"Comprehensive" Health Studies?

1942

1940s-60s: Uranium Mining

1950s-1990s: Miners & Millers Studies

2012: Navajo Birth Cohort Study

Contaminated Structures
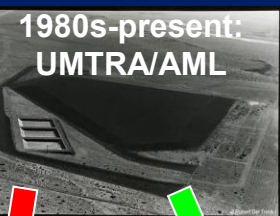
1980s-present: UMTRA/AML

2010-11: DiNEH blood & urine study

Community health?

1979: Church Rock Spill

Navajo land use & health?

Tailings covers

Health Research on Navajo Uranium Legacy

2010-12 CUE-JTH: medical monitoring

1980s: Birth Defects Study

• Other diseases?
• Biological reasons?
• Critical exposure ages?
• Other contamination?
• Early indicators?
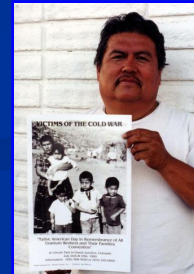
Uranium mining, or other exposures?

2007: Waxman Hearing

Uranium worker families

1990s-2000s: Community Actions for Environmental Health

2001: DiNEH Project 1st Integrated Health Study
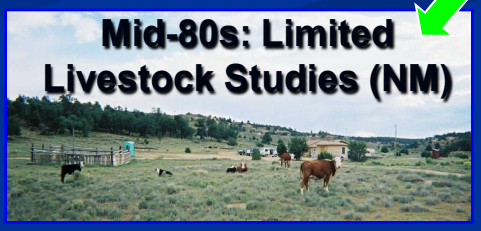
Identification of health risks

2003-2007: CRUMP

Mid-80s: Limited Livestock Studies (NM)

DiNEH Project Partners

- **Researchers:** UNM Community Environmental Health Program and Southwest Research & Information Center

- **Chapters:** Baca-Prewitt, Becenti, Casamero Lake, Church Rock, Coyote Canyon, Crownpoint, Iyanbito, Lake Valley, Littlewater, Mariano Lake, Nahodishgish, Ojo Encino, Pinedale, Pueblo Pintado, Smith Lake, Standing Rock, Thoreau, Torreon, White Rock, Whitehorse Lake

- **Community Advisory Board:** *Thomas Manning, Herbert Enrico, Lynnea Smith, Ed Carlisle, Jay DeGroat*

- **Additional Support:** NNEPA; NNDOH; USEPA Region 9; USACE; University of TX, Houston (Dr. Don Molony); many individuals and agencies

Abandoned Uranium Mines on Navajo

Study Area

• Abandoned Uranium Mines
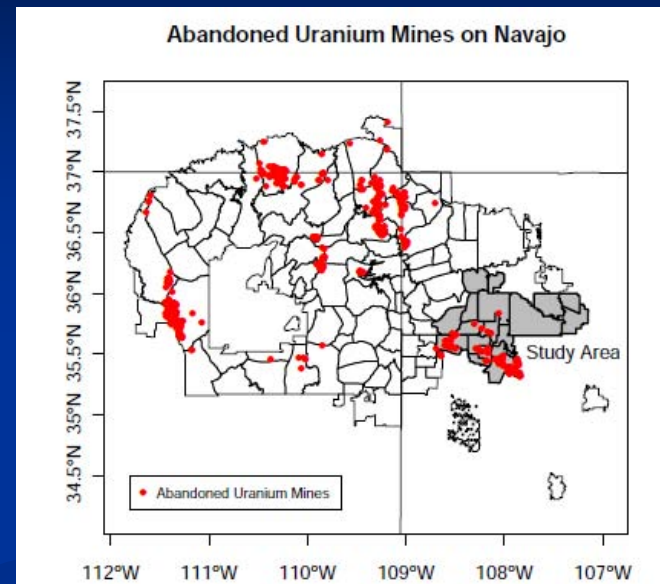
For more information:

UNM/CEHP:
Toll free 1-877-545-6775

SRIC:
505-262-1862
www.sric.org
sric.chris@earthlink.net

DiNEH Project reviewed and approved by:

- Navajo Nation Human Research Review Board
- UNM Human Research Review Committee
- Peer-Reviewed by National Institute of Environmental Health Sciences of NIH
- Data presented reflect participation and support from 20 chapters of the Eastern Agency of the Navajo Nation

DiNEH Project History and Purpose (2000-present)

- Original Goal:
    - ***ENHB's Concern in 1990s: Does drinking uranium in unregulated water increase risk of kidney disease?***
    - Evolved to broadly examine environmental uranium exposures and health

- Community-based participatory research
    - Build Navajo community research capacity
    - Respect culture and language

- Commitment to inform policy and improve clinical care
    - Participation in Waxman Hearing (2007), EPA Five-Year Plan
    - Collaboration with Navajo Area IHS medical monitoring program: Community Uranium Exposure-Journey To Healing

How do we estimate environmental exposures to uranium wastes?

