

UNM METALS

UNM Metals Exposure and Toxicity Assessment on Tribal Lands in the Southwest (UNM METALS) Superfund Research Program Center

COLLEGE OF PHARMACY
METAL EXPOSURE AND TOXICITY ASSESSMENT
ON TRIBAL LANDS IN THE SOUTHWEST



SRP Risk e-Learning webinar

Open and effective communication about environmental health risks in Tribal communities



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Sept 24, 2021



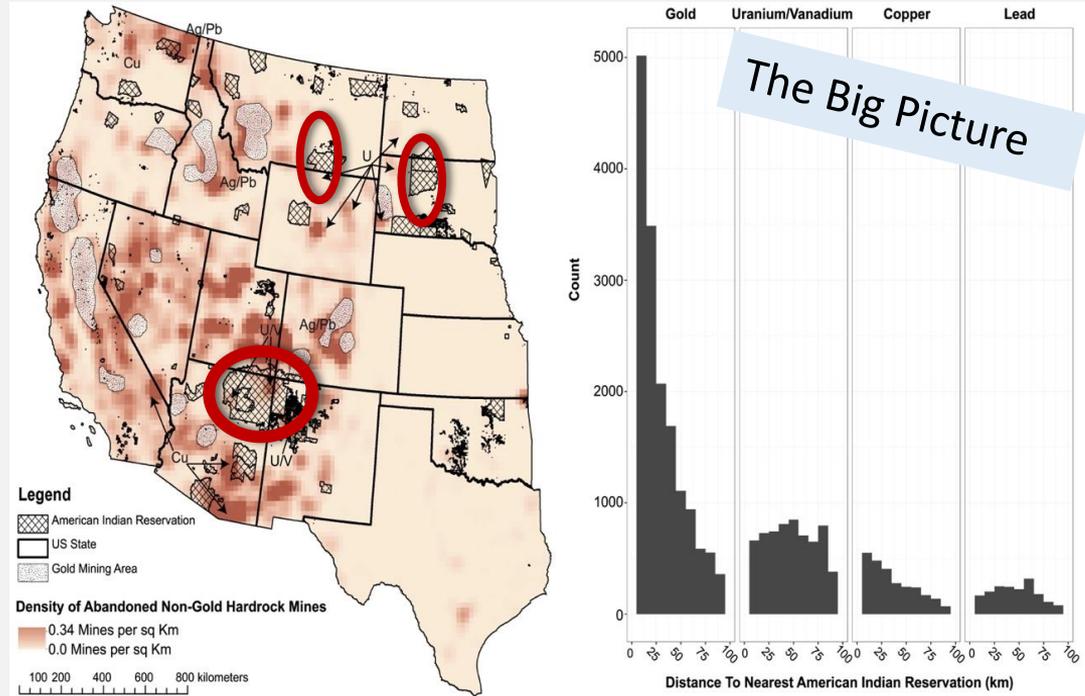
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Abandoned mines and Native Communities



- >1/2 of Native population of US lives in 13 US states where 161,000 abandoned hard rock mines also located
- >600,000 Native Americans live within 10 km of abandoned mines
- Combined with greater reliance on local resources, **potentially >exposure and impacts**



(Lewis, Hoover and MacKenzie, 2017, Current Environmental Health Reports)

Limited understanding about environmental public health for tribes

“unique need for tribal-focused research to identify impacts of pollution, dietary exposure, cumulative risk and climate change as well as to inform decisions to reduce health risks...”

— US EPA, 2004

Land-based cultures

- Contact with their environment
- Historical and current presence of mining, oil and gas industry
- Reliance on natural resources for traditional diets, customs and languages.

