



WASHINGTON STATE UNIVERSITY
College of Pharmacy and
Pharmaceutical Sciences

55 Years of the United States Transuranium and Uranium Registries: History, Contributions and Impact on Radiation Protection

Sergei Y. Tolmachev, Research Professor & Director

United States Transuranium and Uranium Registries

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www.ustur.wsu.edu



1st USTUR Special Session at 2016 Health Physics Society Meeting in Spokane



U.S. AEC 1966 Meeting on Plutonium Contamination in Man (Rocky Flats Plant)



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



Genealogy of the USTUR

REGISTRIES MANAGEMENT

ANALYTICAL SUPPORT

1968 National Plutonium Registry (NPR)
Hanford Environmental Health Foundation

1970 United States Transuranium Registry (USTR)
Hanford Environmental Health Foundation

1978 United States Uranium Registry (USUR)
Hanford Environmental Health Foundation

1992 United States Transuranium and Uranium Registries (USTUR)
College of Pharmacy, Washington State University
1993

Rocky Flats
Facility

Pacific Northwest
Laboratory

Los Alamos
Scientific Laboratory

1971

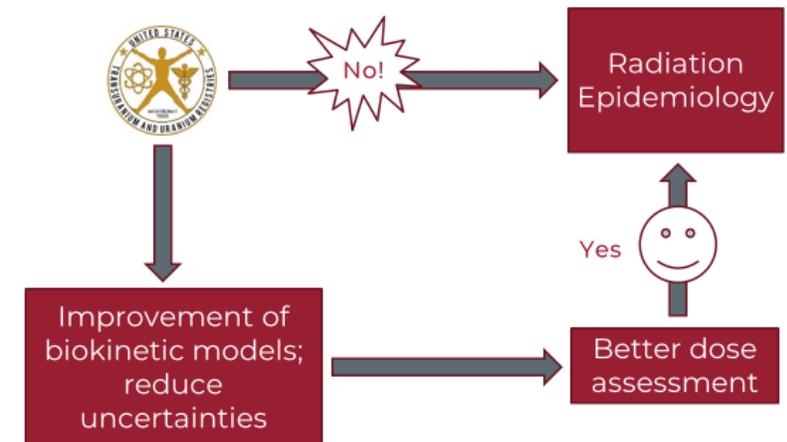
1978

1989



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 [in support of radiation epidemiology studies]

