WASHINGTON STATE UNIVERSITY
College of Pharmacy and Pharmaceutical Sciences

U.S. Transuranium and Uranium Registries: 2010 – 2022 Research Accomplishments and Collaborative Efforts

Sergey Y. Tolmachev, Research Professor & Director

United States Transuranium and Uranium Registries
1845 Terminal Drive, Suite 201, Richland, WA 99354
www.ustur.wsu.edu

USTUR-0538-20A

67th Annual Meeting of Health Physics Society
Spokane, Washington, July 17 – 22, 2022

National Plutonium Registry: Blue Ribbon Committee (1968)

Standing left to right: Carlos E. Newton, Jr., W. Daggett Norwood, H.D. Bruner, Philip A. Fuqua
Seated left to right: Thomas F. Mancuso, J.H. Sterner, Robley D. Evans, Herbert M. Parker
Not photographed: Clarence C. Lushbaugh, Lloyd M. Joshel

USTUR Mission: Then and Now

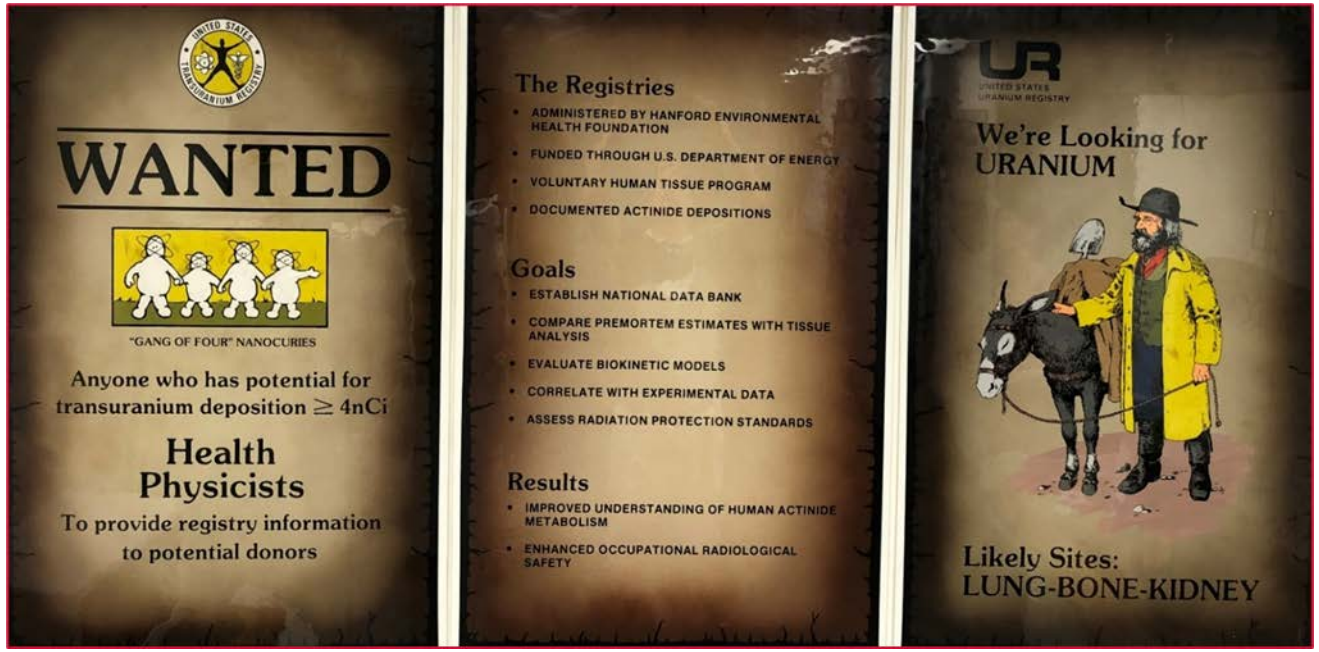
- Initial mission was "*to protect the interests of workers, employees, and the public by …. the acquisition and provision of the latest and most precise information about the effects of the transuranic elements on man*"
- By the end of 1970s, the mission of the Registries moved away from epidemiology
- Today's mission is to follow up occupationally exposed workers by studying the biokinetics and tissue dosimetry of the actinides