- Lifespan exposures
- Exposure surveys:
  - **1,304 participants**
  - Water use, environmental and occupational histories, health
  - Administered by Navajo field staff
- Cross-validation thru medical record reviews
- Locations of participants' homes, abandoned mines, waste piles
- Iterative analyses
- Existing environmental data, water, soils tests
- Blood and urine samples
  - **267 participants**

Abandoned Uranium Mines
Navajo Nation and Four Corners

Navajo Nation Environmental Protection Agency/WRCD/Superfund
Abandoned Uranium Mines Locations and Reclamation Status
Modified by SRIC, 2008
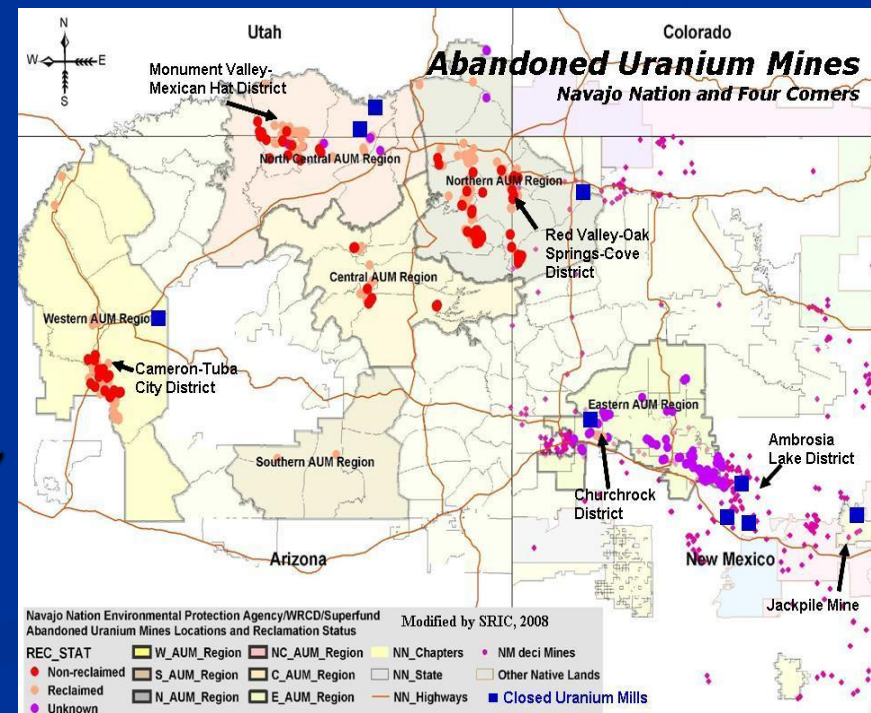
DiNEH Risk Model
Sources of inputs to estimate participants' total exposure

Kidney Risk Model—Structure and Multiple Inputs

Modifying factors

Core Dose-Response Model

Kidney Disease
Self report, medical records, clinical test

(SA1)

Biomarkers
(SA2)
Urine, lab analysis

Uranium exposure assessment
Input from Core Exposure Assessment Model, Urine Confirmation

