UNR Facilities Services Building Radium Contamination
Occupant Health Risk Assessment and Communication

James Craner, MD, MPH, FACOEM, FACP
Occupational & Environmental Medicine, Reno, NV
Assistant Clinical Professor, UCSF School of Medicine
Key Points

1. **Longstanding, low-level radioactive radium contamination** was recently identified in Facilities Building. Low-level, detectable ionizing gamma and other radiation is present in various locations throughout the building. **Occupants have already been, or are in the process of being relocated** to prevent further exposure.

2. **A low probability of increased short- or long-term health risk is estimated** for current and former occupants. Gamma radiation is/was the most significant hazard. **Expert medical assessment** will be offered to current and former occupants as part of ongoing risk management through workers’ compensation insurance.

3. **Medical surveillance (medical testing, screening exams) is NOT scientifically warranted** for early detection or prevention of cancer or other diseases potentially associated with ionizing radiation. Additional expert medical guidance will be provided to occupants and their physicians.
## Radiation Measurements

<table>
<thead>
<tr>
<th>Radiation parameter</th>
<th>Units-CGS (SI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiation activity (decay)</td>
<td>Curies (Bq)</td>
</tr>
<tr>
<td>Exposure (dose)</td>
<td>Roentgens (C/kg air)</td>
</tr>
<tr>
<td>Absorbed dose per unit mass</td>
<td>Rad (Gy)*</td>
</tr>
<tr>
<td>Dose equivalent (biological effect)</td>
<td>Rem (Sv)**</td>
</tr>
</tbody>
</table>

- Alpha, beta particles: high energy, travel millimeters, blocked by most solid surfaces (local tissue effect via inhalation)
- Gamma radiation: high energy, travels through air, blocked by surfaces, affects entire body (no specific organ)

Do not copy, cite, or distribute without permission of UNR Risk Management Department
## Ionizing Radiation
### Dose- and Time-Dependent Health Effects

<table>
<thead>
<tr>
<th>Dose (rem)</th>
<th>Duration</th>
<th>Disease</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;5000</td>
<td>Acute</td>
<td>Death</td>
<td>Hiroshima bomb</td>
</tr>
<tr>
<td>&gt;100-500+</td>
<td>Days-Weeks</td>
<td>Acute radiation syndrome</td>
<td>Chernobyl</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Delayed/long-term:</td>
<td>Radiation therapy (iatrogenic)—localized to organ or body area</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Organ scarring (eye, lung, other)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Gonads (sterility)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Cancer: thyroid, leukemia, bone (marrow, myeloma)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- non-melanoma skin</td>
<td></td>
</tr>
<tr>
<td>&lt;100</td>
<td>Cumulative</td>
<td>[No detectable effects vs. background incidence]</td>
<td>Radon*, cosmic rays, medical &amp; dental x-rays</td>
</tr>
<tr>
<td>10</td>
<td>Lifetime</td>
<td>Average US adult</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Per year</td>
<td>Whole body occup. Exposure limit</td>
<td></td>
</tr>
</tbody>
</table>
Sep 22, 2016
• NRCP notified University mining research on radium ore extraction, 1920-1924

Oct 20, 2016
• Occupants notified

Mar 16, 2017
• Report findings shared with occupants

May 10, 2017
• Risk Management requests Occupational Medicine recommendations

Sep 26-Oct 17, 2016
• UNR, State radiation physicists: confirm detectable radiation “hot spots”

Nov 7, 2016-Mar 9 2017
• Perma-Fix Environmental Services-Bid, investigation, report

Apr 13, 2017
• University decides and begins occupant relocations

May 31, 2017

Do not copy, cite, or distribute without permission of UNR Risk Management Department
Investigations: Key Findings

- Radium with radiation activity exists in structural surfaces throughout occupied spaces in building
  - Highest levels on 2nd floor
  - Maximum ‘elevated activity’ 80 μRem/hr
  - Radon levels are detectable but low
  - Findings are scientifically valid

- Building remediation is required to abate hazard
  - Based on federal radiation requirements
  - *Recommendation was not based on an assessment of occupant health risk.*
Health Risk Concerns Understandable

- Unknown
- Unexpected
- Unfamiliar
- Uncertainty
- Unclear
- Uncontrolled
Exposure Risk Quantitation
Can relative or absolute magnitude of peak or cumulative past exposure to radium-generated gamma irradiation be quantified by work location(s) or duration of occupancy?

