Estimating cancer risk attributable to the Trinity Site nuclear blast of 1945

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New Mexico Cancer Council
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I have no disclosures,
but I do have some confessions...
Next, a little background information...

On July 16th, 1945...

• The world was still at war...
• Germany had surrendered in May of that year
• The United States faced a protracted war with Japan
• In Los Alamos, New Mexico, participants in the Manhattan Project had produced the world's first nuclear weapons, utilizing fuel produced at sister sites near Hanford, Washington and Oak Ridge, Tennessee
• The previous night was marked by intermittent thundershowers in the high desert to the west of the Oscura peaks in Southcentral New Mexico...
The United States conducted nearly 200 atmospheric nuclear weapons development tests from 1945 to 1962

**Radiation Exposure and Compensation Act (RECA)**
- Enacted to administer claims relating to atmospheric nuclear testing and uranium industry employment
- Applications administered by the United States Department of Labor

**Energy Employees Occupational Illness Compensation Program Act (EEOICPA)**
- Provides compensation and medical benefits to employees who worked at certain Department of Energy facilities
  - Includes contractors, subcontractors and some vendors
- Adjudication of claims for benefits is administered by the United States Department of Labor

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**Events Leading to the Present Report**

- New Mexico Senator Jeff Bingaman requested that the National Cancer Institute (NCI) undertake a study to characterize possible cancer risks associated with the Trinity Site test of 1945
  - Request related to efforts to include New Mexico residents in the existing Radiation Exposure and Compensation Act (RECA)
- NCI subsequently produced a draft report with preliminary data to address Senator Bingaman’s request
- Later, NCI re-approached the project with several modifications
  - Characterized diet and behaviors that may have influenced exposure, paying attention to possible differences among the diverse populations of New Mexico
  - Characterized other environmental factors that may have influenced exposure, again, paying attention to possible differences among the diverse populations of New Mexico
  - NCI conducted focus groups and interviews to address the above-listed issues
Seven articles published in the October-2020 edition of *Health Physics* summarized findings from an NCI-led project designed to estimate possible cancer risks in New Mexico due to the Trinity Site Nuclear Test.

<table>
<thead>
<tr>
<th>Lead Author</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simon</td>
<td>Editorial: Introduction to the Trinity Nuclear Test Collection of Papers</td>
</tr>
<tr>
<td>Potischman</td>
<td>Methods and Findings on Diet and Lifestyle Used to Support Estimation of Radiation Doses from Radioactive Fallout from the Trinity Nuclear Test</td>
</tr>
<tr>
<td>Bouville</td>
<td>The Methodology Used to Assess Radiation Doses from the First Nuclear Weapons Test (Trinity) to the Populations of New Mexico</td>
</tr>
<tr>
<td>Simon</td>
<td>Estimated Radiation Doses Received from the 1945 Trinity Nuclear Test</td>
</tr>
<tr>
<td>Cahoon</td>
<td>Projected Cancer Risks to Residents of New Mexico from Exposure to Trinity Radioactive Fallout</td>
</tr>
<tr>
<td>Boice</td>
<td>The Likelihood of Adverse Pregnancy Outcomes and Genetic Disease (Transgenerational Effects) from Exposure to Radioactive Fallout from the 1945 Trinity Atomic Bomb Test</td>
</tr>
<tr>
<td>Beck</td>
<td>Accounting for Unfissioned Plutonium from the Trinity Atomic Bomb Test</td>
</tr>
</tbody>
</table>

The investigators improved their original estimates by obtaining information from members of New Mexico’s diverse populations including:

- 13 focus groups
- 11 interviews with individuals
- Guidance from New Mexico-based investigators and community activists
There is a robust scientific literature regarding the health effects of nuclear fallout

Examples

• Atomic bomb survivors from Hiroshima and Nagasaki, Japan
• Indigenous populations of the Marshal Islands
• Residents near the Chernobyl nuclear reactor accident
• Residents near the Hanford Nuclear Reservation

Methods and Modeling for This Project

• BEIR VII Report (Biological Effects of Ionizing Radiation—Seventh Edition)
• Atomic Bomb Casualty Commission (…now the Radiation Effects Research Foundation)
Estimates of excess cancer risk due to exposure to radiation from Trinity Site fallout were based on many underlying assumptions