USTUR Registrants

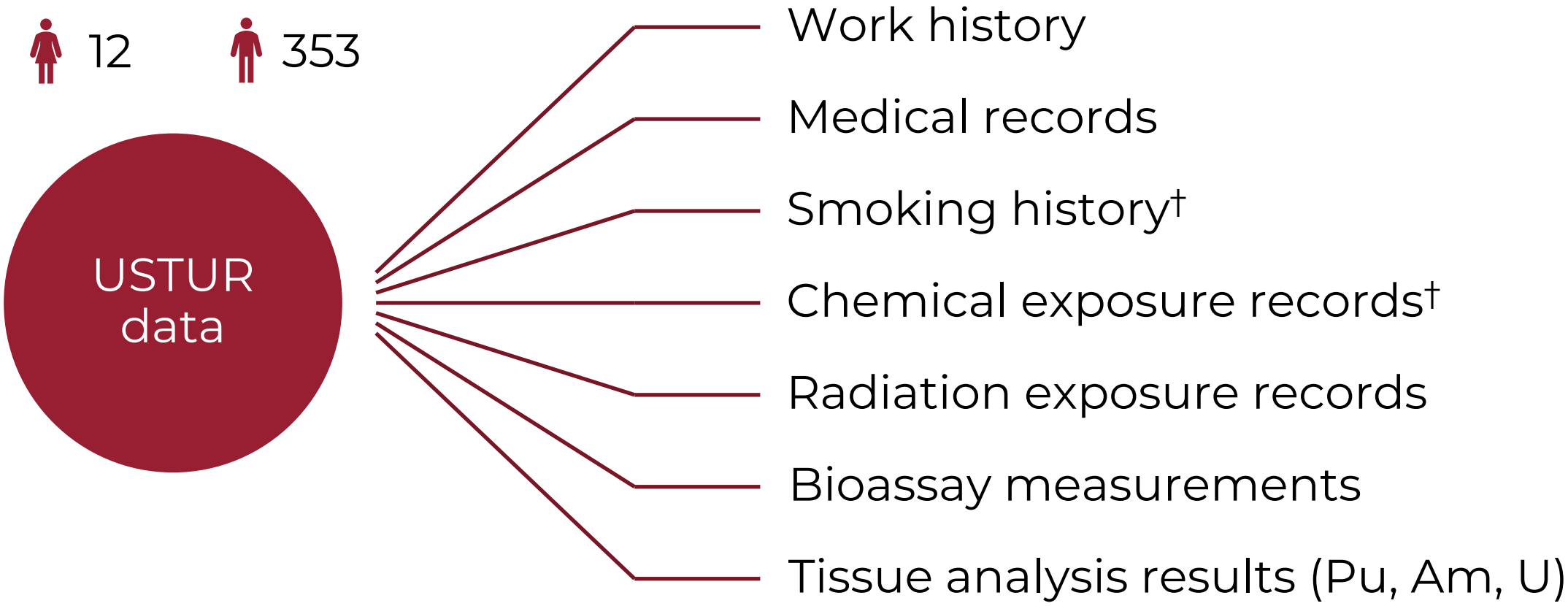
Individuals with documented history of exposure to the actinides

- Selection criteria: ≥2 nCi (internal deposition) or ≥10 rem (external)
- Mainly former nuclear workers from DOE sites
- Voluntary tissue donors (posthumous):

whole- (48) and/or partial-body (317) donations



Unique Data Resource



† - self-reported

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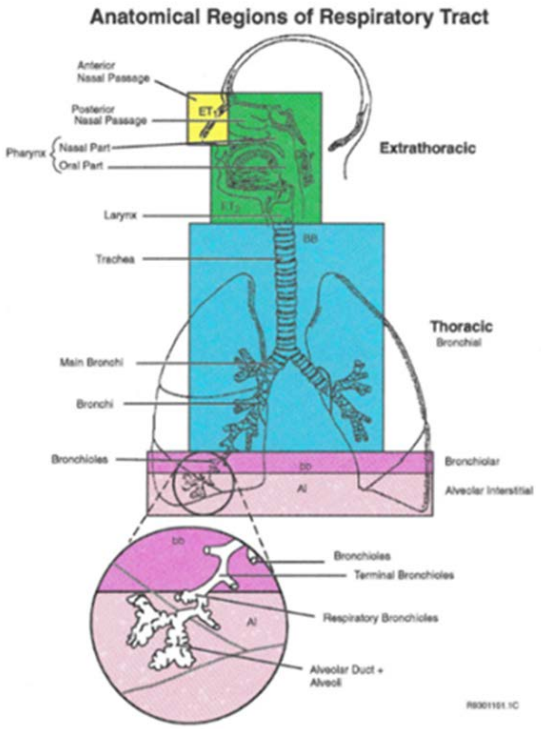
Primary Research: Biokinetic Modeling and Internal Dosimetry of Actinides

- Testing, improving and parameterizing biokinetic models for radiological protection
  - ✓ Human Respiratory Tract Model (ICRP 130)
  - ✓ Wound Model (NCRP 156)
  - ✓ Systemic models for U, Pu, Am (ICRP 137 & 141)
- Modeling actinide decorporation
- Evaluating uncertainties in internal radiation dose assessment



Actinide Decorporation Modeling

- Bastian Breustedt (KIT): sabbatical at the USTUR (2011)