Other exposures
Survey, GPS, Extant location

Co-morbidities
Survey, medical records

Family history
Survey

Tradition, culture, lifestyle
Survey

SES factors
Survey

Core Exposure Assessment Model

Occupational Exposure
Survey

Water Exposure
Survey, lab analysis

Environmental Exposure
Survey, mapping, modeling, field validation

Data inputs to
Glenn Stark's Bayesian statistical analysis

- <u>Self-reported exposure data</u>:
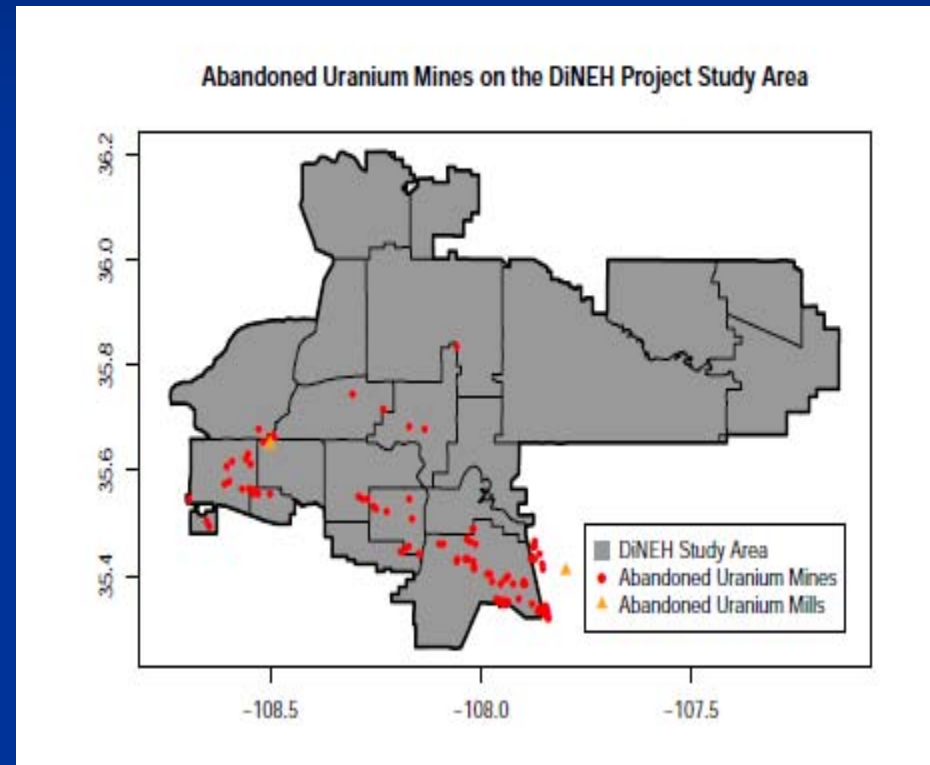 - Occupational histories
  - Environmental exposures
  - Health problems
- <u>Geospatial data</u>:
  - Locations of participants' homes
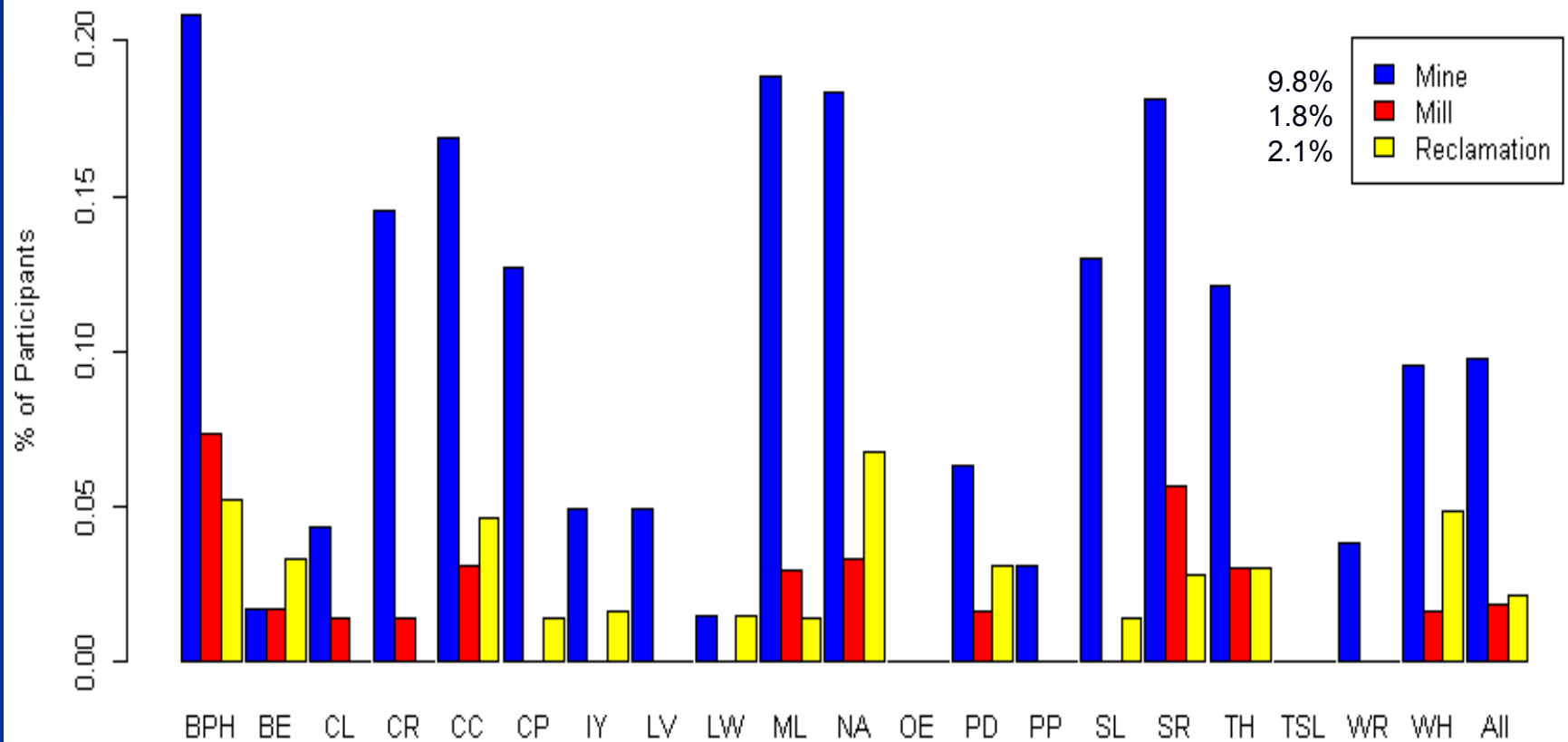 - Locations of abandoned mines, mine "features"
- <u>Used</u>:
  - Bayesian model averaging
  - Conditionally specified logistic regression
  - Multivariate logistic regression

Abandoned Uranium Mines on the DiNEH Project Study Area

Legend:
- DiNEH Study Area
- Abandoned Uranium Mines
- Abandoned Uranium Mills

DiNEH Survey Results for all Chapters:
Self-reported Occupational Exposures


Self-reported Occupational Uranium Exposures Among DiNEH Participants (N=1,304)
(143 different participants were uranium workers)

9.8% ■ Mine
1.8% ■ Mill
2.1% ■ Reclamation

Active-mining Era Exposures Predict Increased Risk of <u>Kidney Disease</u>*

(A)

(A) and (B)

(B)

URANIUM MILL TAILINGS REPOSITORY
NO TRESPASSING
THE U.S. DEPARTMENT OF ENERGY
24- HOUR TELEPHONE NUMBER: (970)-248-6070

(C)

(D)
VICTIMS OF THE COLD WAR

(E)

(A) Worked in uranium mines
(B) Worked in uranium mills
(C) Worked in uranium waste reclamation
(D) Lived in mining camps
(E) Washed clothing of uranium workers
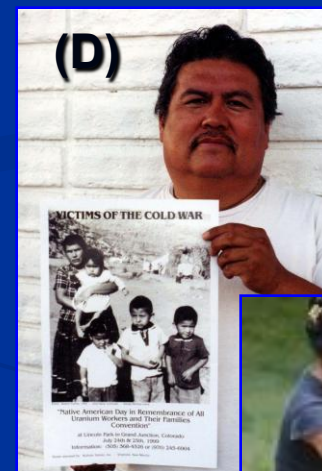
*Does not matter where you live or how far from mines you live.