**New Mexico Cohort (n=581,489)**
- Based on interpolation of figures from 1940 and 1950 decennial censuses
- Some assumptions required
  - Decennial Censuses in 1940 and 1950 documented race as White, Black and Other
  - Distribution of Hispanic whites and non-Hispanic whites based on “language” questions in five-percent sample of respondents
  - “Other” populations were considered to be mostly American Indian

**Baseline Cancer Rates 1945-2034**
- Rates for 1945-1972 based on extrapolation from SEER Program data
- Rates for 1973-2034 based on SEER Program-wide data

**Excess Risk of Cancer Due To Radiation Exposure From Trinity Site**
- Based on estimated doses and exposures as summarized in other reports from the October 2020 issue of *Health Physics*
- Radiation-associated risk estimates applied to New Mexico Cohort and baseline cancer rates
- Estimates incorporated factors relating to geographic location, age and race/ethnicity

Radiation exposure from Trinity Site contributed to the cancer burden in New Mexico, but the case numbers are low

**STATEWIDE**

Projected number of cancers over the lifetimes of 581,489 NM residents, 1945-2034

<table>
<thead>
<tr>
<th>Type of Cancer</th>
<th>Expected Number of Cancer Cases, Without Trinity</th>
<th>Estimated Excess Number of Cancer Cases (i.e., cases due to fallout from Trinity blast)</th>
<th>Attributable Risk (i.e., percent of all cancers due to Trinity)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>95% Uncertainty Range (Maybe as few as, but maybe as many as...)</td>
<td>Median</td>
</tr>
<tr>
<td>Leukemia</td>
<td>2,900</td>
<td>&lt;10</td>
<td>&lt;10</td>
</tr>
<tr>
<td>Thyroid</td>
<td>2,170</td>
<td>80 to 530</td>
<td>210</td>
</tr>
<tr>
<td>Colon</td>
<td>16,300</td>
<td>20 to 40</td>
<td>30</td>
</tr>
<tr>
<td>Stomach</td>
<td>5,180</td>
<td>&lt;10 to 20</td>
<td>&lt;10</td>
</tr>
<tr>
<td>Lung</td>
<td>26,500</td>
<td>20 to 60</td>
<td>30</td>
</tr>
<tr>
<td>All Solid</td>
<td>183,000</td>
<td>210 to 460</td>
<td>310</td>
</tr>
</tbody>
</table>
Radiation exposure from Trinity Site contributed to the cancer burden in New Mexico, but the case numbers are low.

**HIGH-RISK COUNTIES**

*(Guadalupe, Lincoln, San Miguel, Socorro and Torrance)*

Projected number of cancers over the lifetimes of high risk county residents, 1945-2034

<table>
<thead>
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<th>Type of Cancer</th>
<th>Expected Number of Cancer Cases, Without Trinity</th>
<th>Estimated Excess Number of Cancer Cases <em>(i.e., cases due to fallout from Trinity blast)</em></th>
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<td>95% Uncertainty Range May as few as, but maybe as many as...</td>
<td>Median</td>
</tr>
<tr>
<td>Leukemia</td>
<td>360</td>
<td>&lt;10</td>
<td>&lt;10</td>
</tr>
<tr>
<td>Thyroid</td>
<td>270</td>
<td>60 to 370</td>
<td>150</td>
</tr>
<tr>
<td>Colon</td>
<td>1,970</td>
<td>10 to 30</td>
<td>20</td>
</tr>
<tr>
<td>Stomach</td>
<td>620</td>
<td>&lt;10 to 20</td>
<td>&lt;10</td>
</tr>
<tr>
<td>Lung</td>
<td>3,230</td>
<td>20 to 60</td>
<td>30</td>
</tr>
<tr>
<td>All Solid</td>
<td>22,400</td>
<td>150 to 330</td>
<td>210</td>
</tr>
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</table>

Attributable risk for thyroid cancer varied by NM County

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**Fig. 1.** Uncertainty intervals (5%, 95%) for proportion (in %) of thyroid cancer risk attributable to radioactive fallout from the Trinity nuclear test by county among New Mexico residents alive in 1945 (1945 to 2034).
What questions do you have?

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