Sovereign tribal governments

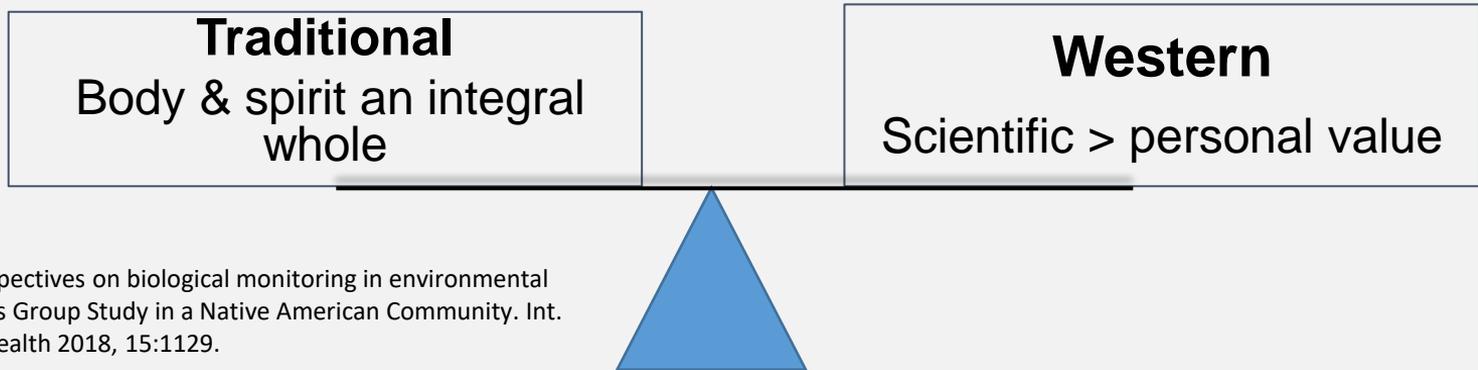
- Tribal IRB is a governing body.
- **Lack of culturally-centered primary research**

US EPA, 2004



Informed consent from the Tribal governance as well as individual participants

- Provide community-specific research-related information needed to make an informed decision
- Assure community of prior endorsement, wider dissemination of the study objectives, methods and results
- Tribal IRB approval, oversight > risk communications – broader aspects of report backs, several levels and increased complexity



Ongoing Collaboration and Trust

UNM Community Environmental Health Program

- Decades of community-engaged research
- Capacity building, environmental health trainings and clinical laboratory expertise & support
- Metals biomonitoring and health effects research

Current Work with Navajo Nation

- **DiNEH Project** – Since 2004
- **Navajo Birth Cohort Study** – Since 2013, now ECHO NIH Program

Expanded Work with Cheyenne River Sioux *and* Crow Nation

- **UNM CTSC, NARCHVII**
- **UNM Native EH Equity Center** a Center for Excellence in Environmental Health Disparities

Tools for successful communication



1. Maps – rural areas, well accepted, used

- Local knowledge of Locations Mine sites and, waste materials, land use



“Traditional Ecological Knowledge”

Lin Y, Hoover J, Beene D, Erdei E, Liu Z. Environmental risk mapping of potential abandoned uranium mine contamination on the Navajo Nation, USA, using a GIS-based multi-criteria decision analysis approach. Environ Sci Pollut Res Int. 2020; doi: 10.1007/s11356-020-09257-3.

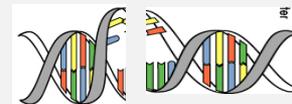
3. Explain scientific study concepts and results



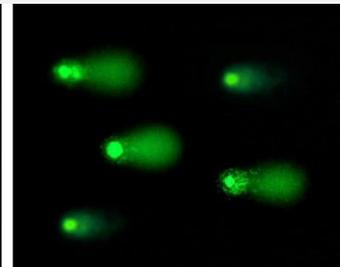
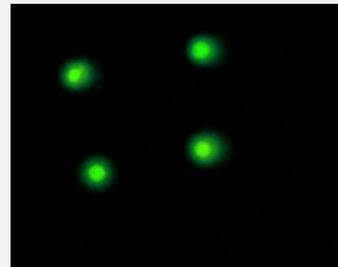
2. Graphical presentation format – always use comparisons



Undamaged DNA:
Cells without tails



Damaged DNA:
Cells with tails



Navajo Nation Abandoned Uranium Mines Superfund Cleanup Sites



Monument Valley Area
- Skyline Mine

Cove / Mesa Area
- 2 Transfer Stations
- Mesa Mines
- Cove Wash

Cameron Area
- 20 Cameron Area Mines
- Tuba City Open Dump



Blue Gap/Tachee AUMs
Not included in Superfund removal actions as of 2013; added to Orphan AUM list in 2015

Eastern Agency Area
- NE Church Rock
- Quivira
- Ruby Mines
- Mariano Lake
- Section 32/33

Exposures:
According to USEPA, people live within a quarter mile of 14% of the 523 AUMs on the Navajo Nation

