

Approach

Aim 3: Estimate the effectiveness of preventive intervention to reduce arsenic exposure.

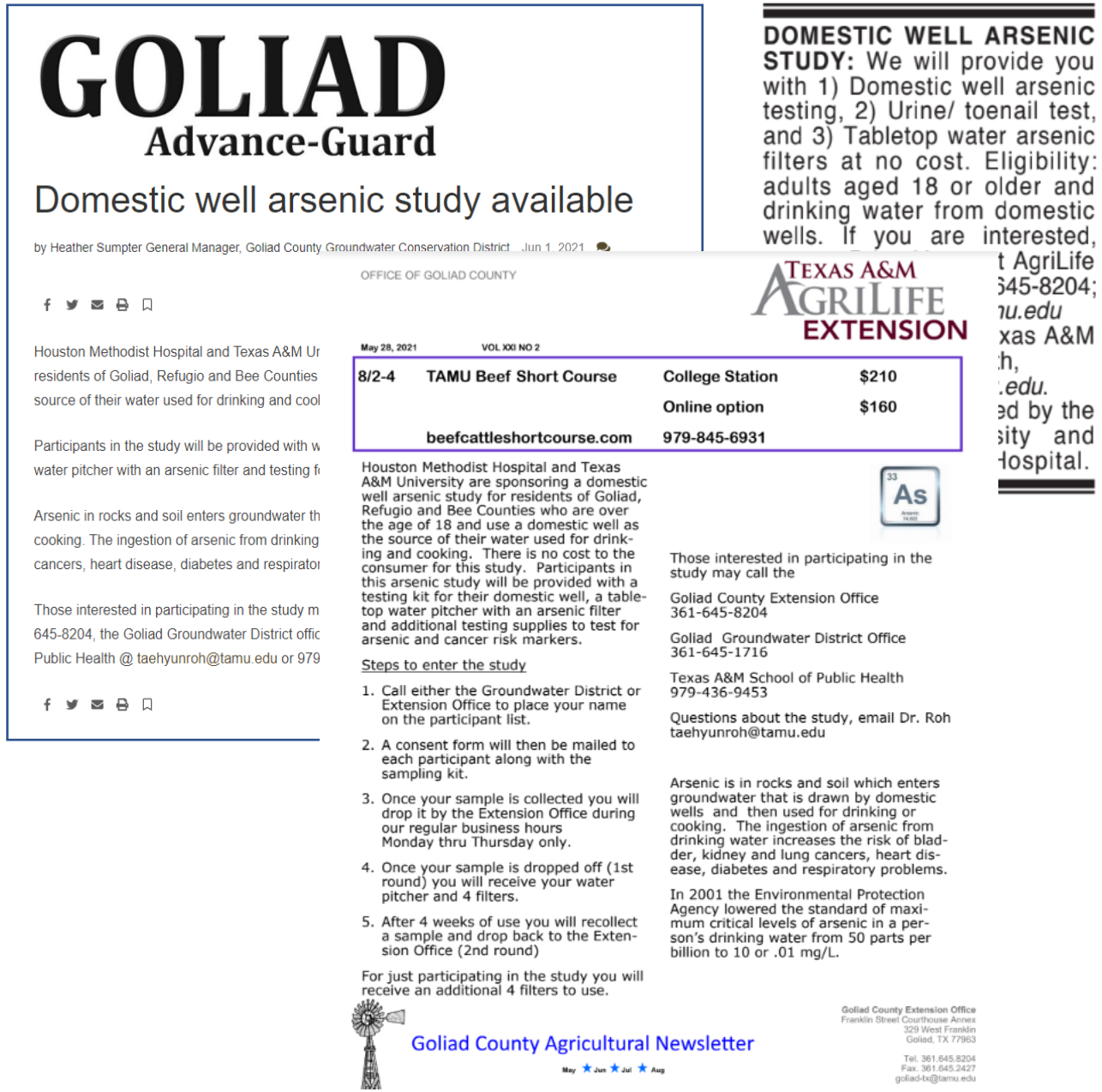
- ❑ Educational materials and a ZeroWater water filtration pitcher provided to households
- ❑ Evaluate the reduction of exposure through urine monitoring.

ELSEVIER

Environmental Research
Volume 158, October 2017, Pages 610-615

Effectiveness of table top water pitcher filters to remove arsenic from drinking water

Roxanna Barnaby [a] ✉, Amanda Liefeld [a] ✉, Brian P. Jackson [b] ✉, Thomas H. Hampton [a] ✉, Bruce A. Stanton [a] ✉



GOLIAD
Advance-Guard

Domestic well arsenic study available

by Heather Sumpter General Manager, Goliad County Groundwater Conservation District Jun 1, 2021

Houston Methodist Hospital and Texas A&M Ur
residents of Goliad, Refugio and Bee Counties
source of their water used for drinking and cool

Participants in the study will be provided with w
water pitcher with an arsenic filter and testing f

Arsenic in rocks and soil enters groundwater th
cooking. The ingestion of arsenic from drinking
cancers, heart disease, diabetes and respirator

Those interested in participating in the study m
645-8204, the Goliad Groundwater District offic
Public Health @ taehyunroh@tamu.edu or 979

DOMESTIC WELL ARSENIC STUDY: We will provide you with 1) Domestic well arsenic testing, 2) Urine/ toenail test, and 3) Tabletop water arsenic filters at no cost. Eligibility: adults aged 18 or older and drinking water from domestic wells. If you are interested, t AgriLife 645-8204; u.edu xas A&M h, .edu. ed by the sity and Hospital.

OFFICE OF GOLIAD COUNTY

TEXAS A&M AGRILIFE EXTENSION

May 28, 2021 VOL XXI NO 2

8/2-4	TAMU Beef Short Course	College Station	$210
		Online option	$160
	beefcattleshortcourse.com	979-845-6931	

Houston Methodist Hospital and Texas A&M University are sponsoring a domestic well arsenic study for residents of Goliad, Refugio and Bee Counties who are over the age of 18 and use a domestic well as the source of their water used for drinking and cooking. There is no cost to the consumer for this study. Participants in this arsenic study will be provided with a testing kit for their domestic well, a tabletop water pitcher with an arsenic filter and additional testing supplies to test for arsenic and cancer risk markers.

Steps to enter the study

1. Call either the Groundwater District or Extension Office to place your name on the participant list.
2. A consent form will then be mailed to each participant along with the sampling kit.
3. Once your sample is collected you will drop it by the Extension Office during our regular business hours Monday thru Thursday only.
4. Once your sample is dropped off (1st round) you will receive your water pitcher and 4 filters.
5. After 4 weeks of use you will recollect a sample and drop back to the Extension Office (2nd round)

For just participating in the study you will receive an additional 4 filters to use.

33 As

Those interested in participating in the study may call the

Goliad County Extension Office
361-645-8204

Goliad Groundwater District Office
361-645-1716

Texas A&M School of Public Health
979-436-9453

Questions about the study, email Dr. Roh
taehyunroh@tamu.edu

Arsenic is in rocks and soil which enters groundwater that is drawn by domestic wells and then used for drinking or cooking. The ingestion of arsenic from drinking water increases the risk of bladder, kidney and lung cancers, heart disease, diabetes and respiratory problems.

In 2001 the Environmental Protection Agency lowered the standard of maximum critical levels of arsenic in a person's drinking water from 50 parts per billion to 10 or .01 mg/L.

