



# Missing Uranium Dose

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*“Learning from Plutonium  
and Uranium Workers”*





## Question

- Should we analyze the acid solutions from our “plutonium” cases for uranium?



## Background

- Traditionally, tissues from Registrants who signed up under the USTR are analyzed only for plutonium and tissues from those who registered under the USUR are analyzed for uranium
- Many of our “plutonium” Registrants worked with uranium before they were transferred to plutonium work
- Could we be underestimating dose to plutonium workers by analyzing tissues for only plutonium and americium?

## Some “plutonium” cases were also analyzed for uranium

- 35 Lungs were analyzed for both plutonium and uranium
- Terminal Dose Rates (TDRs) from Pu and U
  - Absorbed dose rate from internally deposited actinides
  - At the time of death
  - Calculated from the concentration of activity in the lungs.
  - U-Natural assumed

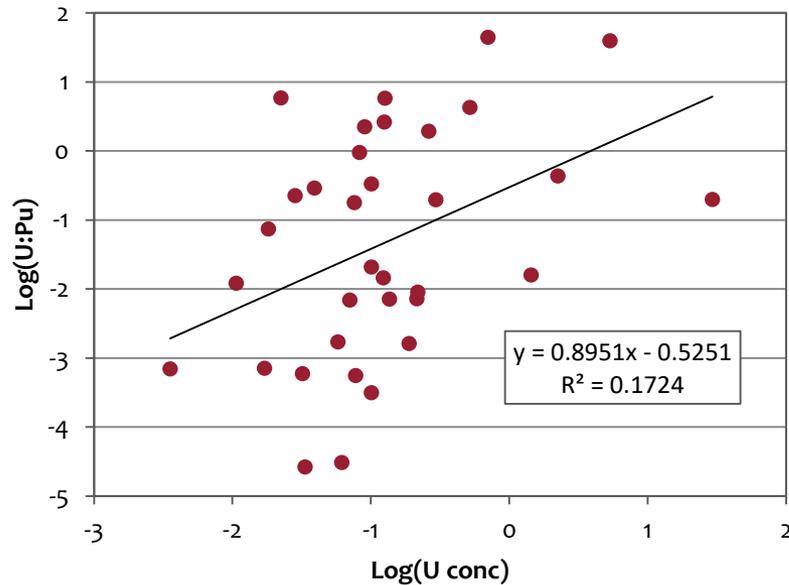
	TDR (mGy/y)	
	Pu	U
Min	0	8.2 e-5
Max	46	1.4
Median	0.12	0.003
Mean	3.2	0.05
Stdev	9.3	0.23

# Lung Results: U:Pu Ratio

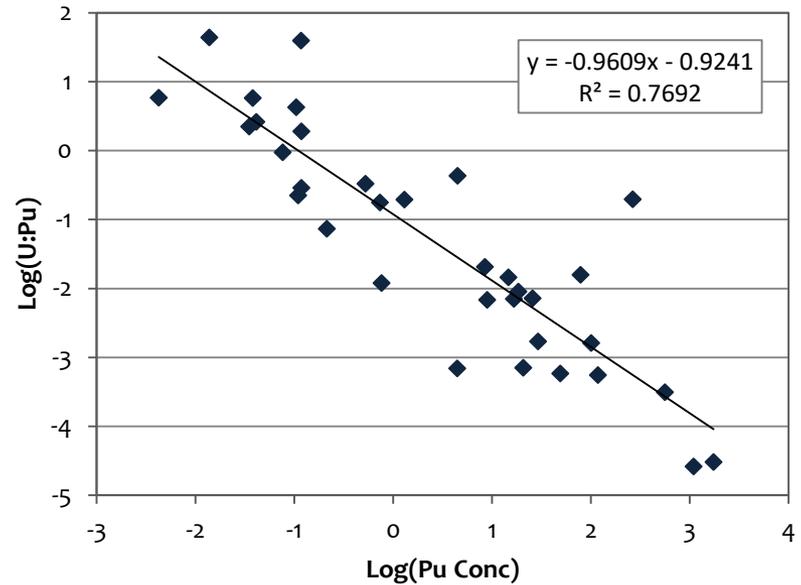
$$\text{U:Pu ratio} = \text{TDR}_U \div \text{TDR}_{\text{Pu}}$$