← Puerco River Valley/
Sanders/Nahata Dziil

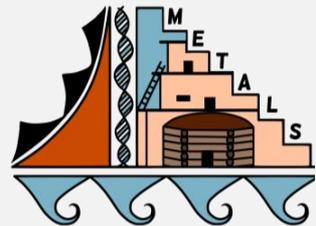


Legend

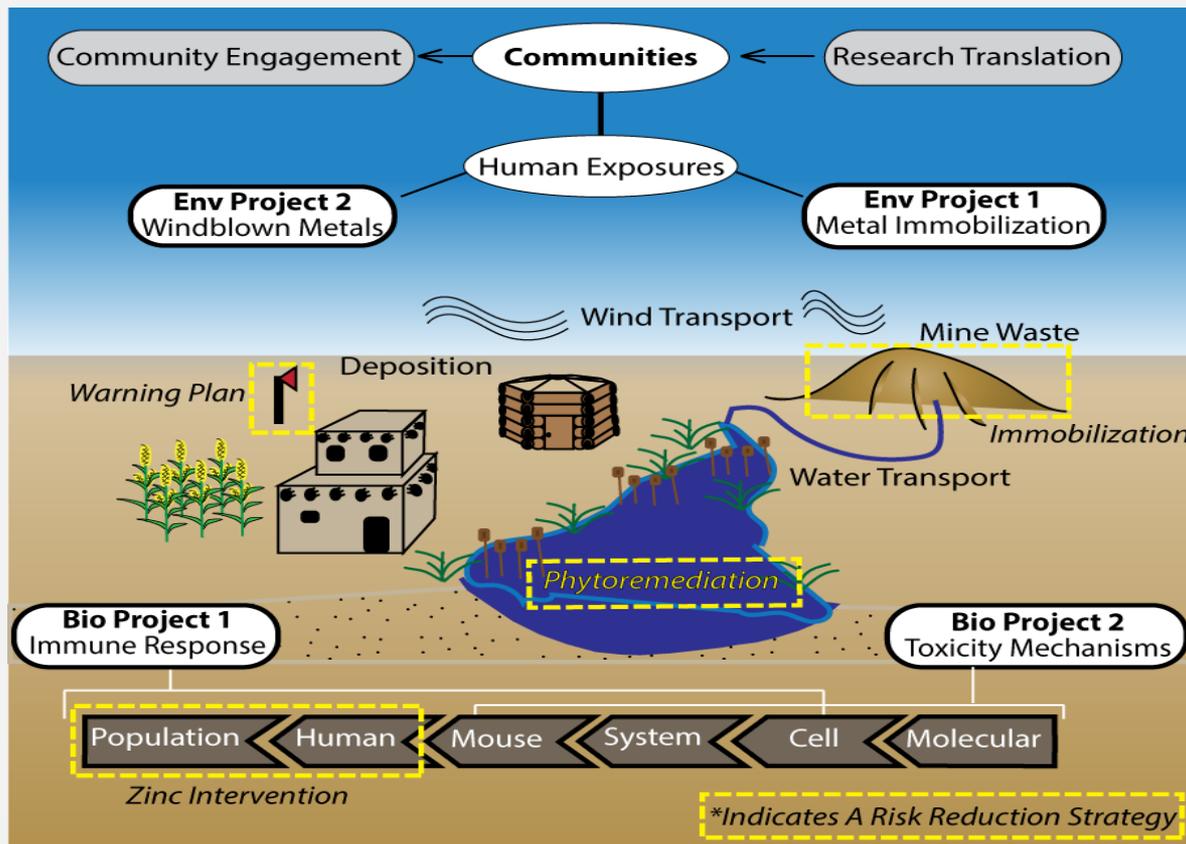
- AUM Sites
- Cleanup Areas
- AUM Region
- Chapter Boundary