Goliad County Agricultural Newsletter

May ★ Jun ★ Jul ★ Aug

Goliad County Extension Office
Franklin Street Courthouse Annex
329 West Franklin
Goliad, TX 77963

Tel. 361.645.8204
Fax. 361.645.2427
goliad-tx@tamu.edu

South Texas Arsenic Study

Sponsored by Texas A&M University and Houston Methodist Hospital

Ingestion of arsenic from drinking water increases the risk of bladder, kidney, and lung cancers, heart disease, diabetes, and respiratory problems.

This study is to provide you with information about the quality of your drinking water and give you options to protect your health. For example, you can keep your current water, have bottled water, or install a treatment system. No information will be disclosed to anyone.

We will provide you with these at no cost. Choose one:

❑ **Option 1:** Water testing for arsenic and other metals ($75 value)

❑ **Option 2:** Water and toenail clipping testing ($175 value)
- You will receive tabletop water pitcher with arsenic filters ($90 value).
- Highly encouraged to know your long-term exposure to arsenic.

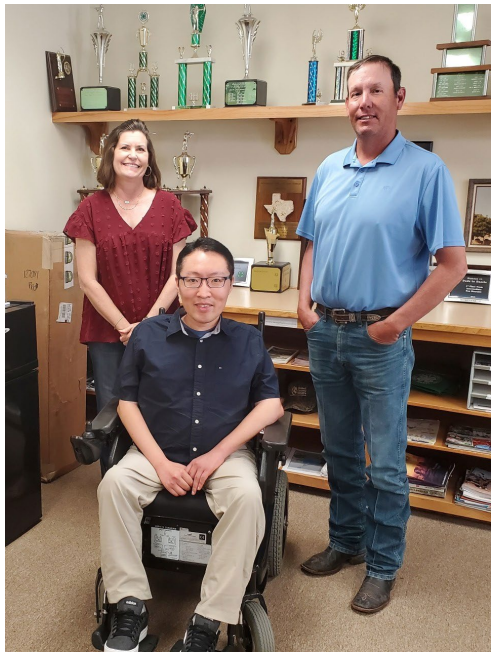
❑ **Option 3:** Water, toenail, and urine testing ($355 value)
- 2nd urine sample submission after 2 weeks of filter use
- You will receive additional replacement filters ($55 value).
- Highly encouraged to know your recent exposure and reduction of exposure after filter use.

How to submit samples

You will receive sampling kits with instructions. For Options 1 and 2, you can mail your samples to us. For Option 3, you will submit your samples at the AgriLife Extension Goliad/Bee Offices or University of Houston Victoria.

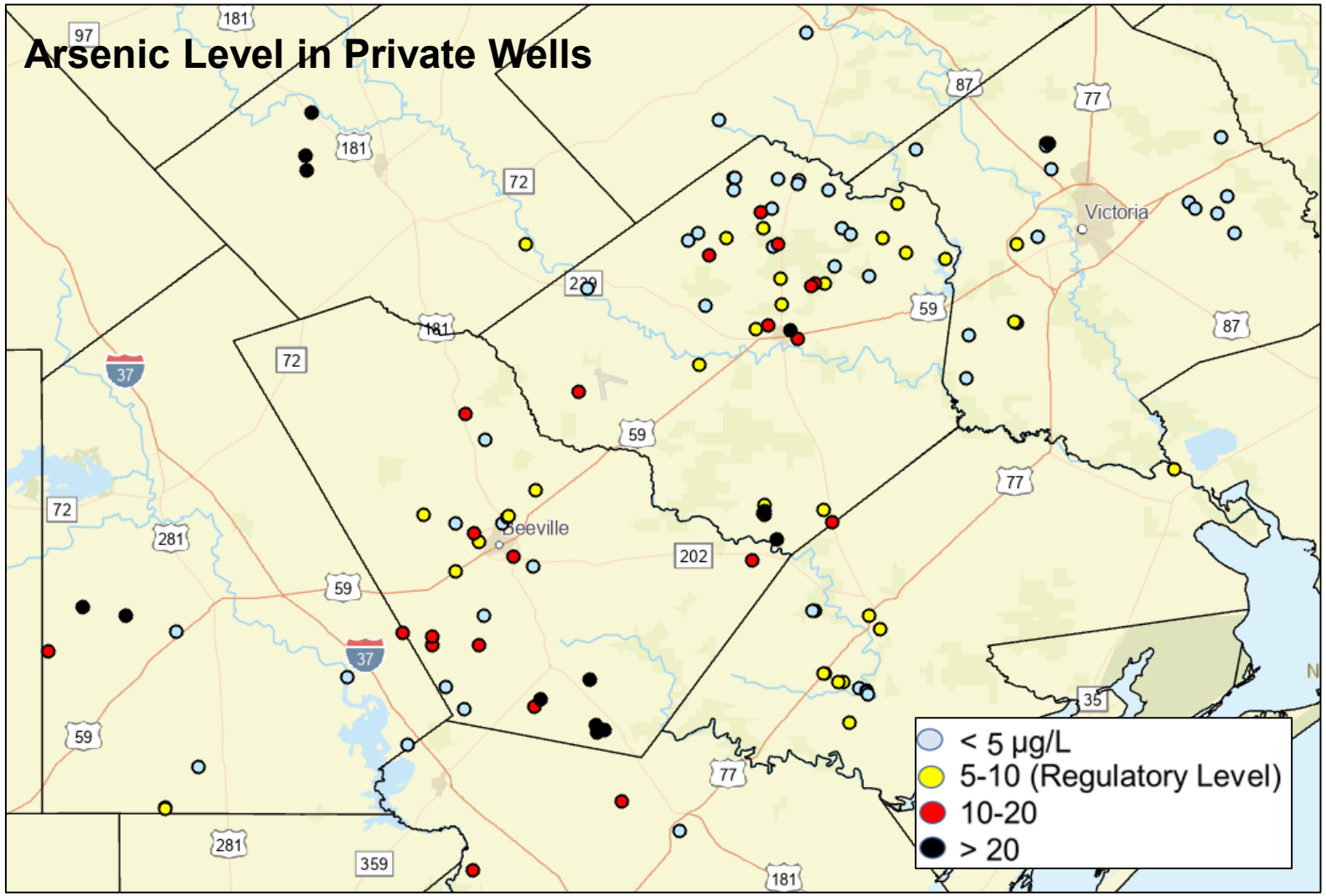
CONTACT
Texas A&M School of Public Health
taehyunroh@tamu.edu
Office: 979-436-9453 (Dr. Taehyun Roh)

AgriLife Extension Goliad County Office
Phone: 361-645-8204 (Brian Yanta)