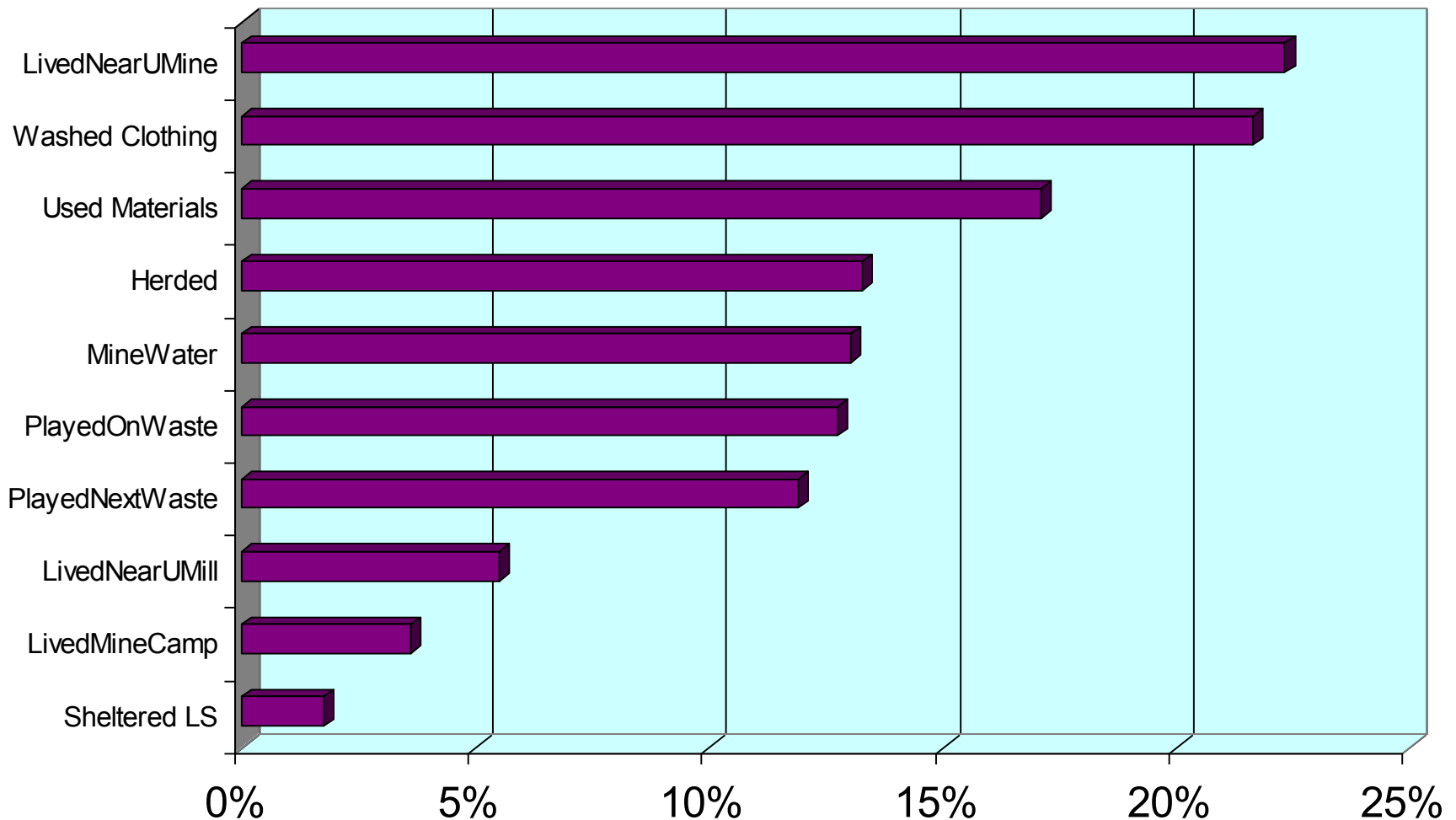# Active-mining Exposure Surrogate Associated with Kidney Disease