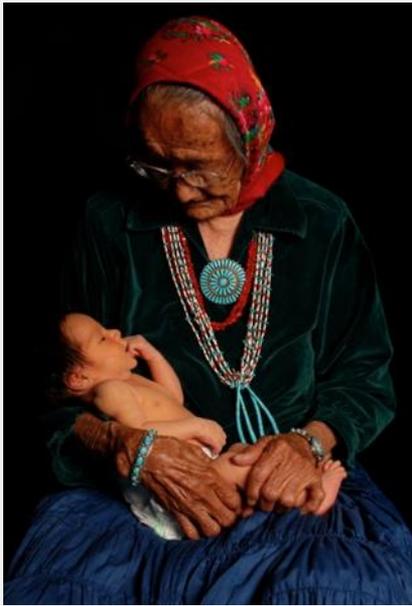
Map courtesy USEPA Region 9, modified by SRIC





Communicating the UNM METALS SRP Center





Navajo Birth Cohort Study (NBCS) Communicating Risk: Biological Monitoring and Report Back



	Blood	Urine	Meconium
Mother	<ul style="list-style-type: none"> ➤ Enrollment ➤ Delivery 	<ul style="list-style-type: none"> ➤ Enrollment ➤ Delivery 	
Father	<ul style="list-style-type: none"> ➤ Enrollment 	<ul style="list-style-type: none"> ➤ Enrollment 	
Baby	<ul style="list-style-type: none"> ➤ Birth (cord blood) ➤ 2-6 months of age ➤ 12 months of age 	<ul style="list-style-type: none"> ➤ Birth ➤ 2-6 months of age ➤ 12 months of age 	<ul style="list-style-type: none"> ➤ Birth



Participant Report Back Letters



Biomonitoring and micronutrients results of all 36 metals (CDC)

- Mother (Enrollment)
- Mother and baby (Delivery)
- Baby (Birth to 12 months)
- Father's letter (Enrollment)
- Focus of Letter
 - 4 reportable metals (U, As, Hg & Pb)
 - Micronutrients (Zn...
 - Participant's own results
 - Cohort ranges – community information!
 - National range - 50- 95% range of NHANES concentrations (2011-2012) – CDC Fourth Report
- Privacy and confidentiality rules followed
- Results placed in NAIHS medical records of participants when explicitly stated in consent form



Helping Your Child to
Grow in Beauty

College of Pharmacy
Community Environmental Health Program
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University of New Mexico
Albuquerque, New Mexico 87131-0001
905 Vassar NE
Telephone 505.272.4087 Fax 505.272.4186

<Date>

<Salutation> <FirstName> <LastName>
<Address1>
<Address2>

RE: Results of Navajo Birth Cohort Study Biomonitoring – Metals in Blood and Urine

Dear <Salutation> <LastName>,

The research team from the Navajo Birth Cohort Study (NBCS) wants to thank you for participating in the study. As you know, the NBCS is studying if uranium on the Navajo Nation affects child birth and development. To fully understand uranium exposures and health, we have also analyzed other environmental chemicals that may occur on Navajo.

Recently, you gave us a sample of blood and urine to analyze to see if you might be exposed to metals in your environment. Below are your results for the four metals of most concern on Navajo Nation that are also reportable to state departments of health. Attached at the end of this letter are also results for all metals for which your blood and urine were tested. If you asked us to put the results in your medical record, the full report will be sent to the medical facility you indicated at enrollment.

Your results are within the normal range for arsenic, lead, uranium and mercury.

In the table below, your results are listed in the second column. To help you compare your results to what we see around the United States, the upper half of the ranges found in the National Health and Nutrition Examination Survey (NHANES) conducted by our partners at the Centers for Disease Control and Prevention (CDC) are listed in the second column. NHANES establishes ranges for these chemicals as they are typically found in people all across the United States. (When we have metals information for more than 100 participants in the NBCS, a column showing the range of levels we see on Navajo Nation will also be presented to help you understand your results relative to your community.)