- Assuming ‘worst case’ scenario, overall exposure is & was relatively LOW vs. background sources
  - Radium decays very slowly (half life = 1,600 years)
  - Exposure intensity 50-90 years ago ≈ now.
  - Occupants are/were ‘moving targets’
  - Major renovations (1997): unclear to what, if any extent they could substantively increase internal exposure.
    - HVAC equipment in attic is/was a very low probability point source or transmitter of radioactive contamination.
Risk Assessment

- Gamma activity: 1-4X background
- Worst case': annual gamma radiation <0.1 mrem*
  - Risk is from body gamma exposure, not alpha or beta particle inhalation
  - >50,000X lower than US allowable occupational exposure limit (5 rem = 5000 mrem)
  - >6X lower than US average annual exposure (0.620 mrem)

Radiation Dose in Millirems Per Year

* On average, Americans receive a radiation dose of about 0.52 mrem (520 millirems) each year. US Nuclear Regulatory Commission

Do not copy, cite, or distribute without permission of UNR Risk Management Department
# Estimating Cancer Risks: Challenges
## Long-Term, Low-Dose Radiation Exposure

<table>
<thead>
<tr>
<th>Causation</th>
<th>• Difficult or impossible to determine (occupational) cause or distinguish from non-environmental causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specificity</td>
<td>• Certain uncommon cancers associated specifically with radiation (thyroid, leukemia, multiple myeloma, bone)</td>
</tr>
<tr>
<td>Latency</td>
<td>• Years to decades (10-40+ years) between first exposure and clinical manifestation of cancer</td>
</tr>
</tbody>
</table>
| Threshold | • Probability of disease increases with dose, but unknown how much exposure is required (“stochastic”). Risk at low doses is inaccurately extrapolated from very high dose incidents.  
• Body’s defenses against cancer development (DNA repair, immunological response) cannot be measured presently to assess individual risk. |
| Evidence | • Human data limited; animal studies unreliable; mechanistic studies theoretical |

Do not copy, cite, or distribute without permission of UNR Risk Management Department
Medical Surveillance (Screening)

- Screening: monitor populations with known hazardous exposures who are at increased risk of treatable or compensable disease.

- Criteria for cancer screening exam or test:
  - Sensitive for diagnosing disease at early enough stage (true positive)
  - Population is at significantly increased risk of particular disease (high probability)
  - Early detection and intervention can prevent ($1^{\circ}$), reverse ($2^{\circ}$), or reduce progression ($3^{\circ}$) of disease.
Medical Screening and Interventions NOT Recommended or Warranted

- Body/organ scans (MRI, CT#, PET)
- Bone scans#
- Radionuclide thyroid scan#
- Thyroid function, blood counts
- Annual or one-time skin or general medical exams
- Radium blood or urine test
- Prophylactic treatments (“detoxification”)

Low Sensitivity (false negative = false reassurance)
Low Specificity (false positive = unnecessary alarm or intervention)*
Case Management

- All occupants (current & former) are considered “exposed” for workers’ compensation purposes.
  - A claim can be filed if a potentially associated illness or disease is diagnosed.
  - Guidance on health effects will be provided to occupants to inform their personal physicians.
- An independent medical expert in radiation health effects will evaluate individuals on a case-by-case basis.
Building Disposition

- Once vacated, building is no longer a public health hazard
  - Contents are not hazardous—radiation does not persist beyond the radium source.
  - Radium itself is embedded in structural materials and/or debris.

- Determination to remediate vs. demolish
  - Legal
  - Economic
  - Historical
  - Architectural & construction
Next Steps

- Completion of occupant relocation (6 weeks)
- Case and claims management process
  - Recommendations and guidance: occupants, physicians
  - Independent expert assessment (workers’ comp.)
- Ongoing risk communication
  - Risk Management web site
  - Questions and answers (FAQs)
  - Register concerns and recommendations
Key Points

1. **Longstanding, low-level radioactive radium contamination** was recently identified in Facilities Building. Low-level, detectable ionizing gamma and other radiation is present in various locations throughout the building. **Occupants have already been, or are in the process of being relocated** to prevent further exposure.

2. **A low probability of increased short- or long-term health risk is estimated** for current and former occupants. Gamma radiation is/was the most significant hazard. **Expert medical assessment** will be offered to current and former occupants as part of ongoing risk management through workers’ compensation insurance.

3. **Medical surveillance (medical testing, screening exams) is NOT scientifically warranted** for early detection or prevention of cancer or other diseases potentially associated with ionizing radiation. Additional expert medical guidance will be provided to occupants and their physicians.
Questions