Paper

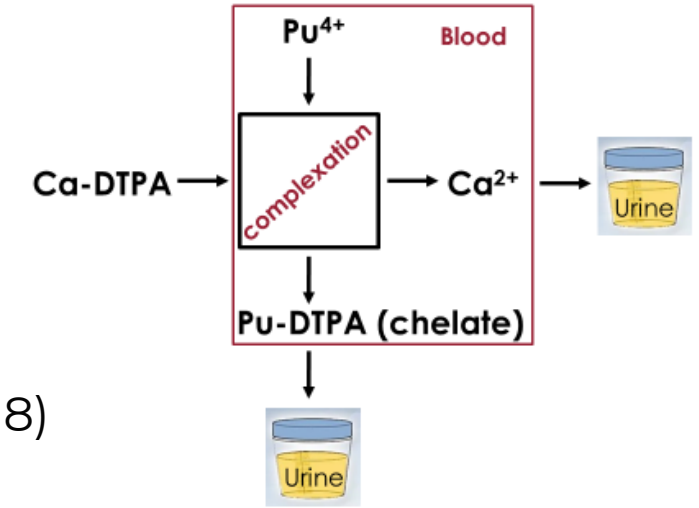
USTUR CASE 0846: MODELING AMERICIUM BIOKINETICS AFTER INTENSIVE DECORPORATION THERAPY

Bastian Breustedt,[1] Maia Avtandilashvili,[2] Stacey L. McComish,[2] and Sergei Y. Tolmachev[2]

Abstract—Decorporation therapy with salts of diethylenetriamine-pentaacetic acid binds actinides, thereby limiting uptake to organs and enhancing the rate at which actinides are excreted in urine. In-

Health Phys. 117(2):168–178; 2019

Key words: ^{241}Am; biokinetics; Ca-DTPA; US Transuranium and Uranium Registries



- Sara Dumit (WSU): PhD at the USTUR (2015 – 2018)

Paper

EVALUATING PLUTONIUM INTAKE AND RADIATION DOSE FOLLOWING EXTENSIVE CHELATION TREATMENT

Sara Dumit, Maia Avtandilashvili, and Sergei Y. Tolmachev[1]

Abstract—A voluntary partial-body donor (US Transuranium and Uranium Registries case 0785) was accidentally exposed to ^{239}Pu via inhalation and wounds. This individual underwent medical treatment including wound excision and extensive chelation

approximately a 50% drop on day 5. The half-time of plutonium ethylenediaminetetraacetic acid complex removal in urine was evaluated to be 1.4 d.

Health Phys. 117(2):156–167; 2019

Radiation Protection Dosimetry (2018), Vol. 178, No. 2, pp. 160–169
Advance Access publication 7 July 2017

doi:10.1093/rpd/ncx092

USTUR WHOLE-BODY CASE 0212: 17-YEAR FOLLOW-UP OF PLUTONIUM CONTAMINATED WOUND

Maia Avtandilashvili*, Sara Dumit and Sergei Y. Tolmachev
US Transuranium and Uranium Registries, Washington State University, 1845 Terminal Drive, Suite 201, Richland, WA 99354-4959, USA

Radiation and Environmental Biophysics (2019) 58:227–235
https://doi.org/10.1007/s00411-018-00773-y

ORIGINAL ARTICLE

CrossMark

Validation of a system of models for plutonium decorporation therapy

Sara Dumit[1,2] · Maia Avtandilashvili[1] · Stacey L. McComish[1] · Daniel J. Strom[1] · George Tabatadze[1] · Sergei Y. Tolmachev[1]

RADIATION RESEARCH **191**, 201–210 (2019)
0033-7587/19 $15.00

DOI: 10.1667/RR15188.1

Improved Modeling of Plutonium-DTPA Decorporation

Sara Dumit,[1] Maia Avtandilashvili, Daniel J. Strom, Stacey L. McComish, George Tabatadze and Sergei Y. Tolmachev

U.S. Transuranium and Uranium Registries, Washington State University, Richland, Washington 99354-4959

Human Respiratory Tract Model: Plutonium Bound Fraction

Anthony C James (USTUR)

Radiation Protection Dosimetry (2007), Vol. 127, No. 1–4, pp. 449–455
Advance Access publication 28 January 2008
doi:10.1093/rpd/ncm473

USTUR WHOLE BODY CASE 0269: DEMONSTRATING EFFECTIVENESS OF I.V. CA-DTPA FOR PU

A. C. James[1,*], L. B. Sasser[1], D. B. Stuit[1], S. E. Glover[2] and E. H. Carbaugh[3]
[1]US Transuranium and Uranium Registries, College of Pharmacy, Washington State University, 1845 Terminal Drive, Suite 201, Richland, WA 99354, USA
[2]Department of Mechanical, Industrial and Nuclear Engineering, University of Cincinnati, 598 Rhodes Hall, Cincinnati, OH 45221, USA
[3]Pacific Northwest National Laboratory, PO Box 999, Richland, WA 99354, USA

Radiation Protection Dosimetry (2017), Vol. 176, No. 1-2, pp. 45–49
Advance Access publication 10 June 2016
doi:10.1093/rpd/ncw1