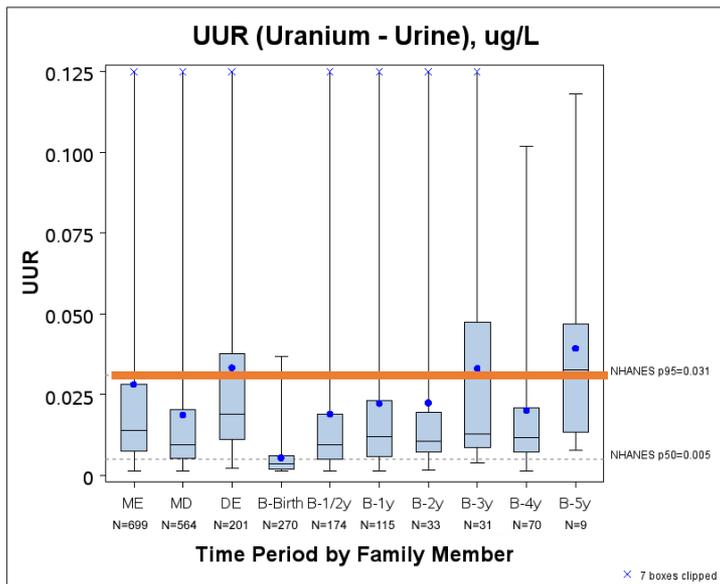
Mother's Enrollment Sample Data

Metal of concern	Your value	NHANES (50 th – 95 th percentile range)	Note: Unavailable, currently fewer than 100 participant samples NBCS (Range: n =)
(Total Arsenic - Urine)	3.82	8.18 - 85.60	
(Lead - Blood)	2.3	<LOD - 50.00	
(Uranium - Urine)	0.0077	0.01 - 0.04	
(Total Mercury - Blood)	< LOD	0.33 - 1.30	

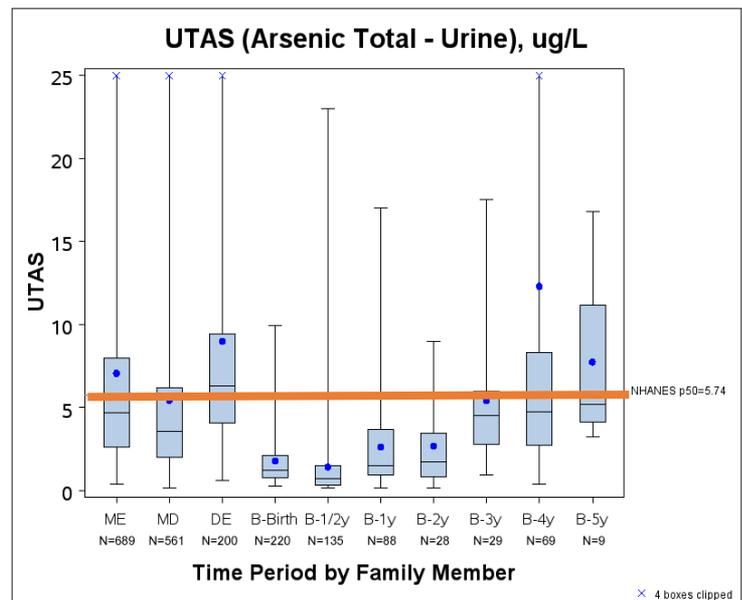


Community Report Back Information: Cohort and National (NHANES) Reference Levels

Urinary Metals- Birth through early childhood



- Median concentration for urine uranium in the US **adult** population from NHANES (2015-16) = (0.005 $\mu\text{g/L}$)
- NBCS children birth to age 4 = 0.0035 – 0.013 $\mu\text{g/L}$

