30 Years of International Collaboration on Cancer Risk Estimation in the Mayak Worker Cohort: What Has Been learned

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Pre 1995 awareness (in English)

- **Albrecht Kellerer organized 1994 special issue of Science in the Total Environment**
  - Occupational disease (Oladnikova)
    - Chronic radiation disease, radiation injury, Plutonium pneumosclerosis, radiation cataract
  - Lympho-hematopoietic diseases (Koshurnikova) in Reactor and Radiochemical plant workers
    - Crude risk estimates
  - Lung cancer (Khokhryakov & Romanov)
    - Radiochemical plant workers only
    - Lina in crease in risk

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Pre 1995 awareness (in English)

- **Albrecht Kellerer organized 1994 special issue of Science in the Total Environment**
  - Cardiovascular disease among amle radiochemical plant workers (Bolatnikova)
    - No effects of external exposure
  - Mortlaity from eternal causesin radiochemical plant workers (Komleva/Shilnikova)
    - Some differences from population rates
    - No evidence of radiation effects

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What have we learned together: External dose effects (1)

- **2003 (Shilnikova et al)**
  - 21,557 Original MWC (1948-72) plus auxiliary plant workers
  - Developed Pu surrogate categories for unmonitored workers
    - Realized that monitored workers had a high risk of dying of lung or other cancers in 2 years after initial monitoring
  - 1854 cancer deaths
    - 1739 solid cancers including 569 lung, 67 liver cancers, and 32 “skeletal” cancers
    - 124 lymphohematopoietic malignancies (66 non-CLL leukemia)
  - Linear dose response for both LLS and other solid cancers
    - No indication of Pu effect for other solid cancers
    - Developed a method for looking at time since dose received effects with chronic exposures
      - No evidence of effect modification

What have we learned together: External dose effects (2)

- **2015 (Sokolnikov et al)**
  - 25,757 workers in extended MWC (1948-82) follow-up 1948-2008
  - MWDS2008 dosimetry
    - Pu surrogate for pre-monitoring period, Pu doses for post-monitoring period
  - 1853 solid cancers other than Lung, liver, or bone
  - No indication of a Pu dose response
    - Some indication of elevated non-LB rates risks for monitored workers
  - Simple smoking adjustment (ever, never, unknown)
  - Significant linear dose-response
  - ERR 0.16/ Gy with no sex effect

What have we learned together: Lung cancer (1)

- **2004 (Gilbert et al)**
  - Original MWC (1948-72) plus auxiliary plant workers 1955-2000
  - 655 lung cancer deaths
  - Early Pu dose estimates for monitored workers with Pu exposure surrogate for unmonitored workers
  - Pu ERR/Gy 4.7 for males and 19 for females, decreasing with increasing attained age
- **2008 (Sokolnikov et al)**
  - Original MWC 17,740 workers 1953-2000
  - 354 lung cancer deaths among monitored workers
  - MWDS 2005 dose estimates
  - Pu ERR/Gy 7 males and 15 for females, decreasing with attained age

What have we learned together: Lung cancer (2)