THE MAYAK WORKER DOSIMETRY SYSTEM (MWDS 2013): SOLUBLE PLUTONIUM RETENTION IN THE LUNGS OF AN OCCUPATIONALLY EXPOSED USTUR CASE

S. Y. Tolmachev[1,*], C. E. Nielsen[2], M. Avtandilashvili[1], M. Puncher[3], F. Martinez[1], E. M. Thomas[1], F. L. Miller[1], W. F. Morgan[4,†] and A. Birchall[5]
[1]US Transuranium and Uranium Registries, College of Pharmacy, Washington State University, 1845 Terminal Drive, Suite 201, Richland, WA 99354, USA
[2]Mission Support Alliance, Richland, WA 99352, USA
[3]Department of Toxicology, Centre for Radiation, Chemical and Environmental Hazards, Public Health England, Chilton, Didcot OX11 0RQ, UK
[4]Pacific Northwest National Laboratory, Richland, USA
[5]Global Dosimetry, Didcot, Oxon, UK

Alan Birchall (PHE, UK)

Paper

THE IMPORTANCE AND QUANTIFICATION OF PLUTONIUM BINDING IN HUMAN LUNGS

Alan Birchall,[1,4] Matthew Puncher,[2,4] Alan Hodgson,[2] and Sergei Y. Tolmachev[3]

Abstract—Epidemiological studies have shown that the main risk

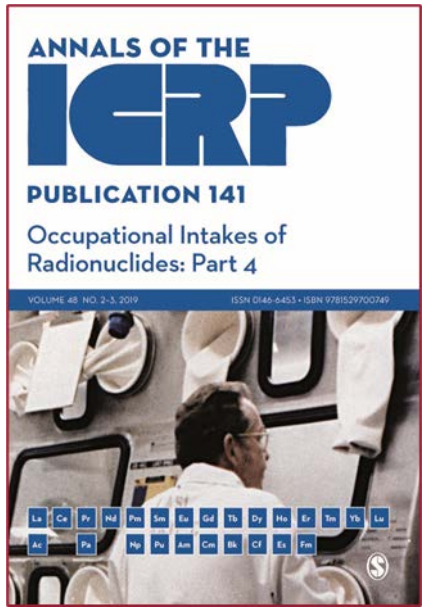
Health Phys. 117(2):133–142; 2019
Key words: dosimetry, internal; inhalation; lungs, human;

Matthew Puncher (PHE, UK)

Radiation Protection Dosimetry (2017), Vol. 176, No. 1-2, pp. 50–61
Advance Access publication 24 April 2016
doi:10.1093/rpd/ncw083

THE MAYAK WORKER DOSIMETRY SYSTEM (MWDS 2013): A RE-ANALYSIS OF USTUR CASE 0269 TO DETERMINE WHETHER PLUTONIUM BINDS TO THE LUNGS

M. Puncher[1,*], A. Birchall[2] and S. Y. Tolmachev[3]
[1]Department of Toxicology, Centre for Radiation, Chemical and Environmental Hazards, Public Health England, Chilton, Didcot OX11 0RQ, UK
[2]Global Dosimetry, Didcot, Oxon, UK
[3]US Transuranium and Uranium Registries, College of Pharmacy, Washington State University, 1845 Terminal Drive, Suite 201, Richland, WA 99354, USA



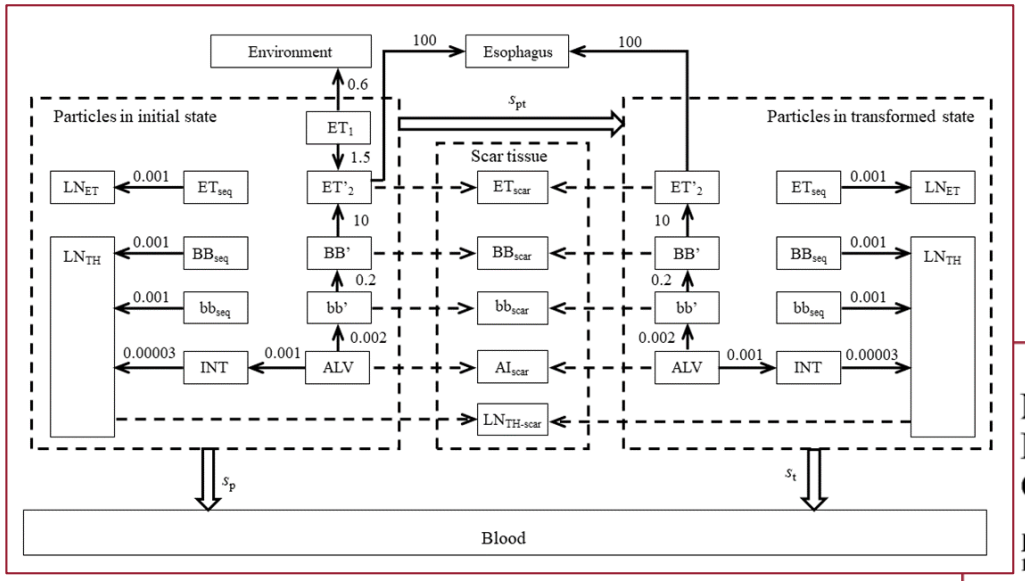
Human Respiratory Tract Model: Scar Tissue