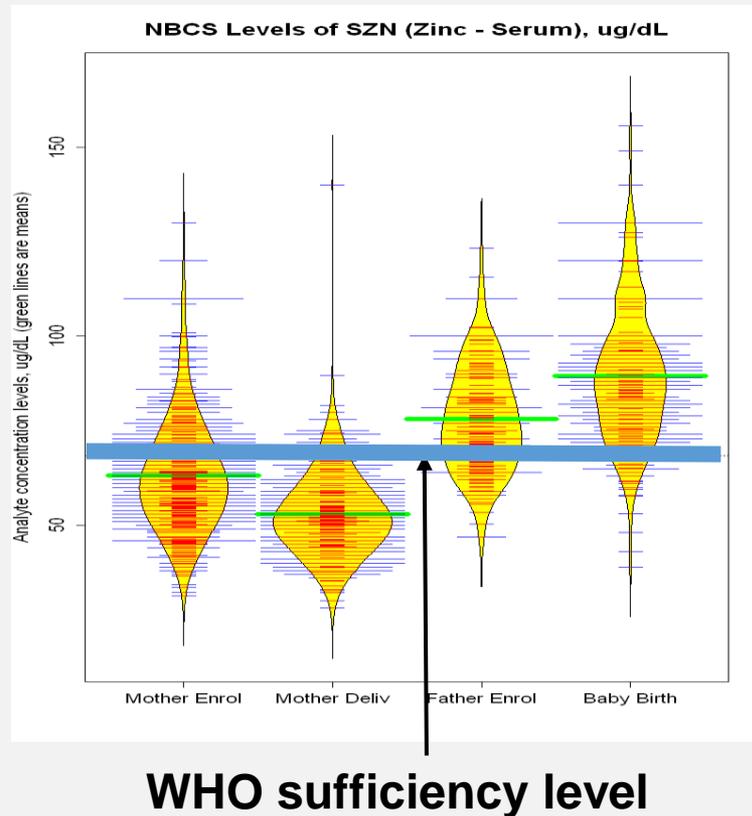
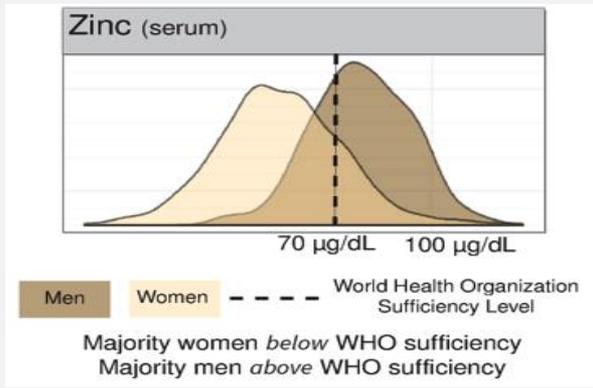


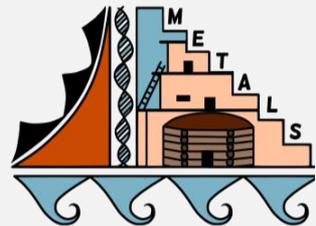
- Median concentration for total arsenic in urine in the US **adult** population from NHANES (2015-16) = (5.41 $\mu\text{g/L}$)
- NBCS children birth to age 4 = 1.2 – 4.5 $\mu\text{g/L}$

Community Report Back Information: Cohort and WHO Reference Levels Micronutrients

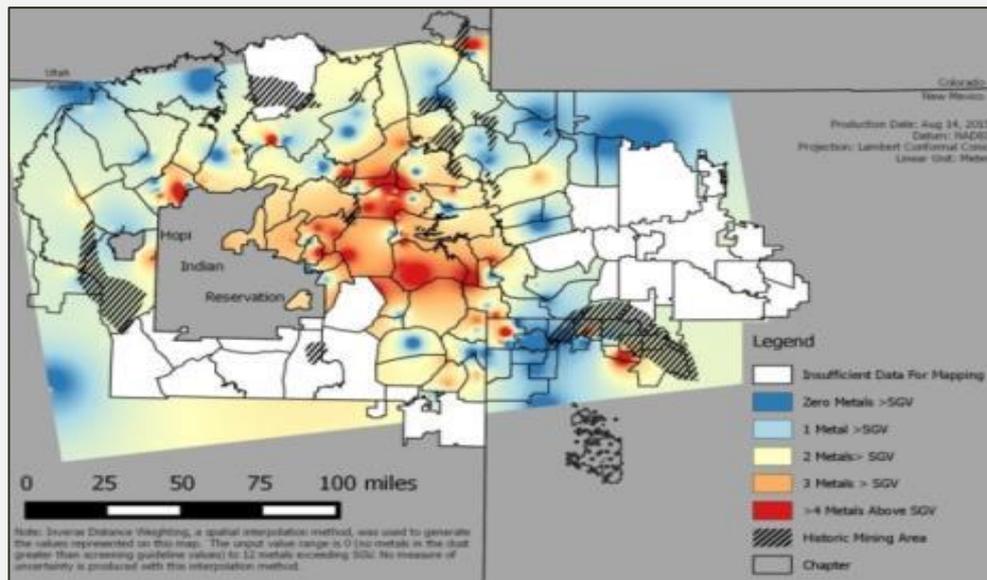


- 61% of NBCS Mothers *below* WHO Zn sufficiency level
- Zn important in healthy immune function and repair of DNA damage/ disrupted by As and U
- Tends to be lower in pregnant women, particularly mothers of several children, but we also see in men
- We have begun a Zn supplementation clinical trial to check function, not just level in serum

