Preliminary Analysis of Area-Level Drinking Water Arsenic and Bladder Cancer Incidence Rates in New Mexico, 1988-2002

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New Mexico Drinking Water Arsenic and Cancer Incidence Linkage Demonstration Project

Study Design: Ecologic, aggregate data linkage

Geographic Level: Census tract (2000 US Census, N=456)

Time Frame: 1988-2002

Health Outcomes: Bladder, lung, kidney, liver (primary)
Other cancers (secondary)

Arsenic Exposure: Municipal water systems (primary)
Private wells (secondary)

Data Management: Geographic information system (GIS)

Data Analysis: Exposure-stratified incidence rates and rate ratios, Poisson regression
### New Mexico

- **33 Counties**

**Main Cities/Towns**

<table>
<thead>
<tr>
<th>City</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albuquerque</td>
<td>448607</td>
</tr>
<tr>
<td>Las Cruces</td>
<td>74267</td>
</tr>
<tr>
<td>Santa Fe</td>
<td>62203</td>
</tr>
<tr>
<td>Rio Rancho</td>
<td>51765</td>
</tr>
<tr>
<td>Roswell</td>
<td>45293</td>
</tr>
<tr>
<td>South Valley</td>
<td>39060</td>
</tr>
<tr>
<td>Farmington</td>
<td>37844</td>
</tr>
<tr>
<td>Alamogordo</td>
<td>35582</td>
</tr>
<tr>
<td>Clovis</td>
<td>32667</td>
</tr>
<tr>
<td>Hobbs</td>
<td>28657</td>
</tr>
<tr>
<td>Carlsbad</td>
<td>25625</td>
</tr>
<tr>
<td>Gallup</td>
<td>20209</td>
</tr>
</tbody>
</table>
### Racial/ Ethnic Distribution of New Mexico Population
#### 2000 US Census

<table>
<thead>
<tr>
<th>RACIAL/ETHNIC GROUP</th>
<th>Count</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total</strong></td>
<td>1819046</td>
<td>100.0</td>
</tr>
<tr>
<td><strong>Not Hispanic or Latino</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White alone</td>
<td>813495</td>
<td>44.7</td>
</tr>
<tr>
<td>Black or African American alone</td>
<td>30654</td>
<td>1.7</td>
</tr>
<tr>
<td>American Indian or Alaska Native alone</td>
<td>161460</td>
<td>8.9</td>
</tr>
<tr>
<td>Asian, Native Hawaiian, Other Pacific Islander alone</td>
<td>19249</td>
<td>1.1</td>
</tr>
<tr>
<td>Some other race alone</td>
<td>3009</td>
<td>0.2</td>
</tr>
<tr>
<td>Two or more races</td>
<td>25793</td>
<td>1.4</td>
</tr>
<tr>
<td><strong>Hispanic or Latino</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White alone</td>
<td>400758</td>
<td>22.0</td>
</tr>
<tr>
<td>Black or African American alone</td>
<td>3689</td>
<td>0.2</td>
</tr>
<tr>
<td>American Indian or Alaska Native alone</td>
<td>12023</td>
<td>0.7</td>
</tr>
<tr>
<td>Asian, Native Hawaiian, Other Pacific Islander alone</td>
<td>1509</td>
<td>0.1</td>
</tr>
<tr>
<td>Some other race alone</td>
<td>306873</td>
<td>16.9</td>
</tr>
<tr>
<td>Two or more races</td>
<td>40534</td>
<td>2.2</td>
</tr>
</tbody>
</table>
Qualitative Data Source for Drinking Water Arsenic Exposure Assessment

Private Wells in New Mexico Office of State Engineer

Well Use
- Domestic
- Other
Geologic Factors Affecting Exposure to Arsenic

Volcanic Geology & Hot Springs
Data Sources for Cancer Case Numerator and Population Denominator Data

• **New Mexico Tumor Registry**
  - NCI/SEER registry since 1973
  - Statewide, population-based
  - 1988-2002: N~ 94,000 case records
    → All invasive cancers
    → Non-invasive (*in-situ*) breast cancers

• **US Census Bureau**
  - Age, gender, racial/ethnic specific counts
    → 1990 Census (385 census tracts)
    → 2000 Census (445 census tracts)
Geocoding Case Address at Diagnosis
(Coordinate location, census block group, census tract)

Geocoding Resources
- Road network - City of Albuquerque
- Road network - StreetMap 2000
- DynaMap
- 2000 TIGER roads
- Zipcodes - StreetMap 2000
- Zipcodes ESRI Data 2002

Initial Geocoding Results (N=93,908 records)
- Street Address Match 74578 (79.4%)
- Zip Code Centroid (PO Boxes, etc.) 19005 (20.2%)
- Unmatched – no address 325 (<1%)
Development of 1988-2002 Age, Sex, and Racial/Ethnic Specific Census Tract Population Denominator Data

University of New Mexico Bureau of Business & Economic Research (UNM/BBER)

• 1990 to 2000 Census Tract Correspondence
  - Reconcile 1990 population data into 2000 tract boundaries