- **Significant predictors of kidney disease include (in top 5 models):**
  - Hypertension
  - Diabetes
  - Family history of kidney disease
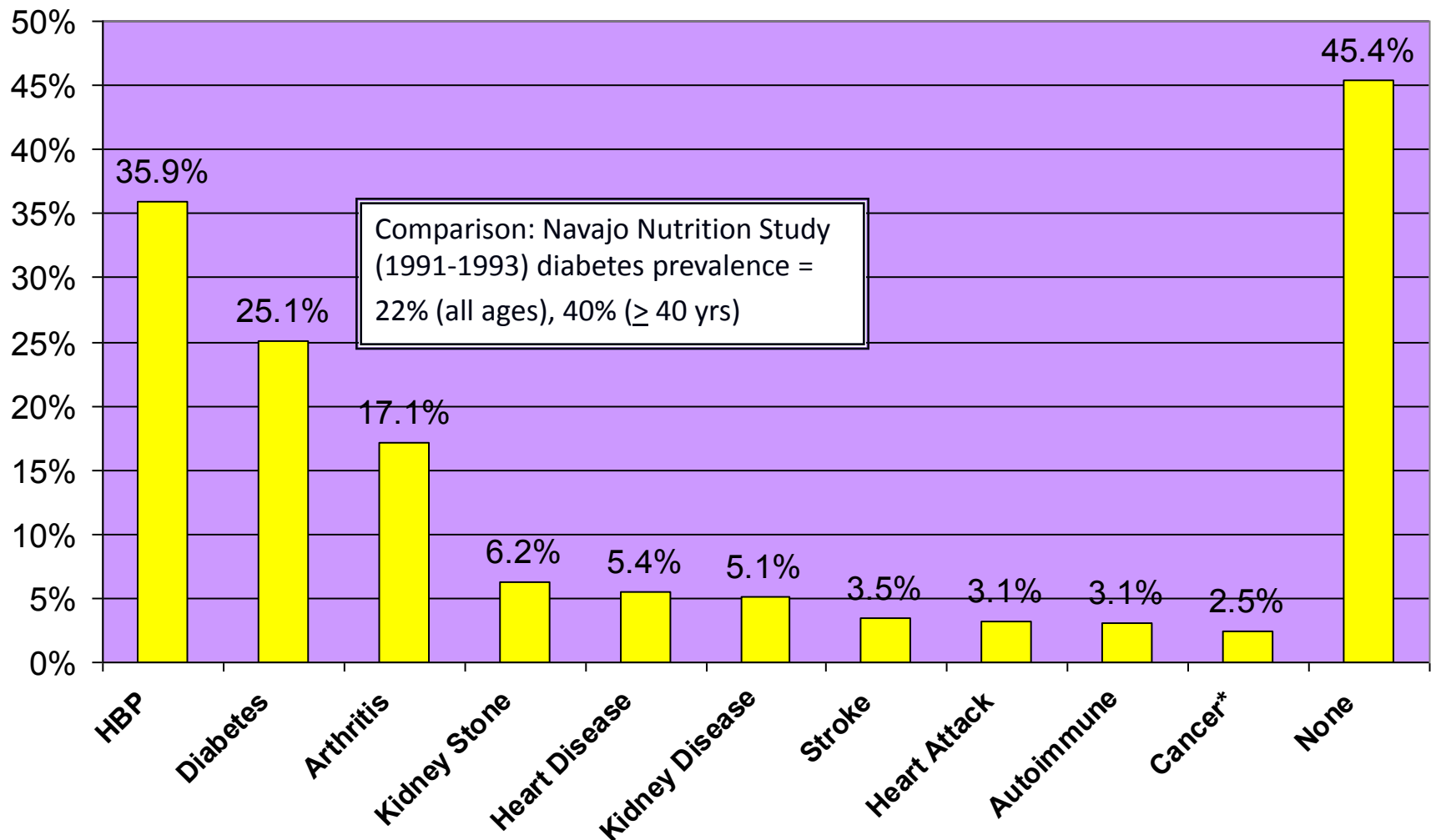 - **Active-mining related exposure surrogate**
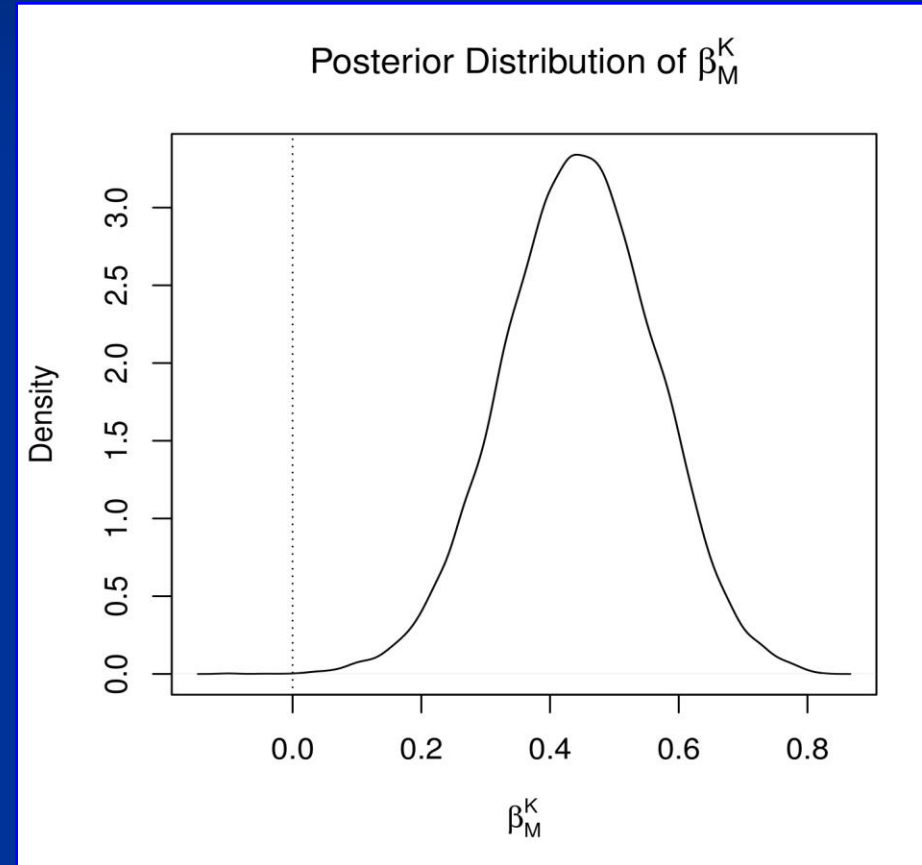
Bayesian distribution graphics and risk maps by Glenn Stark.

Self-reported Exposures to Uranium Wastes, All Chapters (N=1,304)

Prevalence of Self-Reported Health Conditions Among 1,304 DiNEH Survey Participants
(*Cancer prevalence based on 1,011 participants surveyed)

Comparison: Navajo Nutrition Study (1991-1993) diabetes prevalence = 22% (all ages), 40% ($\geq$ 40 yrs)

Condition	Prevalence
HBP	35.9%
Diabetes	25.1%
Arthritis	17.1%
Kidney Stone	6.2%
Heart Disease	5.4%
Kidney Disease	5.1%
Stroke	3.5%
Heart Attack	3.1%
Autoimmune	3.1%
Cancer*	2.5%
None	45.4%

Is living near uranium wastes related to self-reported health problems?