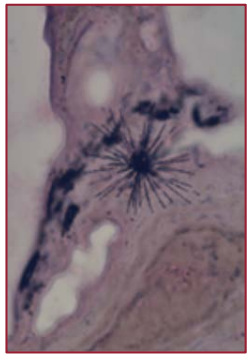
Deepesh Poudel (LANL)

Paper

Long-term Retention of Plutonium in the Respiratory Tracts of Two Acutely-exposed Workers: Estimation of Bound Fraction

Deepesh Poudel,[1] Maia Avtandilashvili,[2] Luiz Bertelli,[1] John A. Klumpp,[1] and Sergei Y. Tolmachev[2]





IOP Publishing | Society for Radiological Protection
Journal of Radiological Protection
J. Radiol. Prot. 41 (2021) 940–961 (22pp)
https://doi.org/10.1088/1361-6498/abca49

Modelling of long-term retention of high-fired plutonium oxide in the human respiratory tract: importance of scar-tissue compartments

Deepesh Poudel[1,*], Maia Avtandilashvili[2], John A Klumpp[1], Luiz Bertelli[1] and Sergei Y Tolmachev[2]

[1] Radiation Protection Division, Los Alamos National Laboratory, Los Alamos, NM, United States of America
[2] U.S. Transuranium and Uranium Registries, Washington State University, Richland, WA, United States of America