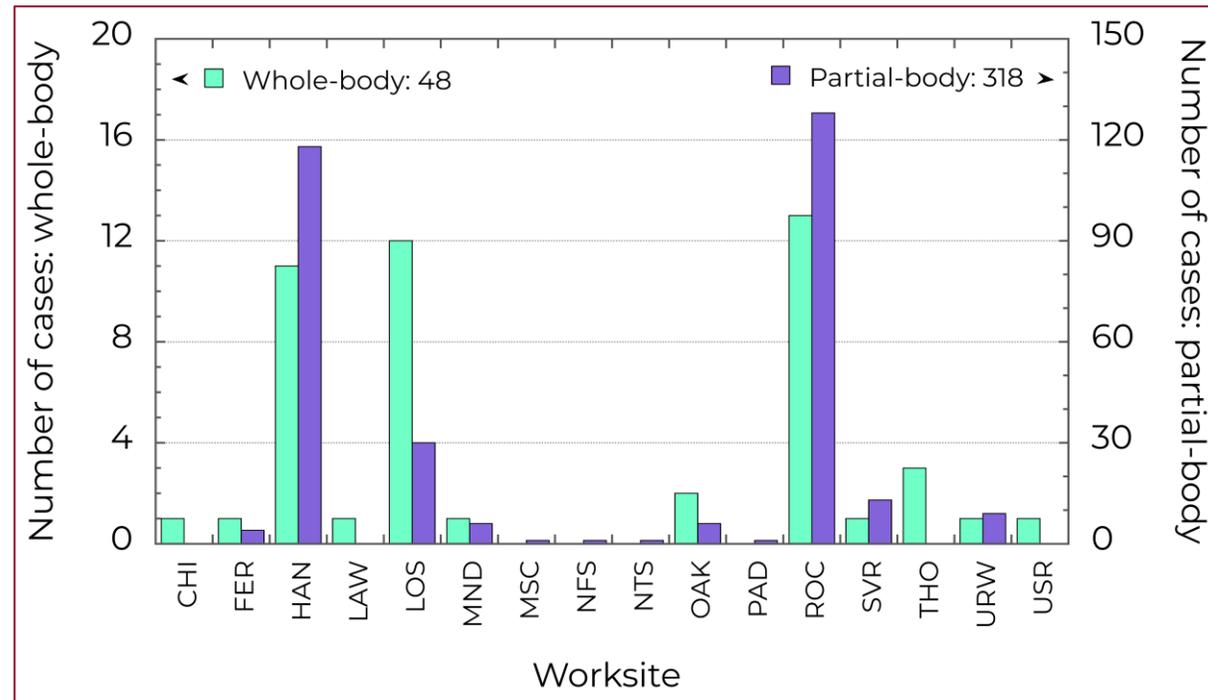


USTUR Registrants

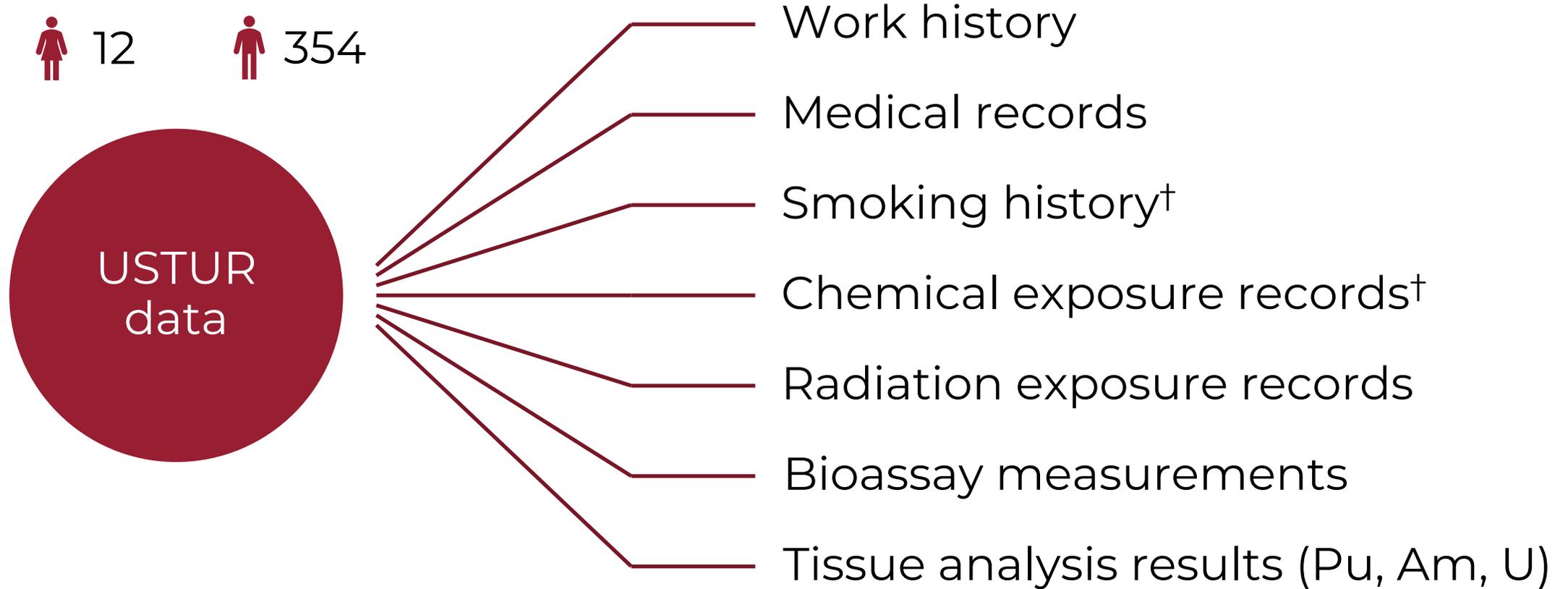
Individuals with documented history of exposure to the actinides

- 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 (318) donations



Unique Data Resource



† - self-reported



National Human Radiobiology Tissue Repository (NHRTR) at the USTUR

NHRTR
materials

USTUR research: *frozen and acid-digested tissues (acid solutions)*

Radium Dial Painter study: *frozen plastic-embedded, and dry tissues*

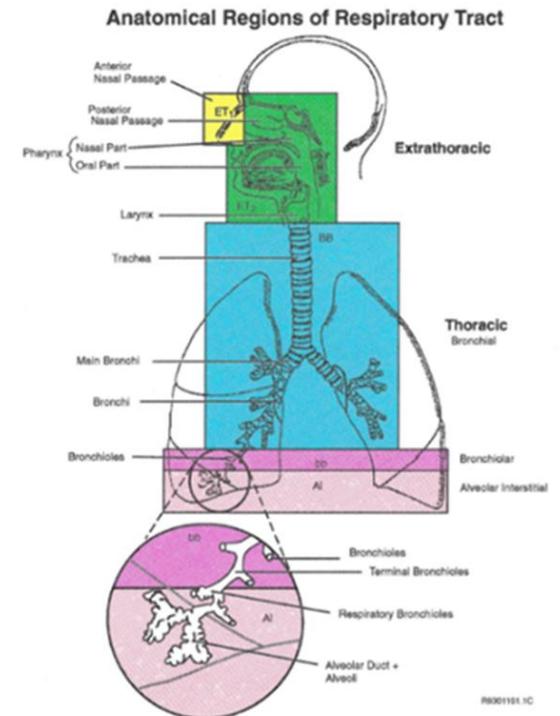
Los Alamos Environmental study: *acid solutions*

Plutonium Injection study: *plastic-embedded bones*



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 and outcomes



Courtesy William J Bair



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. Tolmachev²

Abstract—Decorporation therapy with salts of diethylenetriaminepentaacetic acid binds actinides, thereby limiting uptake to organs and enhancing the rate at which actinides are excreted in urine. *International Commission on Radiological Protection* **117**(2):168–178; 2019

Health Phys. 117(2):168–178; 2019
Key words: ²⁴¹Am; 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. Tolmachev¹

Abstract—A voluntary partial-body donor (US Transuranium and Uranium Registries case 0785) was accidentally exposed to approximately a 50% drop on day 5. ethylenediaminetetraacetic acid complex evaluated to be 1.4 d.