• 2000 to 1990 Racial/Ethnic Bridging
  - Reconcile 2000 multiple races data into 1990 racial/ethnic groups
    • Non-Hispanic White
    • Hispanic
    • American Indian
    • Black
    • Asian/Pacific Islander

• Intercensal/post-censal estimates: linear interpolation
The US Census Bureau defined 456 census tracts in New Mexico for the 2000 Census, of which 141 (31%) are located in Bernalillo County, the state’s most populous and urban county. The state has 33 counties, of which 6 counties include only a single census tract.
Preliminary Linkage and Analysis of Drinking Water Arsenic and Bladder Cancer Incidence in New Mexico, 1988-2002

• Descriptive epidemiology of bladder cancer in New Mexico
  - Person, place, time

• Methods
  - Drinking water arsenic exposure assessment
  - Characteristics of 1988-2002 bladder cancer cases

• Preliminary Results
  - Linkage of bladder cancer incidence data with preliminary census tract drinking water arsenic
Age-Specific Pattern of Bladder Cancer Incidence in New Mexico, 1997-2001

Age-Specific Incidence of Bladder Cancer by Sex, New Mexico, 1997-2001

Age at Diagnosis (Years)

Rate per 100,000


Male
Female

(NHW = Non-Hispanic White)
Temporal Pattern of Bladder Cancer Incidence in New Mexico Hispanics and Non-Hispanic Whites, 1992-2001

### Distribution of 1988-2002 Bladder Cancer Cases by Sex and Race/Ethnicity

<table>
<thead>
<tr>
<th>Race/Ethnicity</th>
<th>Male</th>
<th>Female</th>
<th>Both</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>Non-Hispanic White</td>
<td>2278</td>
<td>60.8</td>
<td>761</td>
</tr>
<tr>
<td>Hispanic</td>
<td>499</td>
<td>13.3</td>
<td>166</td>
</tr>
<tr>
<td>Black</td>
<td>27</td>
<td>0.7</td>
<td>8</td>
</tr>
<tr>
<td>Asian/Pacific Islander</td>
<td>7</td>
<td>0.2</td>
<td>0</td>
</tr>
<tr>
<td>All Race/Ethnicities</td>
<td>2811</td>
<td>75.0</td>
<td>935</td>
</tr>
</tbody>
</table>

**Excludes 43 Native American cases**
## Geocoding Results for 1988-2002 Bladder Cancer Cases

<table>
<thead>
<tr>
<th>Race/Ethnicity</th>
<th>Address Match</th>
<th>Zipcode Centroid</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>Non-Hispanic White</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1839</td>
<td>80.7</td>
<td>439</td>
</tr>
<tr>
<td>Female</td>
<td>632</td>
<td>83.0</td>
<td>129</td>
</tr>
<tr>
<td>Hispanic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>358</td>
<td>71.7</td>
<td>141</td>
</tr>
<tr>
<td>Female</td>
<td>124</td>
<td>74.7</td>
<td>42</td>
</tr>
</tbody>
</table>
Distribution of 1988-2002 Bladder Cancer Cases by Census Tract at Diagnosis

Frequency Distribution of Bladder Cancer Cases
Per Census Tract (403 Tracts)

Number of Cases Per Tract

Number of Tracts

1-5 6-10 11-15 16-20 21-25 26-30 31-35 36-40 41-45

140
120
100
80
60
40
20
0
Geographic Distribution of New Mexico Census Tracts According to Drinking Water Arsenic

**Tract Arsenic (ppb)**
- No Data
- 0.1 - 0.9
- 1.0 - 10.0
- 10.1 - 30.0
- >30.0

**Arsenic (ppb)**
- <1.0
- 1.0 – 10.0
- 10.1 - 30.0
- 30.1 - 50.0
- >50.0
Geographic Distribution of Albuquerque Census Tracts According to Drinking Water Arsenic

Tract Arsenic (ppb)
- No Data
- 0.1 - 0.9
- 1.0 - 10.0
- 10.1 - 30.0
- >30.0

Arsenic (ppb)
- <1.0
- 1.0 – 10.0
- 10.1 - 30.0
- 30.1 - 50.0
- >50.0
Preliminary Bladder Cancer Incidence Rates by Sex, Race/Ethnicity and Drinking Water Arsenic Levels
New Mexico, 1988-2002

Average Annual Age-Adjusted (2000 US) Bladder Cancer Incidence Rates by Sex, Race/Ethnicity, and Grossly Estimated Census Tract Drinking Water Arsenic Concentrations

- Male
  - Non-Hispanic White
  - Hispanic
- Female
  - Non-Hispanic White
  - Hispanic

Concentrations
- <1.0 ppb
- 1.0-10.0 ppb
- 10.1-30 ppb
- >30.0 ppb

New Mexico, 1988-2002
Preliminary Findings

- Geocoding cancer data requires significant effort to resolve non-address level records, but provides the level of resolution needed for geospatial data linkage.

- Estimating exposure concentrations of arsenic in drinking water requires finer geographic resolution than the census tract in many New Mexico tracts.

- Once these tools are developed they can easily be adapted to other drinking water and cancer studies.