- 29% (374) participants live within 2 miles of AUM, but only 56% (210) were aware they lived that close

- Proximity – inverse of the sum of distances from each participant's home to 100 uranium mine and mill features in Study Area

- *Proximity by itself consistently predicts increased risk of disease*

Can You Tell These are Abandoned Uranium Mines?

Left: Homes next to abandoned mine in Church Rock area. Above: mine waste dumps not recognizable: overgrown, unmarked

Environmental Legacy Exposures* Predict Increased Risk of <u>High Blood Pressure</u> and <u>Autoimmune Disease</u>

(B)

About 26% of participants reported 1 or more environmental exposures

(C)

(D)

(E)

(F)

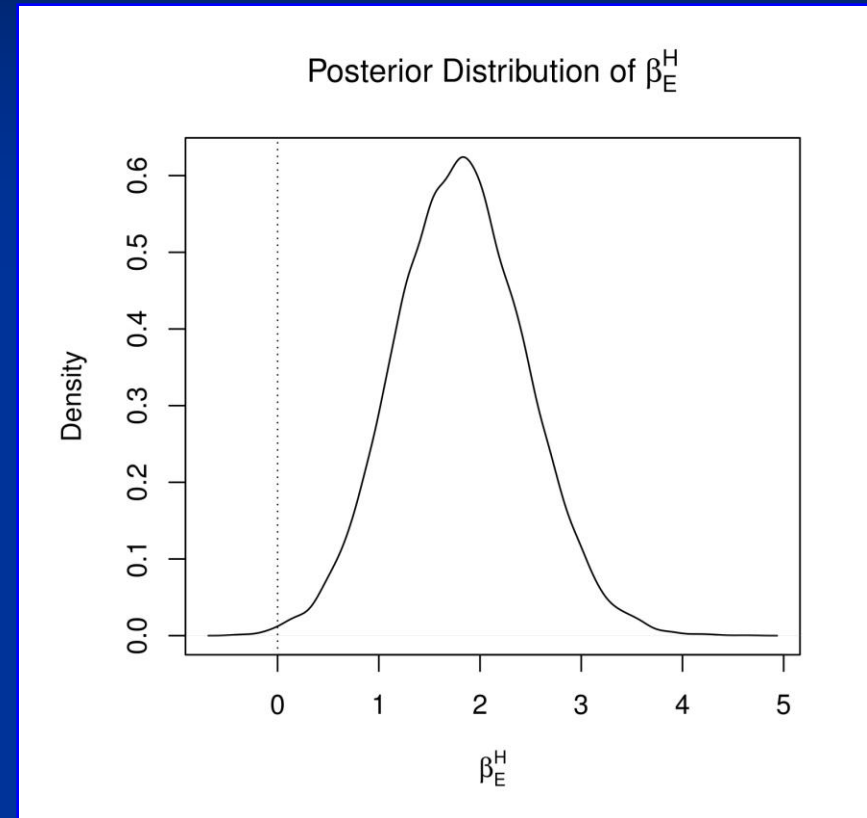*Environmental legacy exposures are <u>activities</u> that bring people close to or in contact with uranium wastes, over their lifetimes:*

(A) Lived near abandoned mines
(B) herded livestock near mines
(C) sheltered livestock in mines
(D) played on or near mines, mills
(E) used mine materials in home
(F) drank or contacted mine water

Environmental Legacy Exposure Surrogate Associated with High Blood Pressure

- Environmental Legacy Surrogate:
  - Behaviors and activities
  - Weighted by proximity to abandoned uranium mine and mill waste

- Significant predictors of hypertension include:
  - Diabetes
  - Age
  - Body mass index
  - Family history of hypertension
  - Gender
  - Kidney disease
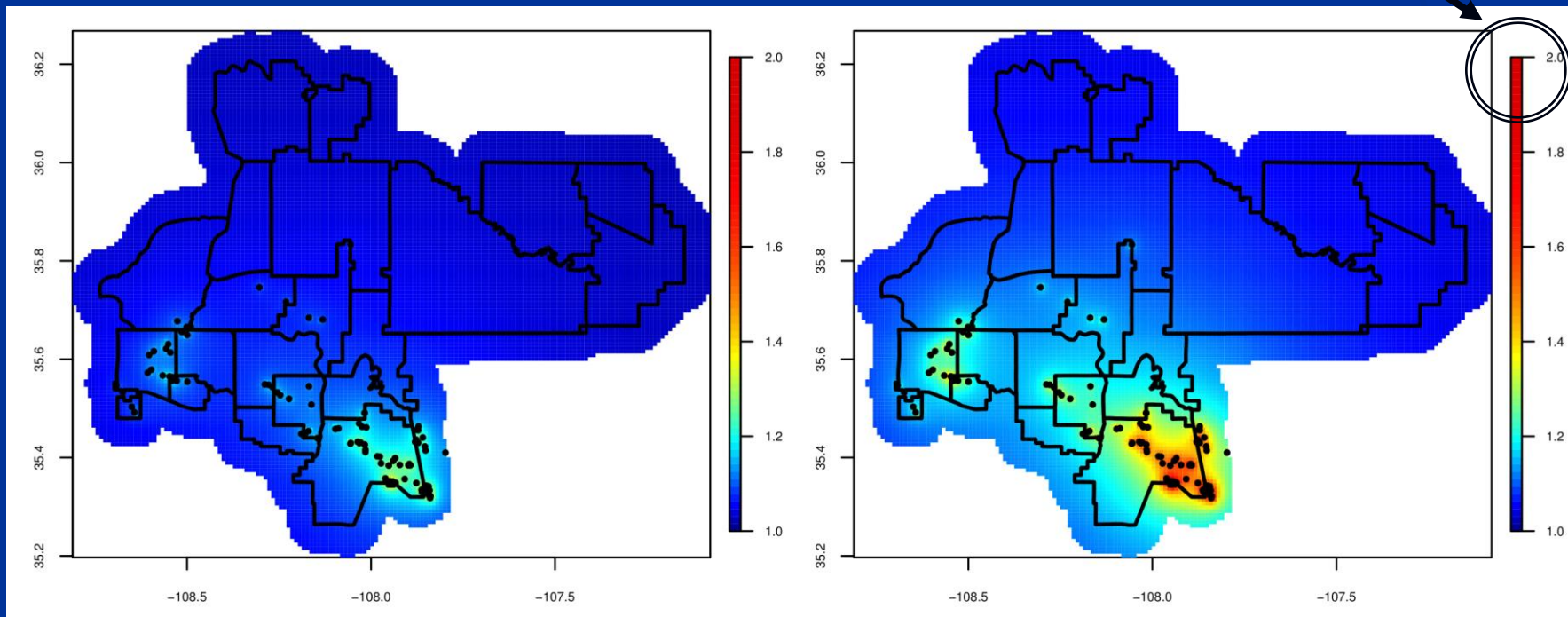 - **Environmental legacy exposure surrogate**