Partnership with Texas Department of State Health Services - Chemical Threat Lab

Results



132 households

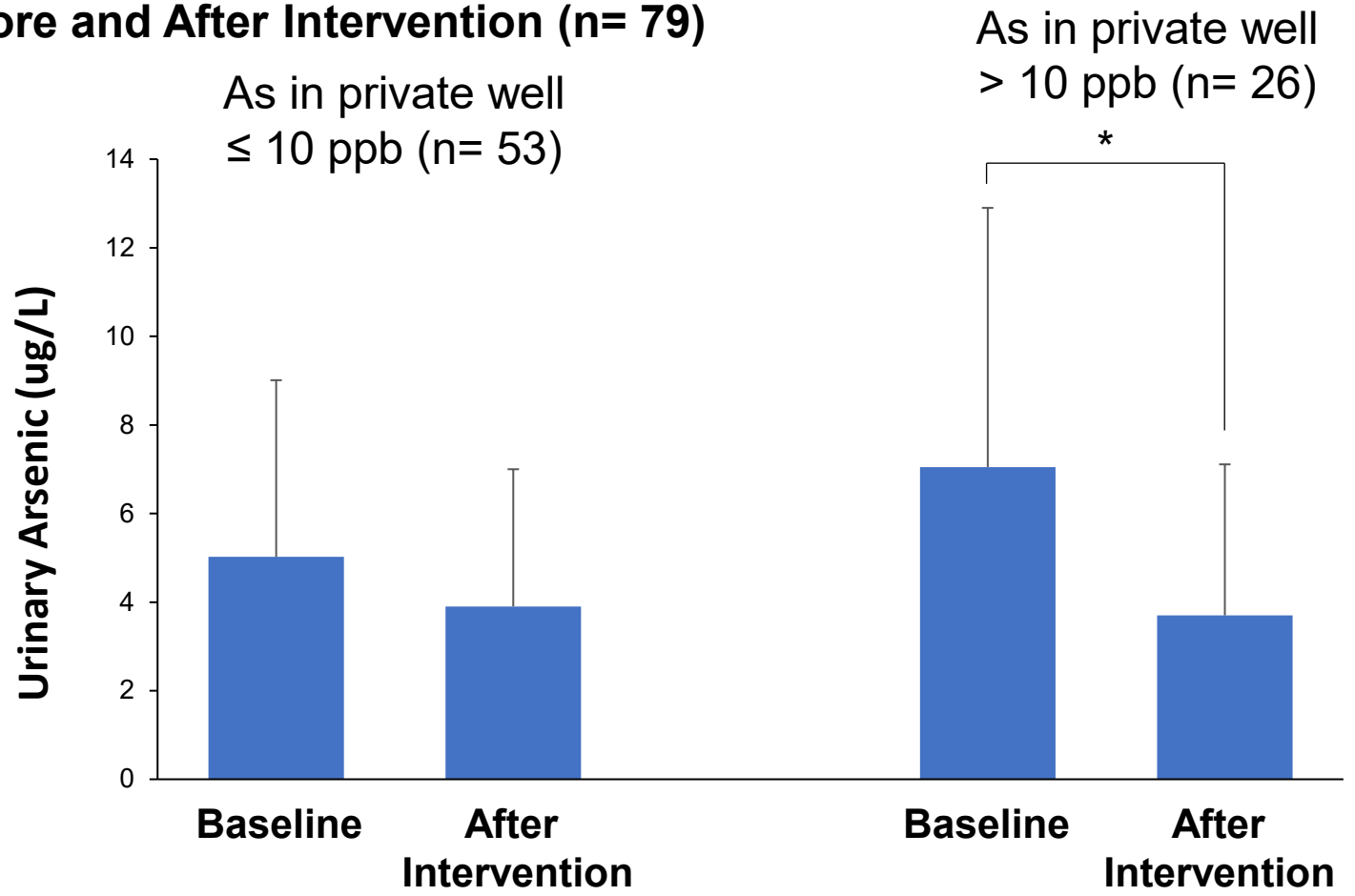
Arsenic	#Raw	#Final *
< 5 ppb	53	65
5 – 10	33	29
10 – 20	22	23
> 20	24	15

35 % of wells have arsenic greater than MCL 10 ppb.

* Water samples after any types of treatment and actual water consumed by residents

Intervention

Urinary Arsenic Before and After Intervention (n= 79)

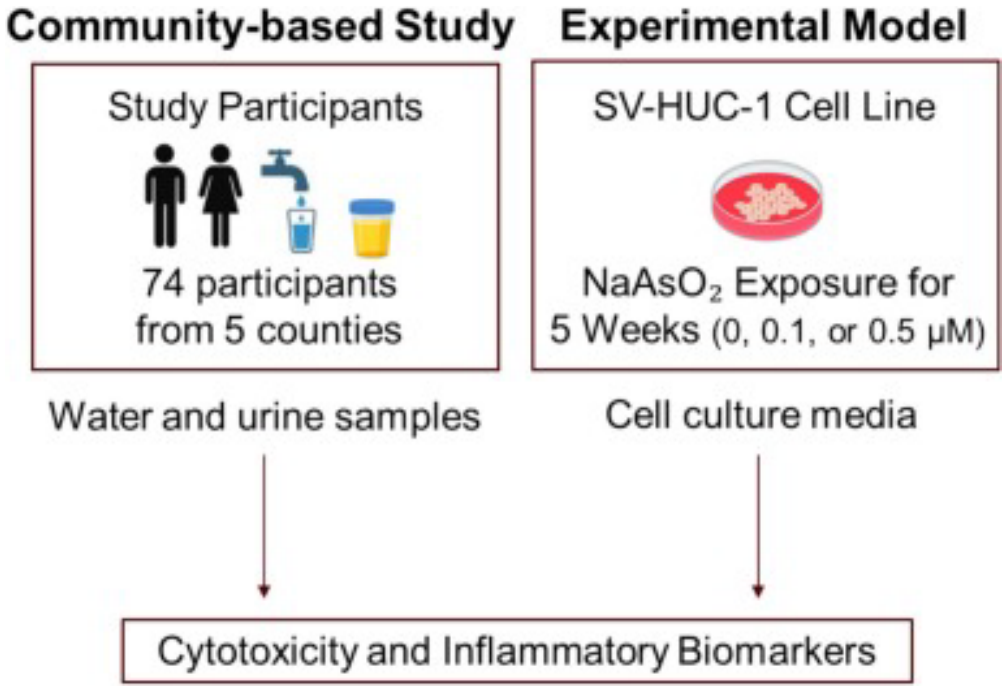


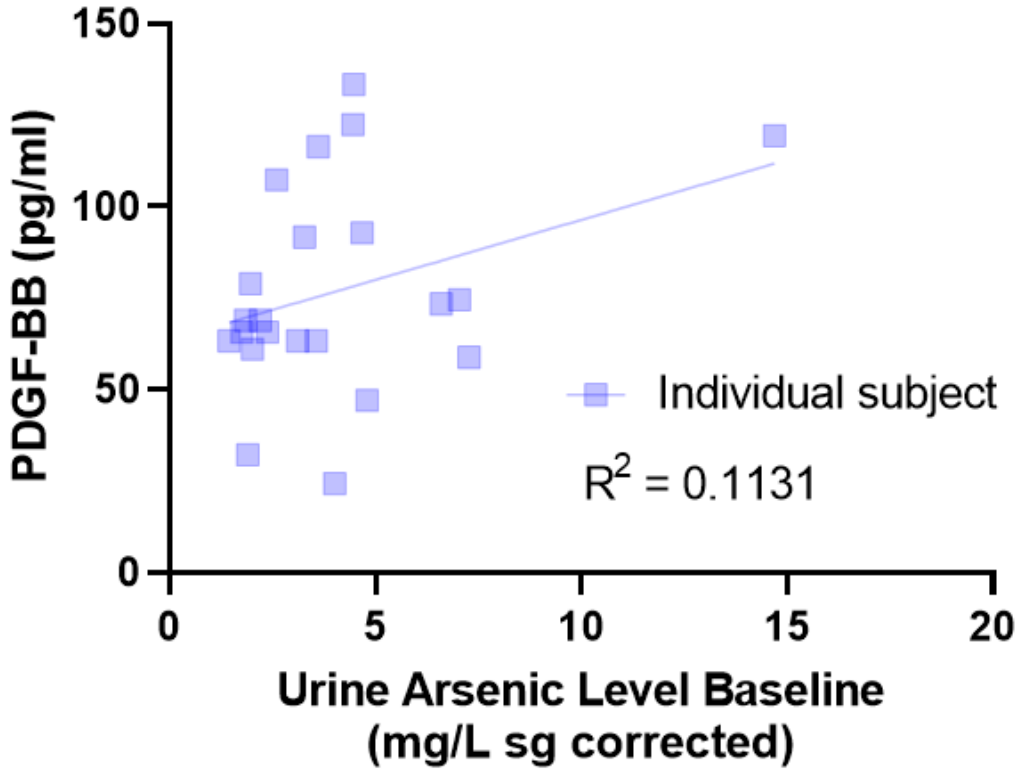
Geometric Mean	**5**.02	3.90	7.05	3.70
(95% CI)	(2.79, 9.01)	(2.18, 7.00)	(3.85, 12.9)	(1.93, 7.11)

