Limitations of Cause of Death Data Among Autopsied Population in the United States Transuranium and Uranium Registries

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USTUR: Who are we?

- A tissue program established in 1968 to use human data to verify biokinetic models
- Follows up former nuclear workers by studying the biokinetics and tissue dosimetry of uranium and transuranium elements (typically Pu, Am)
- Conduct autopsies and obtain tissues for radiochemical analysis, which allows us to
  - Determine actinide content in organs at the time of death
  - Verify, modify, and/or parameterize biokinetic models
USTUR: Who are our donors?

357 Registrant Donations

Primary Work Site

- Hanford (126)
- Rocky Flats (136)
- Los Alamos (41)
- Oak Ridge (8)
- Savannah River (14)
- Mound (7)
- Fernald (5)
- Uranium Miners (10)
- Miscellaneous (10)

Male: 345
Female: 12

Ever-smokers: 218 (61%)
Non-smokers: 51 (14%)
Unknown: 88 (25%)

+31 Living Registrants (age: 82 ± 11 years)

Age at death
69 ± 13 years
International Classification of Diseases (ICD)

• International standard for reporting diseases and health conditions

• USTUR death certificates and autopsy reports coded by a professional nosologist
  ✓ ICD-9
  ✓ ICD-10

• The nosologist simultaneously considered the death certificates and autopsy reports to identify:
  ✓ Underlying cause of death
  ✓ Up to 7 contributing causes of death
Underlying Causes of Death

- Circulatory system, 41.6%
- Cancer, 33.9%
- Respiratory disease, 8.3%
- External causes, 6.8%
- Other causes, 6%
- Nervous system, 3.4%
Types of Cancer

- Bronchus and lung, 30.8%
- Digestive organs, 24.8%
- Other cancers, 29.1%
- Prostate and urogenital, 7.7%
- Mesothelioma, 7.7%

Mesothelioma higher than expected, but asbestos exposure plays a role

2019 Health Physics Society Meeting
USTUR ≠ Epidemiological Study

• Example: Brain cancer cases
  ✓ Six donors died from glioblastoma and/or astrocytoma
  ✓ ALL six were current or former Rocky Flats workers
  ✓ ALL six registered as donors AFTER they were diagnosed

• This illustrates two reasons that the USTUR population isn’t suitable for epidemiological studies
  ✓ Self-selection
  ✓ Post-mortem enrollment

• Inconsistent recruitment: e.g. since 2001, donors must have intakes > 2 nCi (74 Bq) or external dose > 10 rem (100 mSv)
Causes of Death from Death Certificates May Not Match Autopsy Reports

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<thead>
<tr>
<th>Mesothelioma</th>
<th>Mesothelioma</th>
<th>Brain Cancer</th>
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<tbody>
<tr>
<td><strong>Case</strong></td>
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<td><strong>Autopsy Report</strong></td>
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**Mesothelioma**
Autopsy report compared to...
Death certificates: 4 of 6 match
Death certificates + National Death Index: 4 of 8 match

**Brain Cancer**
Good agreement
Death Certificates vs. Autopsy Reports

• Work is underway to compare causes of death on autopsy reports to those on death certificates among 357 deceased USTUR Registrants

• Autopsies are performed on all USTUR donors, regardless of how/where/when they passed away

• The findings will shed light on the reliability of using death certificates to determine causes of death in epidemiological studies (death certificate misclassification bias)
USTUR Post-mortem Data is Extremely Useful in Support of Epidemiological Studies!

• Epidemiological studies rely on accurate health outcomes classification and dose assessments

• This study will evaluate death certificate misclassification bias

• USTUR data have recently been used to
  ✓ Define the bound fraction of plutonium in the lung for ICRP’s upcoming Occupational Intakes of Radionuclides (OIR) Part 4
  ✓ Determine if the plutonium biokinetic model needs a separate compartment for the brain (THAM-C.8)
Questions?