Posterior Distribution of β_E^H

Proximity to AUMs + Environmental Legacy Exposures Increase Risk of High Blood Pressure

Red areas represent doubling of risk (Odds Ratio = 2.0)

1 activity → 2 activities
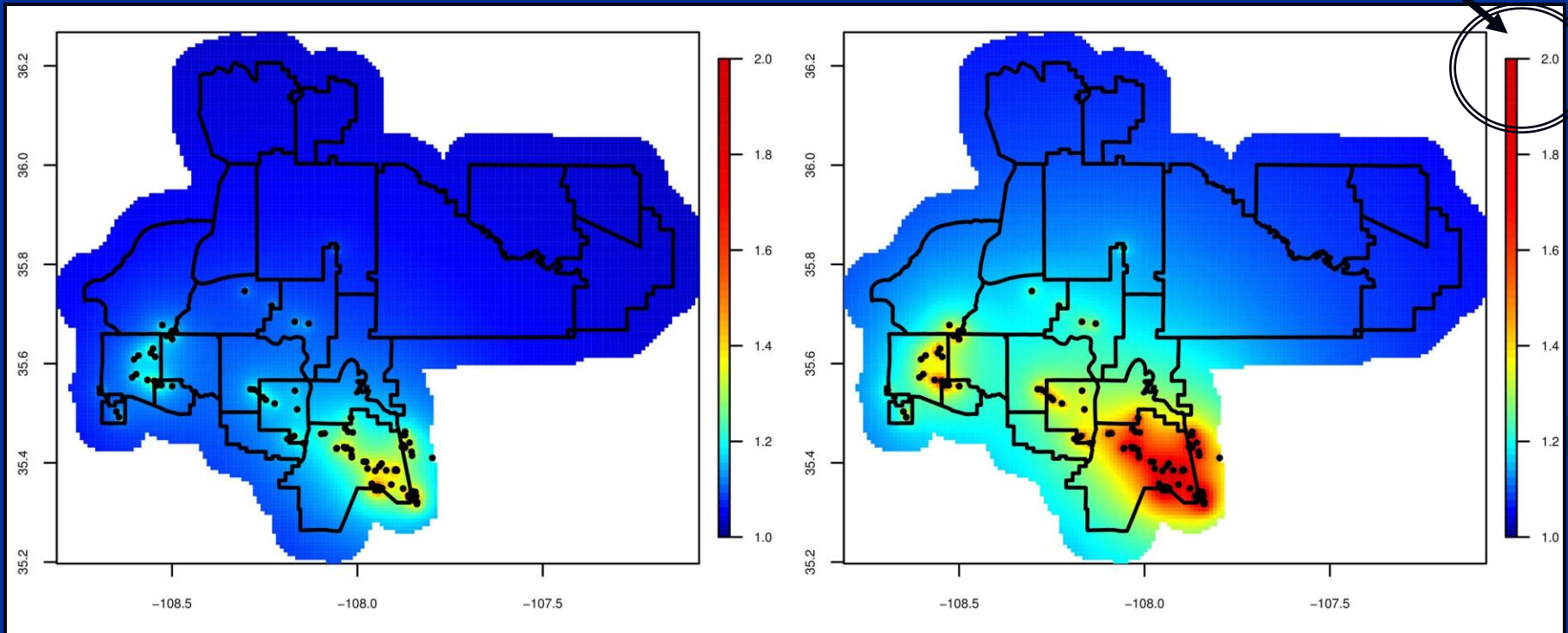

Maps by Glenn Stark

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Proximity to AUMs + Environmental Legacy Exposures Increase Risk of Autoimmune Disease

Red areas represent doubling of risk (Odds Ratio = 2.0)