Note: Adjusted for urinary creatinine, sociodemographic characteristics, smoking, and diet

Results

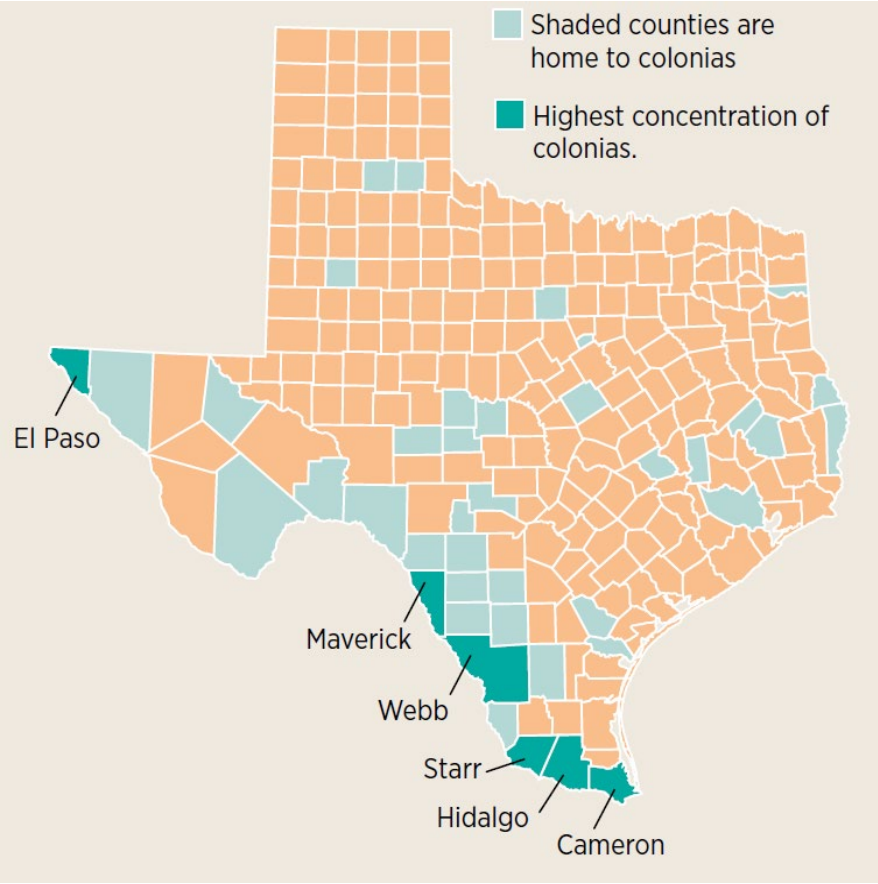
Correlation between Urinary Arsenic and PDGF-BB





Colonia Safe Water Project

Colonias in Texas



- Unincorporated, rural, and semi-rural communities primarily located along the Texas-Mexico border
- 2,294 colonial communities in TX, with approximately 500,000 residents.

Lack of Basic Infrastructure

Many colonias **lack essential services**, including potable water, sewage systems, paved roads, and adequate drainage. **Approximately 34% of residents do not have access to clean drinking water**, and over 50% lack proper wastewater disposal systems, which poses severe health risks

High Poverty and Unemployment Rates

Residents of colonias experience extreme poverty, with the **average household income being less than $834 per month**. **Unemployment rates in these areas range from 20% to 60%**, significantly higher than the state average of 7%

Educational Challenges

A significant proportion of colonia residents have limited educational attainment, with **70% having less than a high school education**. This limitation severely impacts their economic opportunities and overall quality of life

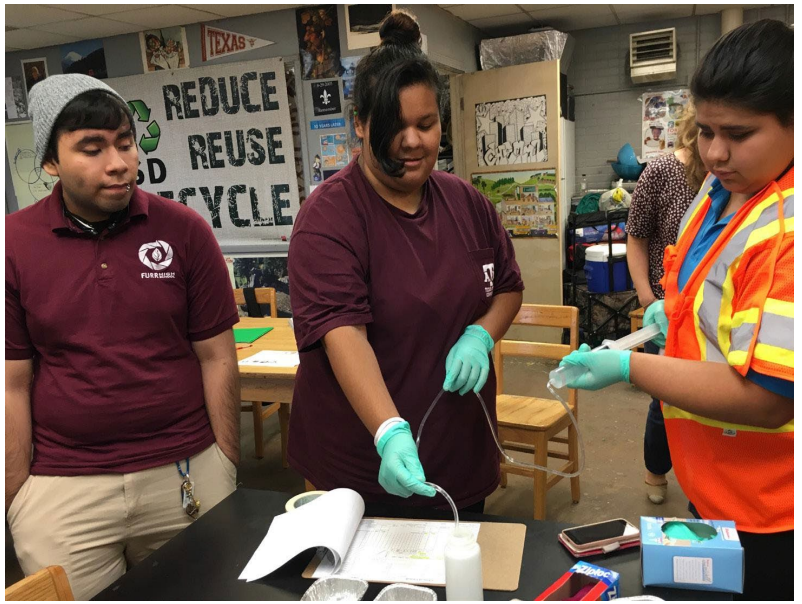
Partnerships

The success of this program was made possible through a broad and diverse network of partnerships.

ADDITIONAL PARTNERS: Angie's Day Spa | Guajira Clinic | Wesley Nurse Program | Progreso Fire Department | Alamo Fire Department | San Juan Advancement Center | Alamo Advancement Center | Progreso Community Resource Center | San Carlos Endowment Community Resource Center | Iglesia Bautista Bethel | Iglesia Puerta Del Cielo | Texas A&M University Admissions Office | Texas A&M University School of Public Health Graduate Student Services.