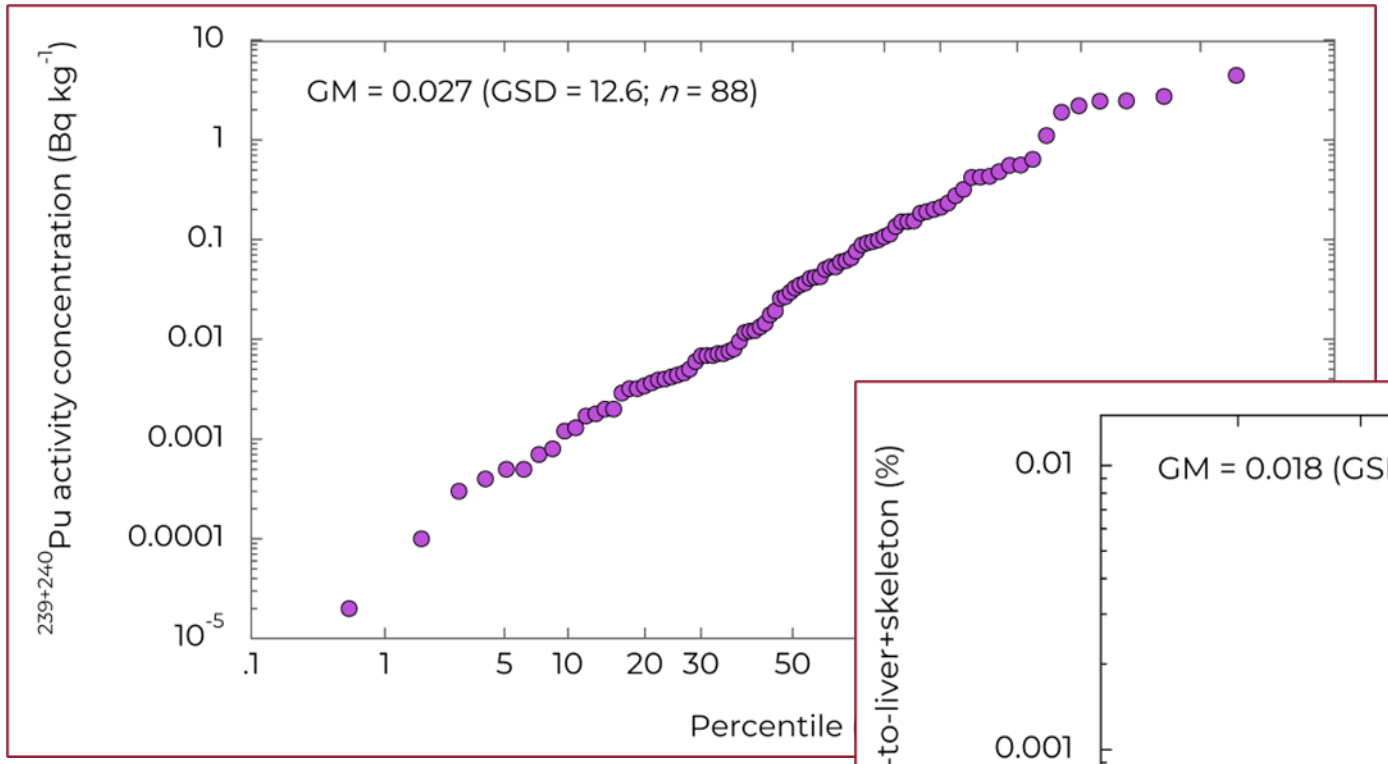
E-mail: dpoudel@lanl.gov

MODELING THE LONG-TERM RETENTION OF PLUTONIUM IN THE HUMAN RESPIRATORY TRACT USING SCAR-TISSUE COMPARTMENTS

Deepesh Poudel[1,*], Maia Avtandilashvili[2], John A Klumpp[1], Luiz Bertelli[1] and Sergei Y Tolmachev[2]
[1]Radiation Protection Division, Los Alamos National Laboratory, Los Alamos, NM, USA
[2]United States Transuranium and Uranium Registries, Washington State University, Richland, WA, USA