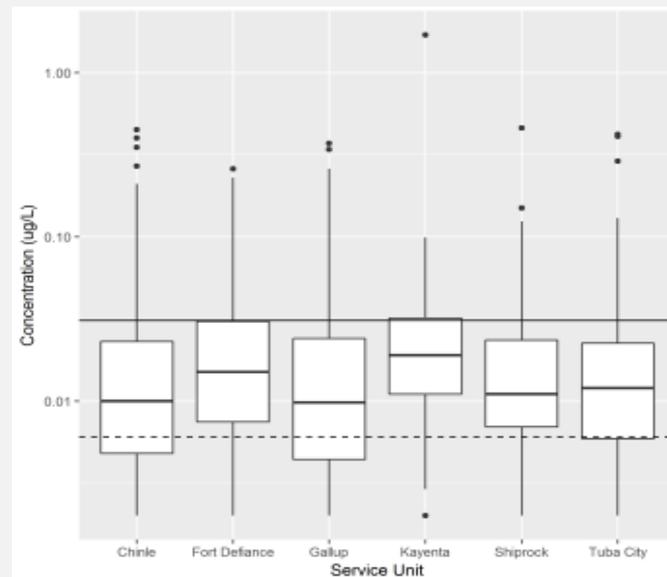




Navajo Birth Cohort Study (NBCS) Communicating Risk: Home Environmental Monitoring and Report Back



Map data based on indoor dust samples collected in NBCS, map by J. Hoover (UNM-CEHP)



Uranium in urine also similar across service units

Participant Report Back Letters



Home Environmental Results

- Gamma radiation, indoor Rn
- 22 metals in dust
- Quality information of drinking water sources used in the home
- Used in mapping of environmental exposures across Navajo Nation
- Attachment of Letter - developed w/ field staff - FAQs about biomonitoring and metal exposure avoidance, list of abbreviation used in letters

Lebow-Skelley E, Yelton S, Janssen B, **Erdei E**, Pearson MA. Identifying Issues and Priorities in Reporting Back Environmental Health Data. *Int J Environ Res Public Health*. 2020; doi: 10.3390/ijerph17186742.



Navajo Birth Cohort Study
c/o Southwest Research and Information Center
P.O. Box 4524
Albuquerque, NM 87196
505-262-1862; fax: 505-262-1864
sric.chris@earthlink.net

December 27, 2013

Name
Address
City, State, Zip

Re: Results of Home Environmental Assessment Conducted July 8, 2013

Dear _____,

Thank you for participating in the Navajo Birth Cohort Study (NBCS). This letter provides results of the Home Environmental Assessment (HEA) conducted by Ms. Cora Phillips and myself on July 8, 2013 at your home in Tonalea, AZ in accordance with our approved research protocol.

The HEA is a one-time snapshot of environmental conditions in and around your home. The results indicate whether and how you have been exposed to environmental contaminants; they do not mean you or your family will have any health effects from your exposures. You can use these results to look for ways to reduce exposures in your home.

In summary, the HEA we conducted showed that maximum gamma radiation levels exceeded one of two "Investigation Levels" for your home and property, but for the reasons given later in this letter, we do not believe a referral to the Navajo Nation Environmental Protection Agency (NNEPA) is necessary. The maximum levels are very low and much lower than in other places on the Navajo Nation. We explain how to interpret these results in more detail below.

Our assessment found no contamination from indoor radon gas or metals in dust, and the water that is piped into your house met all federal and tribal safe drinking water standards in 2010 and 2011. We have not located water quality data for a windmill you said you drank from in the recent past, and therefore will have to collect samples from this well for testing in the coming months.

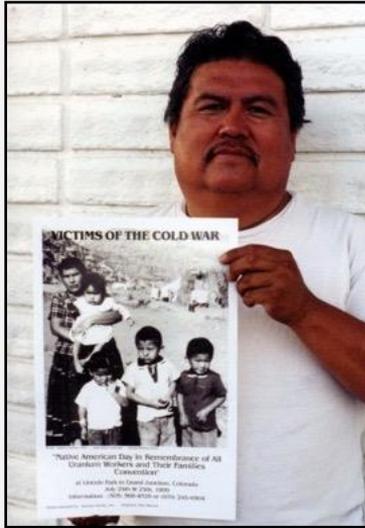
Gamma Radiation Assessment

Results of the gamma radiation surveys we conducted in and around your home are shown in the table below. The results are expressed in units of microrentgens per hour, abbreviated $\mu\text{R/hr}$. Please consult the attached Frequently Asked Questions (FAQ) for an explanation of how "background" radiation levels were determined for your area and how "Investigation Levels" (ILs) are used to determine if a referral to NNEPA is needed.