Citizen Scientist

A member of the public who participates in scientific research activities in collaboration with professional scientists

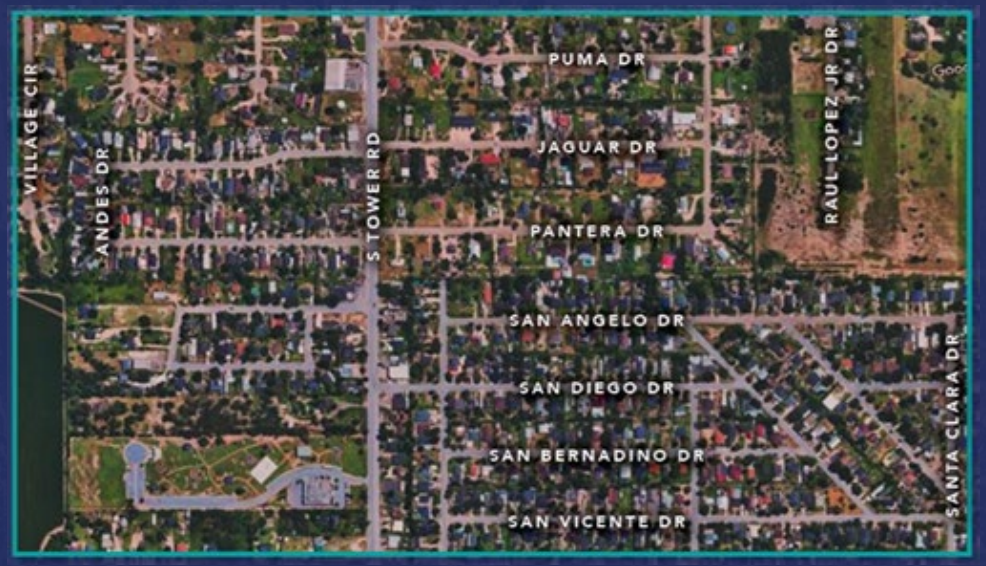


Community Health Workers

A frontline public health worker who is a trusted member of and/or has an unusually close understanding of the community served.

SITE 1

PROGRESO COMMUNITY



SITE 2

ALAMO COMMUNITY

Community-Based Participatory Research

PARTICIPANT RECRUITMENT

SURVEY ADMINISTRATION

ONSITE WATER TESTING & ADDITIONAL WATER SAMPLE

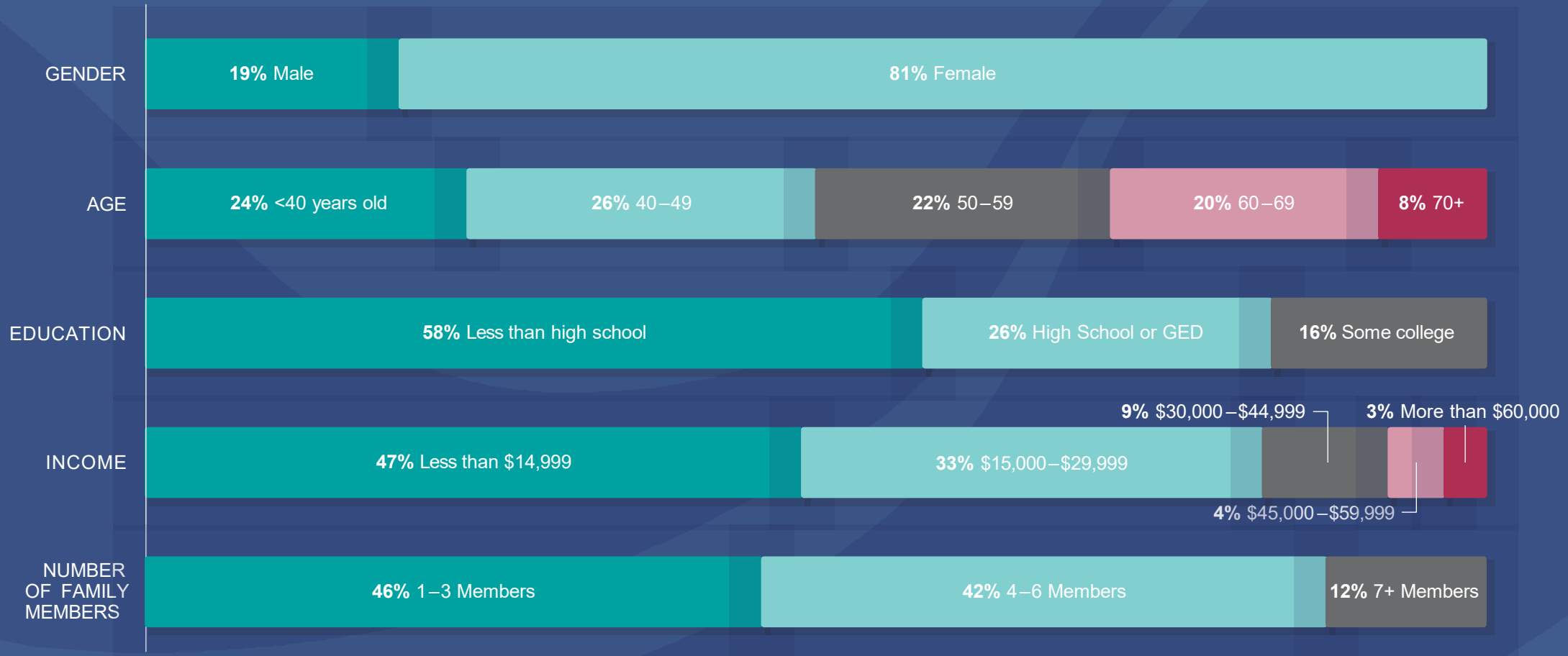
INTERVENTION ITEMS & STIPEND

COLLECTION OF BIOMARKER SAMPLES (URINE, TOENAIL, & DRY BLOOD)