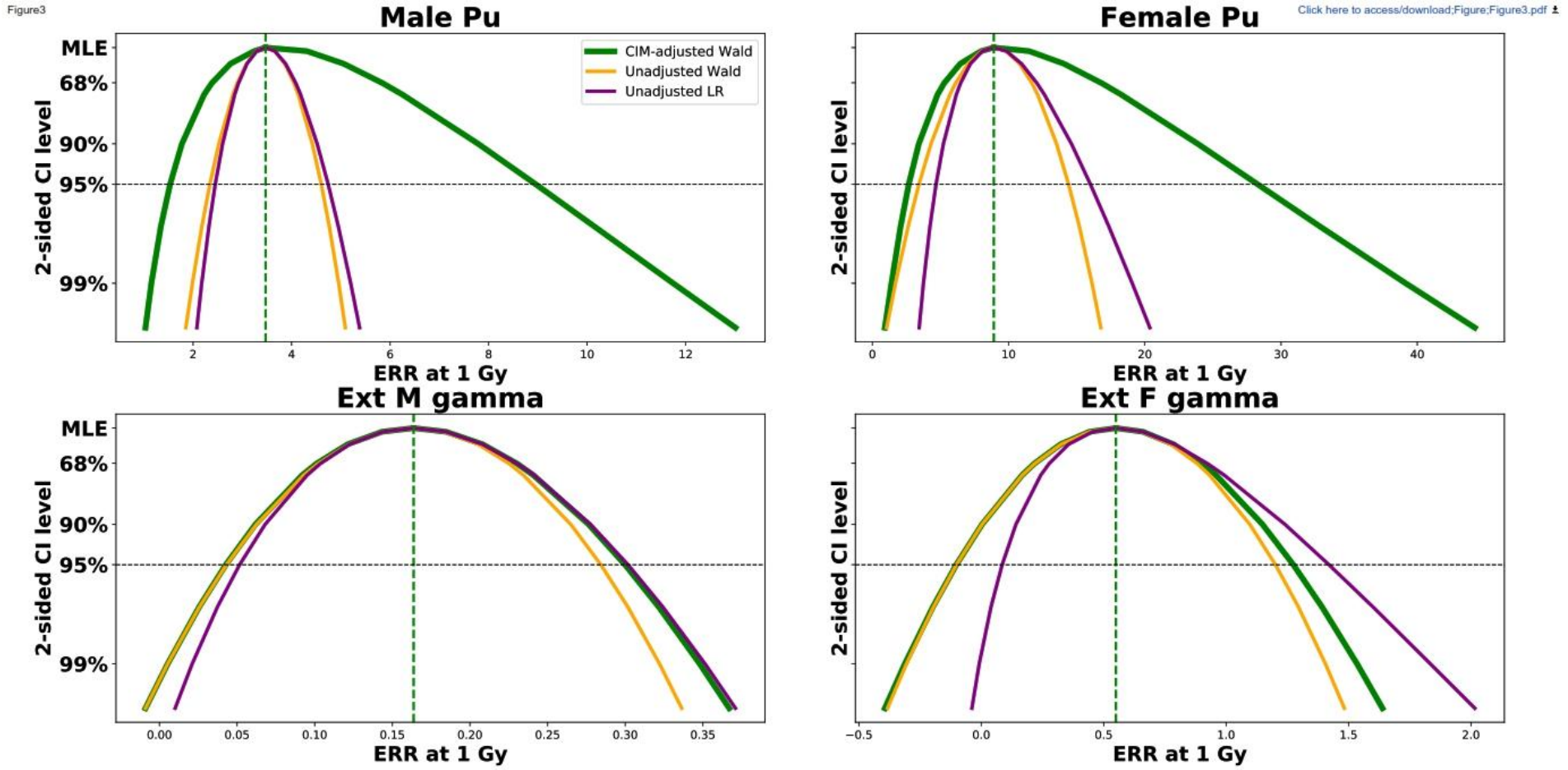
- **2013 (Gilbert et al)**
  - Extended MWC (1948-82) plus auxiliary plant workers 1953-2008
  - Focus on monitored workers and unmonitored Reactor and auxiliary plant workers
  - 486 lung cancer deaths
  - MWDS-2008 doses for monitored workers
  - Smoking adjustment (ever, never, unknown)
  - Pu ERR/Gy 7.4 for males 24 for females, decreasing proportional to age$^{-3.3}$

What have we learned together: Lung cancer (3)

- **2021 (Stram et al)**
  - Extended MWC (1948-82) plus auxiliary plant workers 1948-2015
  - 930 lung cancer deaths
  - MWDS-2016MC doses for monitored workers with surrogate categories for unmonitored workers
  - Smoking adjustment (duration, intensity)
  - Pu ERR/Gy 3.5 for males and 8.9 for females
    - Decrease proportional to age$^{-3.8}$
    - Dose uncertainty increases upper confidence bounds

What have we learned together: Lung cancer (4)

- **2021 (Stram et al)**



What have we learned together: Liver and Bone cancers

- **2000 (Gilbert et al)**
  - Larger risks for monitored workers with higher measured activity compared
  - No dose-response estimates made
- **2008 (Sokolnikov et al)**
  - Post monitoring RC and Pu workers with MWDS 2005 1953-2000
  - 40 of 75 liver cancer deaths and 11 of 30 bone cancer deaths
  - Liver Pu linear ERR 2.6 for males and 29 for females
  - Bone Pu ERR highly nonlinear with significant effects only in highest exposure category