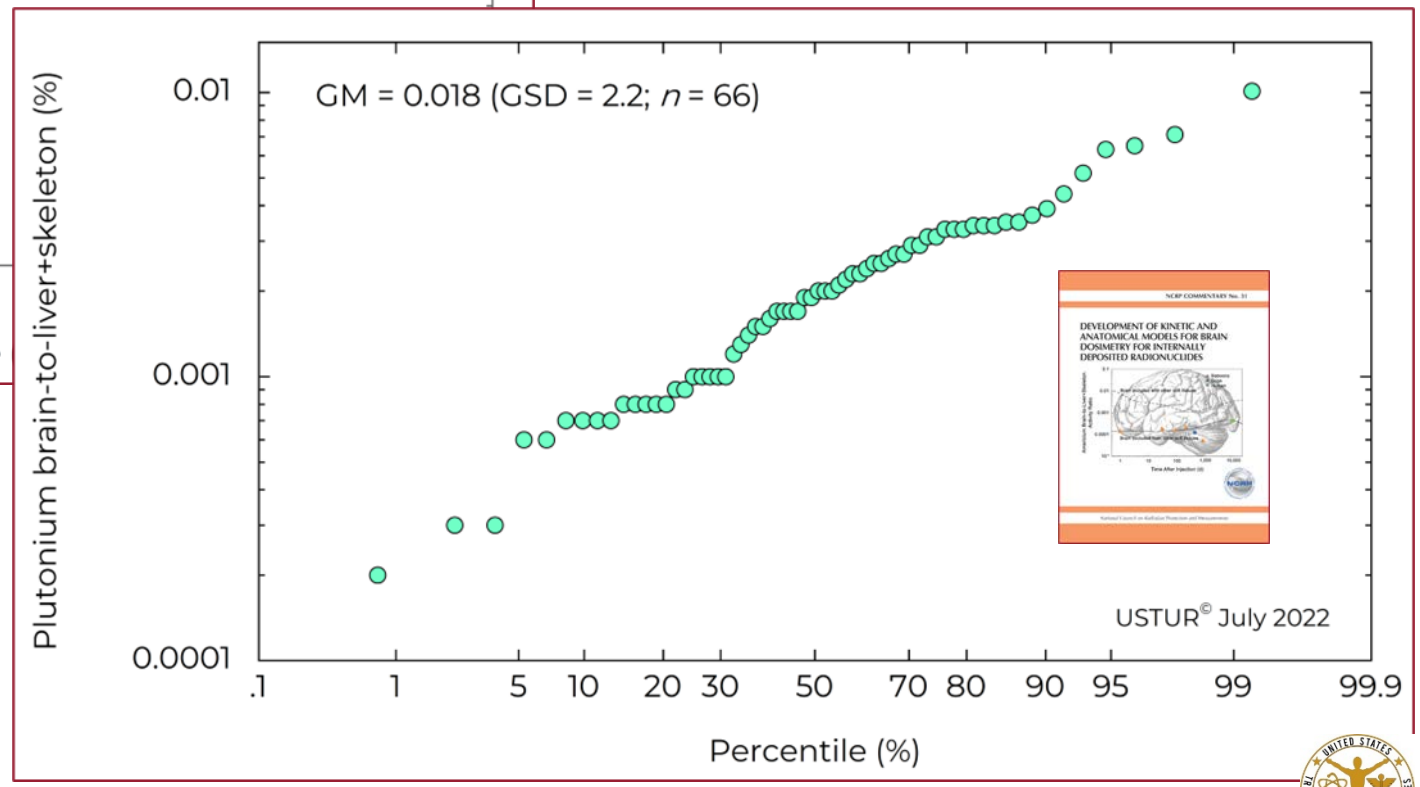
*Corresponding author: dpoudel@lanl.gov

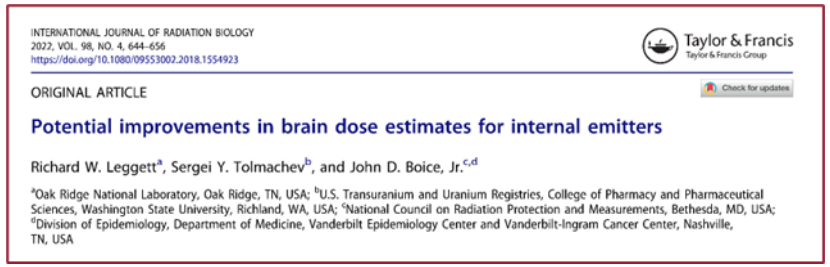
Plutonium in Human Brain



National Council on Radiation Protection and Measurements

The Million Person Study





INTERNATIONAL JOURNAL OF RADIATION BIOLOGY
2022, VOL. 98, NO. 4, 644–656
https://doi.org/10.1080/09553002.2018.1554923

Taylor & Francis
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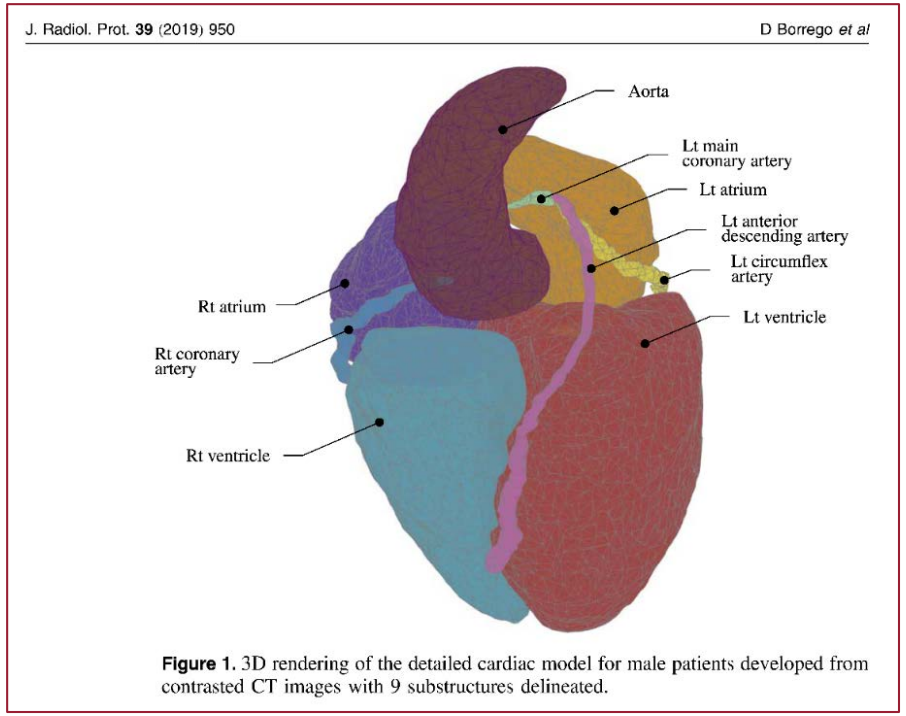
ORIGINAL ARTICLE

Potential improvements in brain dose estimates for internal emitters

Richard W. Leggett[a], Sergei Y. Tolmachev[b], and John D. Boice, Jr.[c,d]

[a]Oak Ridge National Laboratory, Oak Ridge, TN, USA; [b]U.S. Transuranium and Uranium Registries, College of Pharmacy and Pharmaceutical Sciences, Washington State University, Richland, WA, USA; [c]National Council on Radiation Protection and Measurements, Bethesda, MD, USA; [d]Division of Epidemiology, Department of Medicine, Vanderbilt Epidemiology Center and Vanderbilt-Ingram Cancer Center, Nashville, TN, USA