BASELINE & FOLLOW-UP DIETARY CONSUMPTION SURVEYS

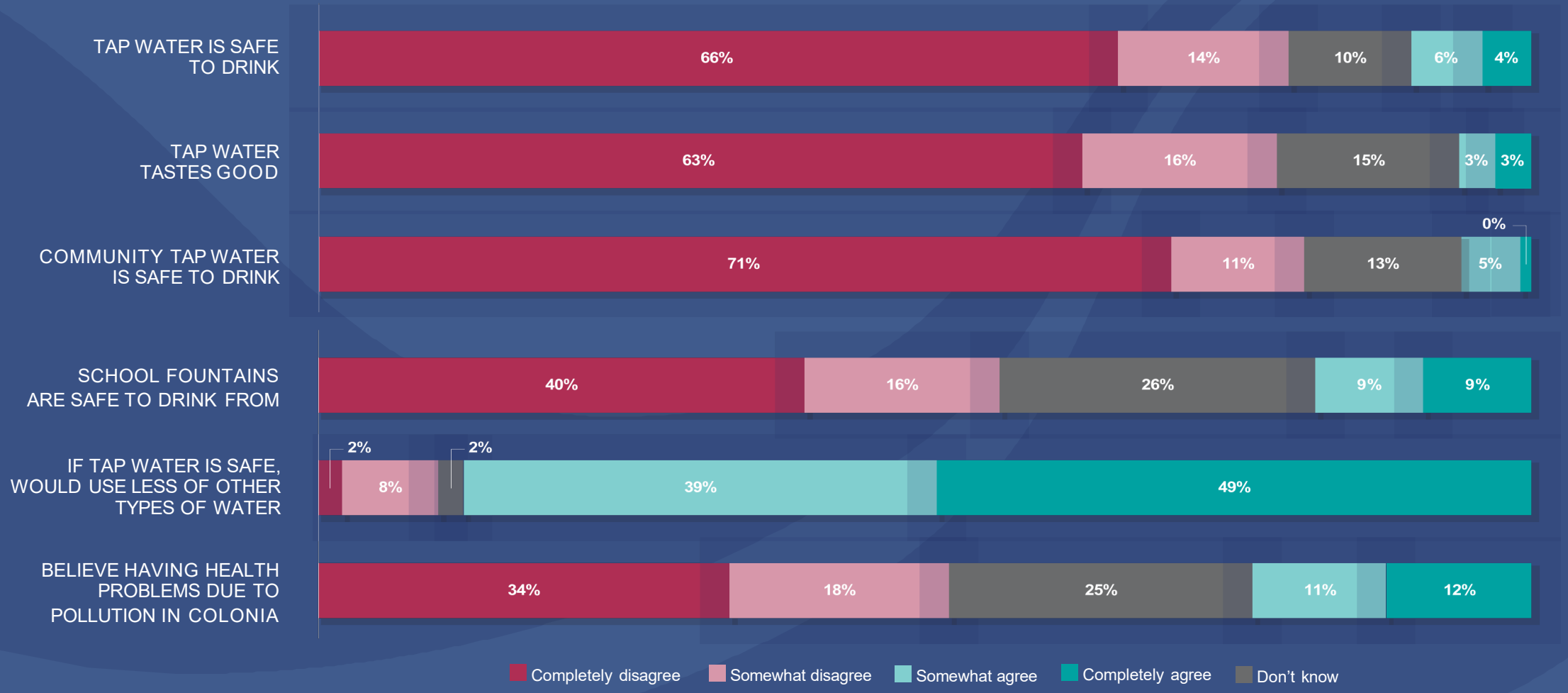
PARTICIPANT CERTIFICATE OF ACKNOWLEDGMENT & STIPENDS

Characteristics of Participants

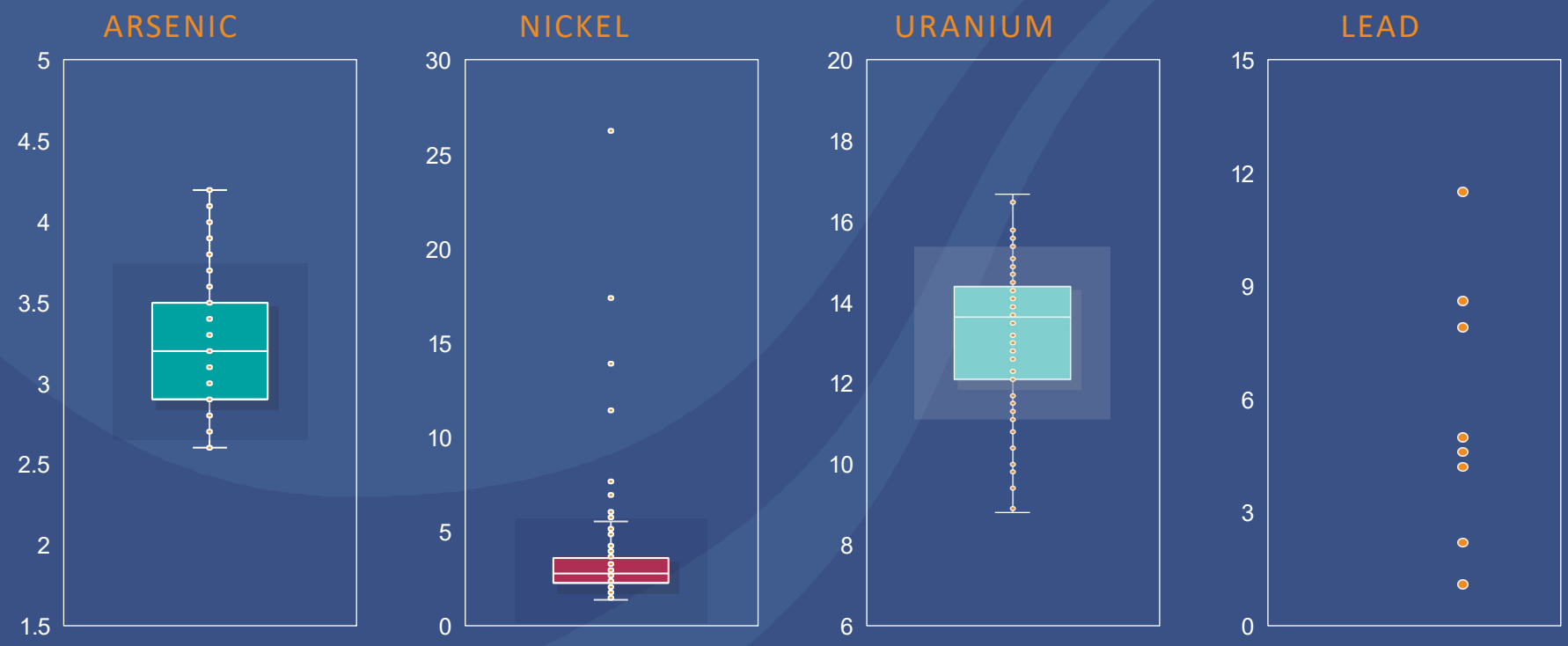


Characteristics of Participants *(CONTINUED)*

Perception of Drinking Water Quality

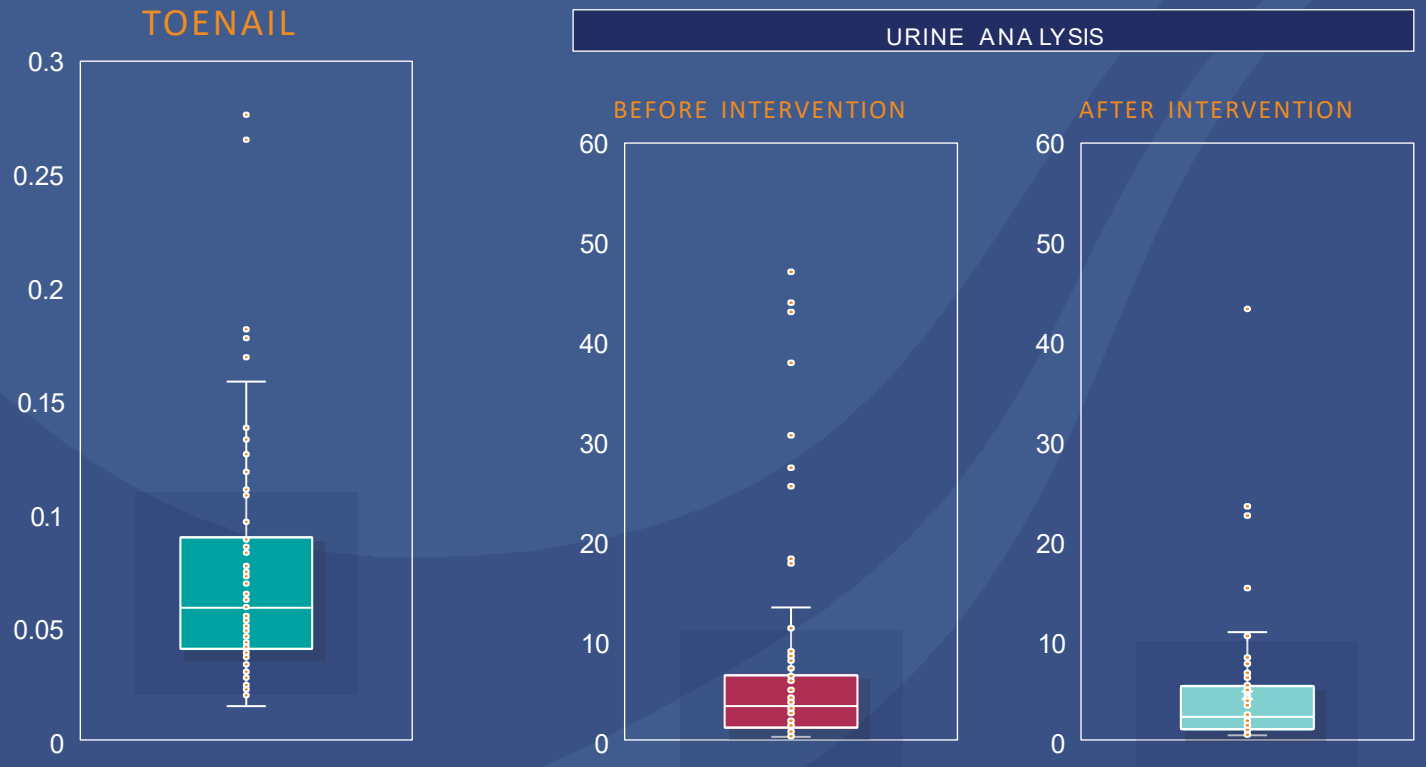


Water Quality – Metals



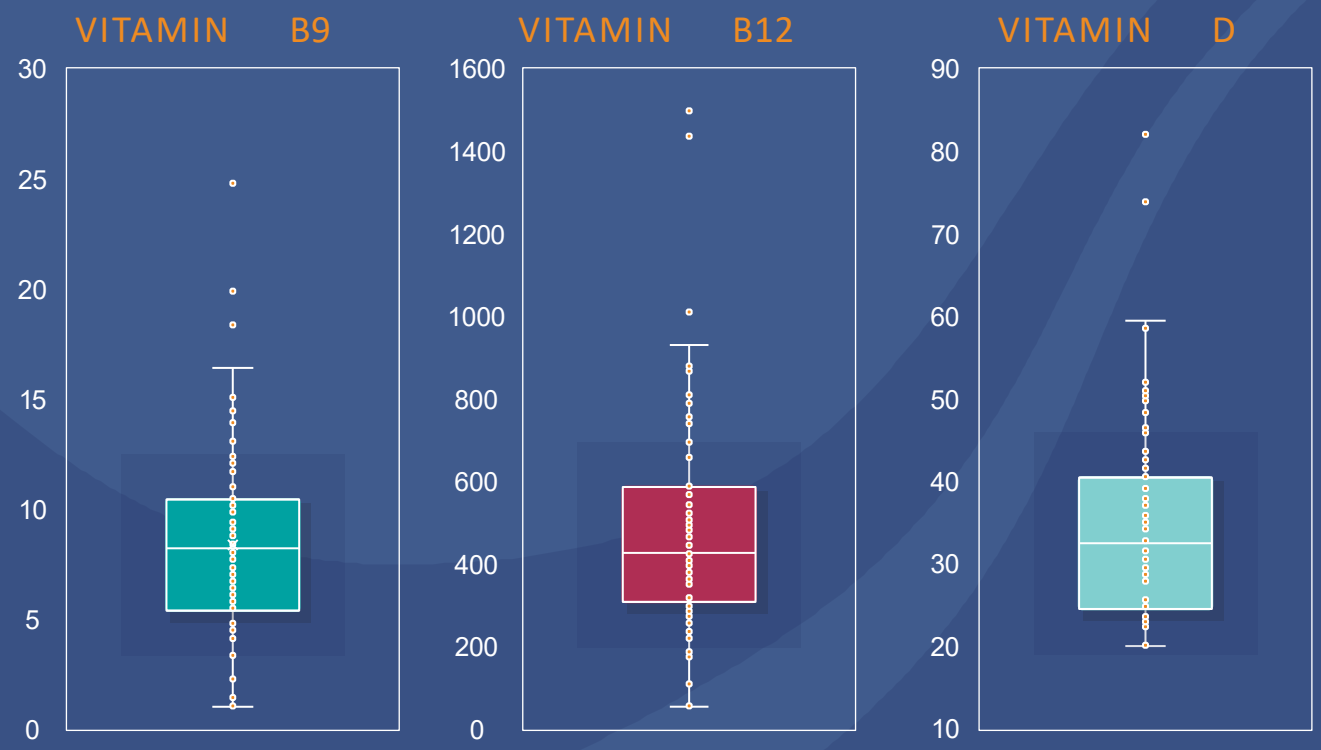
	ARSENIC	NICKEL	URANIUM	LEAD
% Homes with detection	100%	100%	100%	7%