U:Pu ratio	
Min	2.6 e -5
Max	44
Median	0.047

### Uranium vs. U:Pu



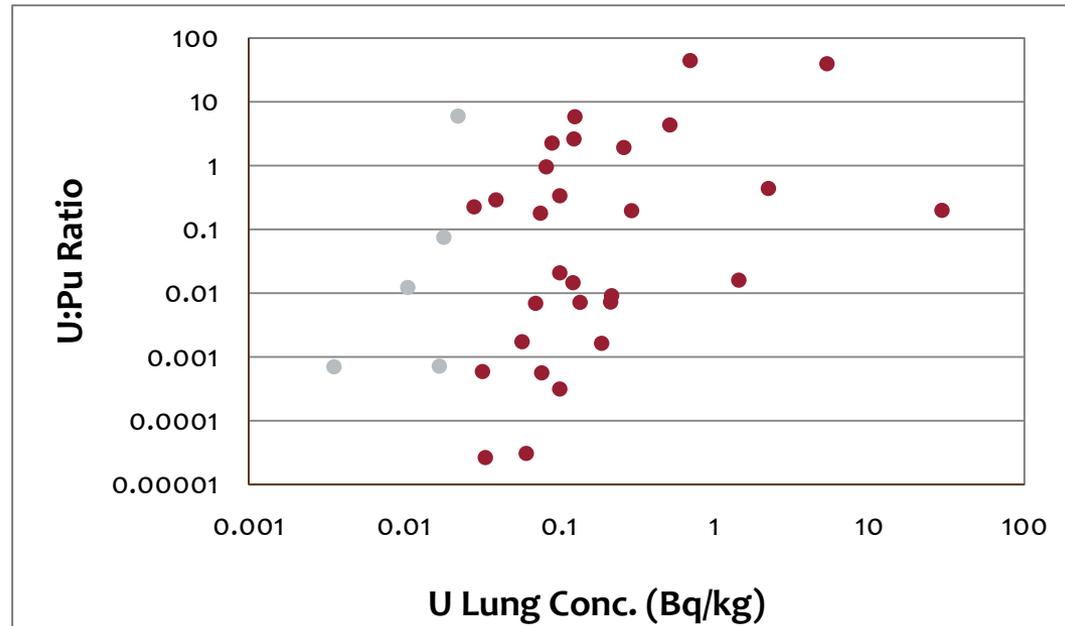
### Plutonium vs. U:Pu



\*Data are log transformed

## Lung Results

- Wrenn et al. lung concentrations (environmental)
  - Review paper: IL, PA, NYC, CO
  - Average: 0.0273 Bq/kg
  - Range: 0.0134 to 0.043 Bq/kg



	U:Pu ratio	
	All data	>Ave Wrenn
Count	34	29
Min	2.6 e -5	2.6 e -5
Max	44	44
Median	0.049	0.18



## Case A (x44) Machinist

- U:Pu TDR ratio: 44
- 25x Wrenn's lung concentration
- No incidents in his exposure file
- Worked in DU and EU buildings
- Monitored for DU and EU
- Not monitored for Pu
- Termination Occupational Exposure Report:
  - “Minimal” U-235
  - “Minimal” Pu-239/U-235



## Case B (x40) Machinist

- U:Pu TDR ratio: 40
- 195x Wrenn's lung concentration
- No incidents in his exposure file
- Worked in DU and Pu buildings for ~20 years
- Urine monitored for U, Pu, Am
  - Highest Uranium: 1.71 dpm/24-h (MDA: 25 dpm/24-h)
- Termination Occupational Exposure Report:
  - 1 nCi Pu-239
  - “Minimal” U-235
  - “Minimal” Pu-239/Am-241
  - “Minimal” Am-241



## Case C (x??)

- Monitored for uranium: 15 years
- Monitored for plutonium: 24 years
- Several positive uranium in urine measurements
- Plutonium inhalation (positive lung count)
- 4 wounds:
  - 2 DU, 1 Pu, 1 DU/EU/Pu
  - All monitored negative by the health physics department
- Termination Occupational Exposure Report:
  - 2 nCi Pu-239
  - “Minimal” U-235
  - “Minimal” Pu-239/U-235
  - “Minimal” Am-241

## Estimated Cost of Analysis

- ICP-MS analysis
  - Provides isotopic information
- 310 “plutonium” cases
- Acids are available from 205 cases
  - 152 Lung
  - 127 Lymph Node (Thoracic)
  - 187 Skeletal
  - 159 Liver
  - 112 Kidney
- 737 samples x \$50 = \$36,850

Variation in doses (normalized to U-Nat)	
U-Natural	1.0
Depleted	0.9
Low Enriched	1.08
High Enriched	1.12

## To Analyze, or Not to Analyze

- Many cases will have little contribution to the dose from uranium
- There are also other cases, like case C, with a high potential for a uranium intake
- Screening cases vs. analyzing all cases: time is money
- Bonus data: levels of uranium from environmental intakes
- The best approach is to analyze all tissues and let the results tell the story



# Questions?