Plutonium Distribution in Human Heart



National Council on Radiation Protection and Measurements

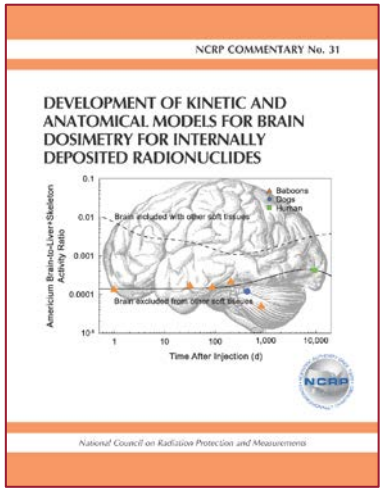
The Million Person Study

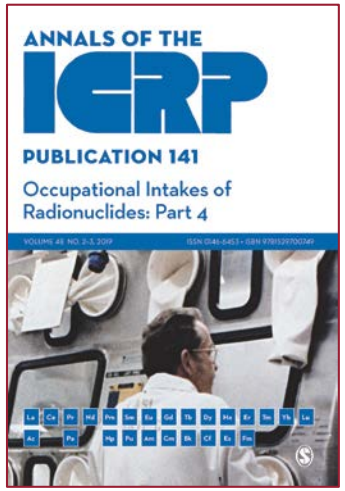
Seven registrant cases

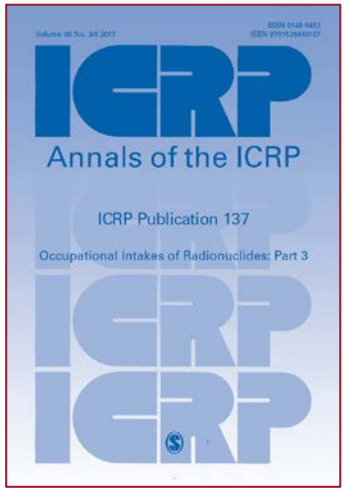
- Systemic Pu deposition: <2 – 33 nCi

Recent Contributions to ICRP and NCRP

- NCRP Commentary 31: Development of Kinetic and Anatomical Models for Brain Dosimetry for Internally Deposited Radionuclides (2022)
- ICRP Publication 141: Occupational Intakes of Radionuclides - Part 4 (2019)
- ICRP Publication 137: Occupational Intakes of Radionuclides - Part 3 (2017)







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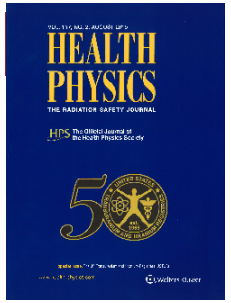
4th Special Issue of Health Physics Journal



The United States Transuranium and Uranium Registries (USTUR): Five Decade Follow-up of Plutonium and Uranium Workers. Vol. 117(2); 2019

- Worthington. Introduction to the US Transuranium and Uranium Registries (USTUR) special issue
- Kathren and Tolmachev. The United States Transuranium and Uranium Registries (USTUR): A five-decade follow-up of plutonium and uranium workers
- Birchall *et al*. The importance and quantification of plutonium binding in human lungs
- Goans *et al*. The pseudo-Pelger Huët cell as a retrospective dosimeter: analysis of a Radium Dial Painter cohort
- Avtandilashvili and Tolmachev. Modeling the skeleton weight of an adult Caucasian man
- Dumit *et al*. Evaluating plutonium intake and radiation dose following extensive chelation treatment
- Breustedt *et al*. USTUR Case 0846: modeling americium biokinetics after intensive decorporation therapy
- Tabatadze *et al*. Mapping ^{241}Am spatial distribution within anatomical bone structures using digital autoradiography
- Zhou *et al*. A Monte Carlo t-test to evaluate mesothelioma and radiation in the U.S. Transuranium and Uranium Registries
- Lopez *et al*. Measurements and Monte Carlo simulations of ^{241}Am activities in three skull phantoms: EURADOS-USTUR collaboration
- Tolmachev *et al*. Estimation of total skeletal content of plutonium and ^{241}Am from analysis of a single bone
- Tolmachev *et al*. USTUR special session roundtable – US Transuranium and Uranium Registries (USTUR): a five-decade follow-up of plutonium and uranium workers

More on USTUR Research

- TAM-A2.4: Goans *et al*. The Neutrophil to Lymphocyte Ratio Shows Evidence for Chronic Inflammation in a Radium Dial Painter Cohort
- TPM-D.1: Strom *et al*. Revision of the ICRP 141 Pu Systemic Model to Incorporate the HAT Model and the Hepatic Portal Vein
- TPM-D.2: McComish *et al*. Misclassification of Causes of Death Among USTUR Registrants: Death Certificates vs. Autopsy Reports
- WPM-B.2: Šefl *et al*. Uncertainties in Radiation Dose Assessment for Internally Deposited Plutonium in Support of Radiation Epidemiology
- WPM-B.3: Avtandilashvili *et al*. Beryllium in Tissues of Former Nuclear Workers

WASHINGTON STATE UNIVERSITY

Collaborative Network

The Million Person Study

Los Alamos NATIONAL LABORATORY EST. 1943

OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION

VANDERBILT UNIVERSITY

NICRP National Council on Radiation Protection and Measurements

MURR

MISSOURI

OAK RIDGE National Laboratory

EURADOS

UK Health Security Agency

CORNELL UNIVERSITY FOUNDED A.D. 1865

ARIZONA STATE UNIVERSITY 1885

reac/ts

CLEMSON UNIVERSITY

一般財団法人 九州環境管理協会

NORTHWESTERN UNIVERSITY 1851

Northwestern University

FM PHYSICS & ENGINEERING FRANCIS MARION UNIVERSITY

NAVAL DOSIMETRY CENTER Coma - Appeto - Veritas

1884 Memorial Sloan Kettering Cancer Center

Health Canada

ЮУрИБФ

UNIVERSITÉ LAVAL

Pacific Northwest NATIONAL LABORATORY

World Health Organization

UNITED STATES TRANSURANIUM AND URANIUM REGISTRIES

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Thank You!