Ranges of levels	2.6 – 4.2 ppb	1.3 – 26.3 ppb	8.8 – 16.7 ppb	ND – 11.5 ppb
EPA Action level	10 ppb	100 ppb	30 ppb	15 ppb
Maximum contaminant goal	0 ppb			0 ppb

Biomonitoring – Arsenic



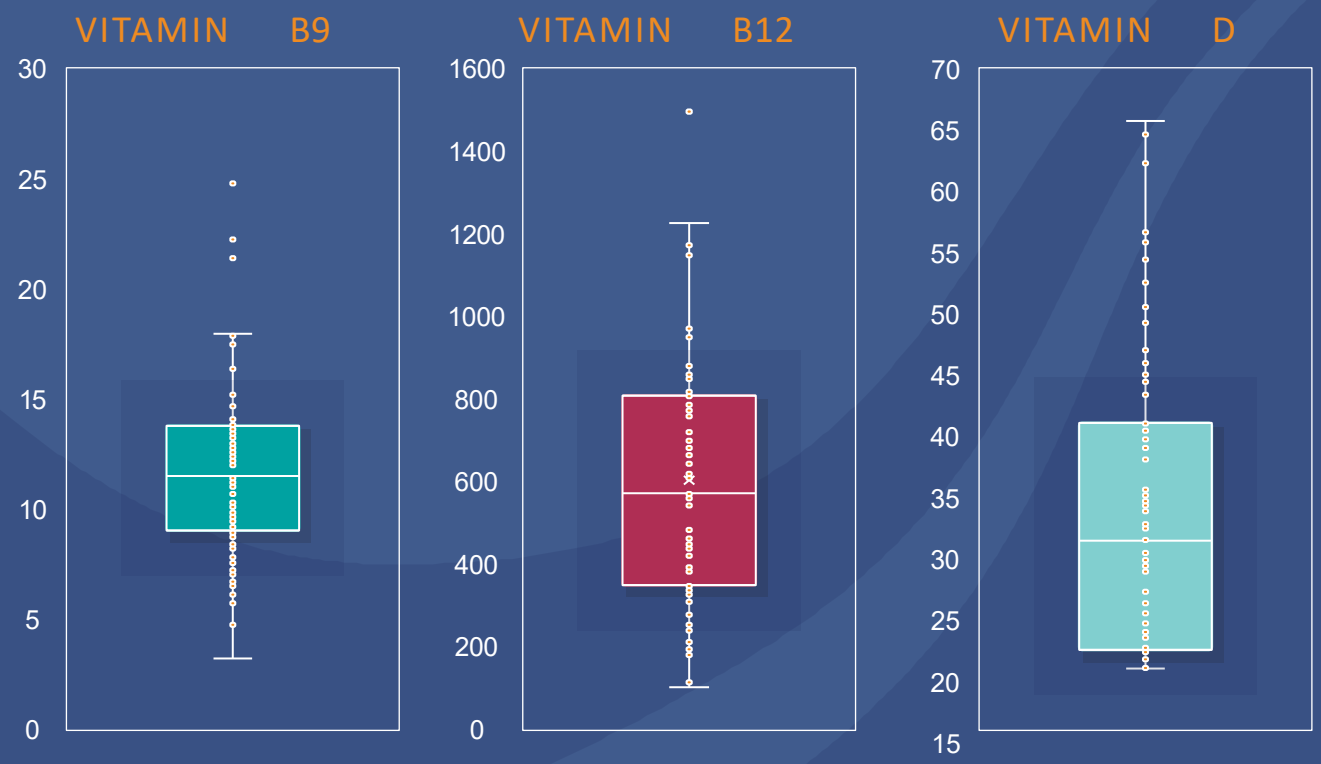
	TOENAIL	URINE ANALYSIS	
		BEFORE INTERVENTION	AFTER INTERVENTION
% Participants with detection	100%	100%	100%
Ranges of levels	0.03 – 0.37 µg/g weight	0.21 – 47.2 µg/g creatinine	0.29 – 43.4 µg/g creatinine
% High risk	20%	23%	13%