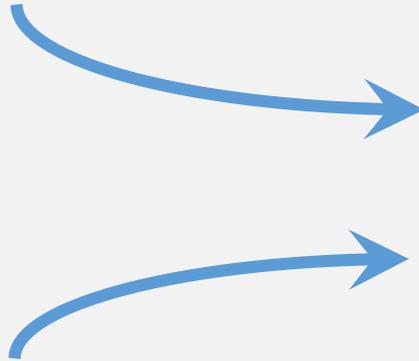
As shown in the table, the maximum indoor and outdoor gamma radiation level of $7.0 \mu\text{R/hr}$ is greater than the second of two Investigation Levels calculated for your property, based on local background radiation levels. While the IL-2 level of $6.9 \mu\text{R/hr}$ is slightly lower than $7.0 \mu\text{R/hr}$, there is virtually no difference between these two readings given the normal fluctuations of gamma radiation on the surface of the Earth and the limitations of our meters at these low levels. Furthermore, you will notice that the maximum indoor and outdoor levels are less than IL-1, which was calculated as $8.6 \mu\text{R/hr}$.

Thinking Zinc: METALS SRP Clinical Trial

Can Zn reduce metals toxicity?



Community Concerns



Zinc-rich Native foods:
blue corn mush,
lamb, pinon nuts



Bench Research

Testing a mechanism-based risk reduction strategy in healthy adults 18-64 yrs of age, Diné men/women

- Navajo IRB Approval January 2019
- Registration Clinical trials.gov



Zinc, at dietary levels, can restore PARP function, allow damaged DNA to be repaired



Damage to DNA in immune system can underlie immune dysfunction, autoimmunity, or disrupt tumor surveillance



+ ZN



=



U Damages Immune Cell DNA

Zinc → Repair of DNA Damage

Healthy Immune Function Restored

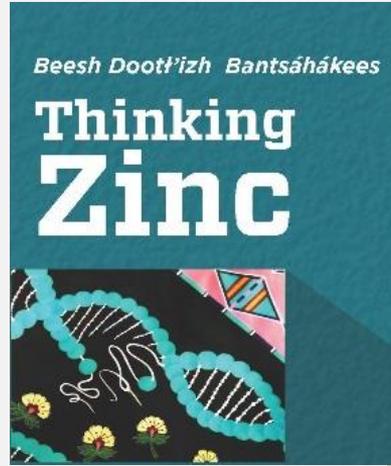


Will it work in people? Protect against new damage? Reverse previous damage?

Paintings by Mallery Quetawki, Zuni Pueblo

Risk Communication: Informing Tribal Policy Makers

- May 18th, 2021, METALS hosted a full-day meeting at the request of the Navajo Health, Education, and Human Services Committee (HEHSC).
- HEHSC Council Delegates updated on research results and progress during the pandemic.



- Ongoing communication with effected communities
- Thinking Zinc continues.





Questions?

Priorities: Community Concerns and Questions

Air Pathway	Water Pathway	Plant, Animal Pathways	Combined Pathways
<ul style="list-style-type: none"> • Long-term effects of exposure to mine dusts • Indoor dusts and radon • Gamma radiation levels around mine • Women exposed to husbands' clothes 	<ul style="list-style-type: none"> • Drinking water quality • Uranium in Rio Paguete stream, sediments • Groundwater impacts in the backfilled pits • Possible discharges from St. Anthony Mine 	<ul style="list-style-type: none"> • Are pinons affected? • Soil in gardens, farmland safe to grow crops? • Effects on livestock and wildlife • Petrified wood has elevated radiation 	<ul style="list-style-type: none"> • Former uranium workers need compensation • Health risks of living close to mine • No monitoring before mining began • Lack of pre-operational "background" • Collect, categorize anecdotal information on health problems • Never had comprehensive health study

(Summary of comments at Mesita and Paguete Village meetings on Pueblo of Laguna)