1 activity → 2 activities

How Our Community Uses Health Study Results

Teddy Nez
Red Water Pond Road Community Association

Model of Responses to Community Concerns About Health and Environmental Effects [of Uran]ium Legacy
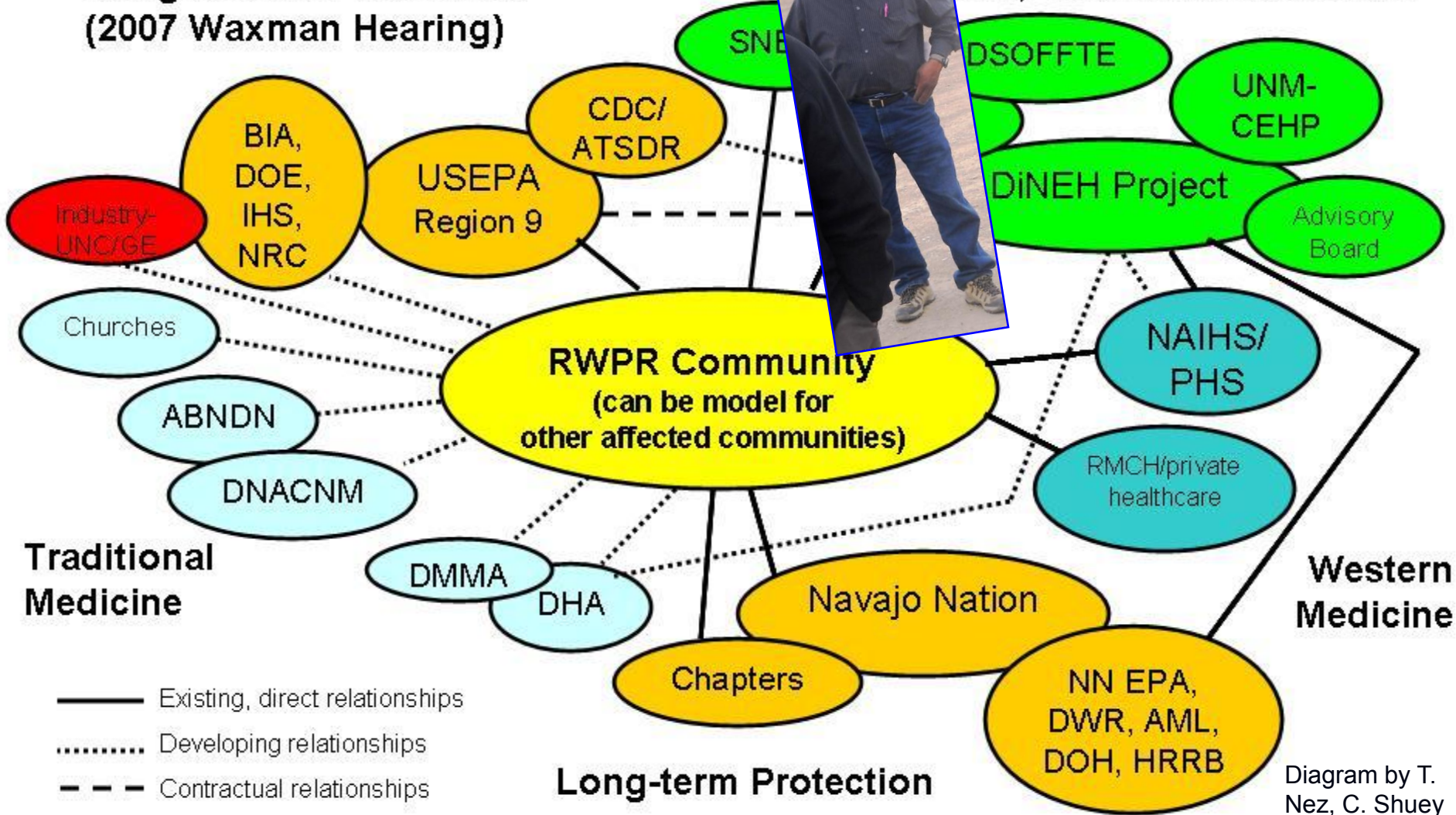
Diagram by T. Nez, C. Shuey

Etiology of Uranium Cycle on Navajo

Long-term Protection

1 - Human Health

Air

Earth

Water

Plants

What is Our Future Plan ?

Grass Roots

1980s RECA
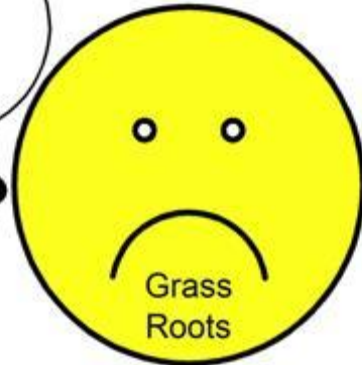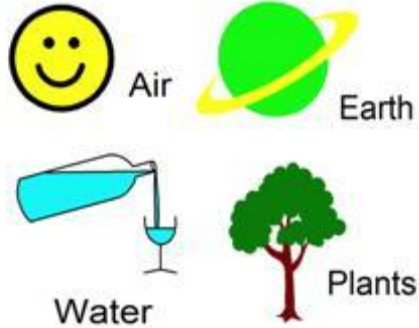
1940s Mining Begins

1980s Animals grazing take up uranium in muscle

1970s Lung Cancer linked to mining

1980s UMTRA clean-up of mills

1970s Shields small study Link between birth abnormality and living near mine

1990s AML mine stabilization

2001 RECA reform compensates downwinders, post '71 miners still excluded

2005 Navajo ban on uranium mining and processing

2004 First Large-Scale Community Health Assessment (DiNEH Project) begins

2007 Waxman Government Oversight Hearings

2008 5-year plan for clean-up

2008 DiNEH Project shows first link to kidney disease from living near uranium mines

2008 -- New Mining ?????

2013 -- Restoration of Navajo Lands???

Diagram by Teddy Nez