Vitamin Levels



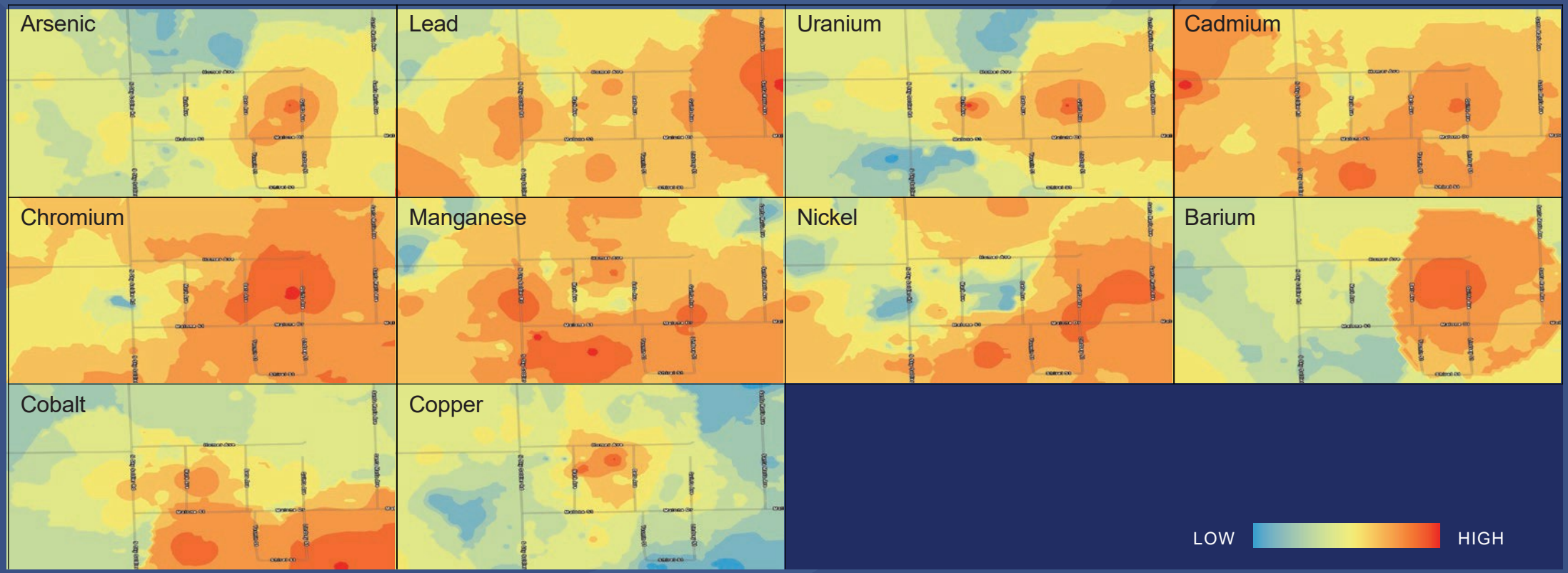
Ranges of levels	1.0 – 24.8 ng/ml	50.0 – 1500 pmol/ml	20.0 – 82.2 ng/ml
Deficiency cut-off	4 ng/ml	180 pmol/ml	25 ng/ml
% Deficiency	16.9%	4.5%	25.8%

Vitamin Levels



Ranges of levels	4.7 – 24.8 ng/ml	112.9 – 1500 pmol/ml	20.0 – 64.6 ng/ml
Deficiency cut-off	4 ng/ml	180 pmol/ml	25 ng/ml
% Deficiency	1%	5%	28%

Spatial Patterns of Heavy Metals in Toenails



By the Numbers

3 COMMUNITY ADVISORY BOARDS STRENGTHEN WITH 60+ PARTICIPANTS

We maintained three Community Advisory Boards with over 60 active participants.

203 HOMES SURVEYED AND ASSESSED

We approached 203 homes, completing surveys along with urine, toenail, and blood assessments.

400+ WATER FILTERS DISTRIBUTED

We provided over 400 water filters to households in need.

COMMUNITY ADVISORY BOARD

COLLECTING SAMPLES

COLLECTING SAMPLES

By the Numbers

63+% REDUCTION IN ARSENIC LEVELS

We successfully reduced arsenic levels in 63% of Alamo participants and 65% of Progreso participants.

43+% ARSENIC REDUCTION FROM HIGH-RISK TO LOW-RISK LEVELS

In Progreso, we successfully reduced the number of participants with high-risk arsenic levels to low-risk, in 43% of participants. Similarly, in Alamo, we successfully reduced the number of participants with high-risk arsenic levels to low-risk, in 44% of participants.

$48,000+ GIVEN BACK TO SOUTH TEXAS COMMUNITIES

We directly invested over $48,000 to support South Texas communities.

PRESENTATION

COMMUNITY ADVISORY BOARD

The Time is Now

PRELIMINARY FINDINGS INDICATE THERE EXISTS:

- **100% OF HOMES** had arsenic, nickel, and uranium in their drinking water.
- **A DISCONNECT BETWEEN ENVIRONMENTAL PROTECTION AGENCY (EPA) STANDARDS** for safe levels of heavy metals in drinking water and Public Health standards.
- The possibility of **ADDITIONAL ENVIRONMENTAL FACTORS** (bacteria, soil & air quality) impacting water quality in these communities.
- Real challenges for community members to have **ACCESS TO SAFE DRINKING WATER.**
  - ***Individual Level*** *– Cost, Misinformation, & Disinformation*
  - ***Community Level*** *– Infrastructure, Funding, & Practical Access to State-Based Resources.*

The Time is Now

PRELIMINARY FINDINGS INDICATE THERE EXISTS:

- These communities have been underserved for far too long — CREATING TRUE BARRIERS TO HEALTH EQUITY.
  - *Let's build on the momentum now that we have the support and trust of the community.*
- We have a SOCIAL RESPONSIBILITY TO CONTINUE OUR EDUCATION AND RESEARCH to provide more adequate short- and long-term practical solutions.
  - *The community is watching.*
- Our **COMMUNITY-BASED APPROACH** is working in creating:
  - *Practical Short- and Long-Term Solutions*
  - *A Reduction in Exposure*
  - *Linguistically and Culturally Sensitive Education*
  - *Community Empowerment*

Summary

- Provide critical data on the arsenic contamination in drinking water sources and determine the burden of arsenic exposure and related diseases in the border communities
- Use biomarkers to provide unique insights into prognosis and potential targets for screening
- Establish a pragmatic prevention strategy to reduce exposure from drinking water and health outcomes
- Provide evidence and rationale to raise local arsenic containment advocacy or potential policy changes


"SAFE
DRINKING
WATER
FROM ANY
SOURCE,
ANYWHERE"