RADIATION RESEARCH **191**, 201–210 (2019)
 0033-7587/19 \$15.00
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 DOI: 10.1667/RR15188.1

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

ORIGINAL ARTICLE

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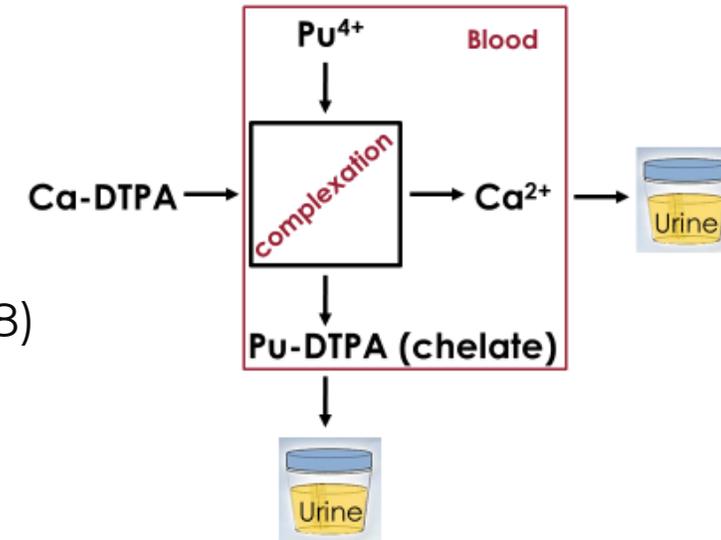
Validation of a system of models for plutonium decorporation therapy

Sara Dumit^{1,2} · Maia Avtandilashvili¹ · Stacey L. McComish¹ · Daniel J. Strom¹ · George Tabatadze¹ · Sergei Y. Tolmachev¹

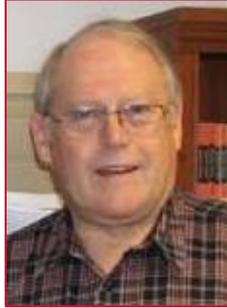
Improved Modeling of Plutonium-DTPA Decorporation

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



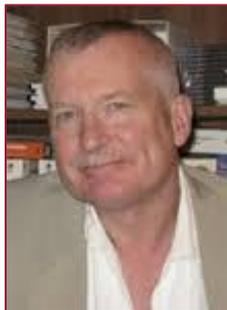
Anthony C James (USTUR)

Radiation Protection Dosimetry (2007), Vol. 127, No. 1–4, pp. 449–455
Advance Access publication 28 January 2008

doi:10.1093/rpd/nem473

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

A. C. James^{1,*}, L. B. Sasser¹, D. B. Stuit¹, S. E. Glover² and E. H. Carbaugh³
¹US Transuranium and Uranium Registries, College of Pharmacy, Washington State University, 1845 Terminal Drive, Suite 201, Richland, WA 99354, USA
²Department of Mechanical, Industrial and Nuclear Engineering, University of Cincinnati, 598 Rhodes Hall, Cincinnati, OH 45221, USA
³Pacific Northwest National Laboratory, PO Box 999, Richland, WA 99354, USA



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. Tolmachev³

Abstract—Epidemiological studies have shown that the main risk arising from exposure to plutonium aerosols is lung cancer, with

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. Birchall² and S. Y. Tolmachev³
¹Department of Toxicology, Centre for Radiation, Chemical and Environmental Hazards, Public Health England, Chilton, Didcot OX11 0RQ, UK
²Global Dosimetry, Didcot, Oxon, UK
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Radiation Protection Dosimetry (2017), Vol. 176, No. 1-2, pp. 45–49
Advance Access publication 10 June 2016

doi:10.1093/rpd/ncw11

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. Nielsen², M. Avtandjashvili¹, M. Puncher³, F. Martinez¹, E. M. Thomas¹, F. L. Miller¹, W. F. Morgan^{4,†} and A. Birchall⁵
¹US Transuranium and Uranium Registries, College of Pharmacy, Washington State University, 1845 Terminal Drive, Suite 201, Richland, WA 99354, USA
²Mission Support Alliance, Richland, WA 99352, USA
³Department of Toxicology, Centre for Radiation, Chemical and Environmental Hazards, Public Health England, Chilton, Didcot OX11 0RQ, UK
⁴Pacific Northwest National Laboratory, Richland, USA
⁵Global Dosimetry, Didcot, Oxon, UK

ANNALS OF THE
ICRP

PUBLICATION 141

Occupational Intakes of
Radionuclides: Part 4

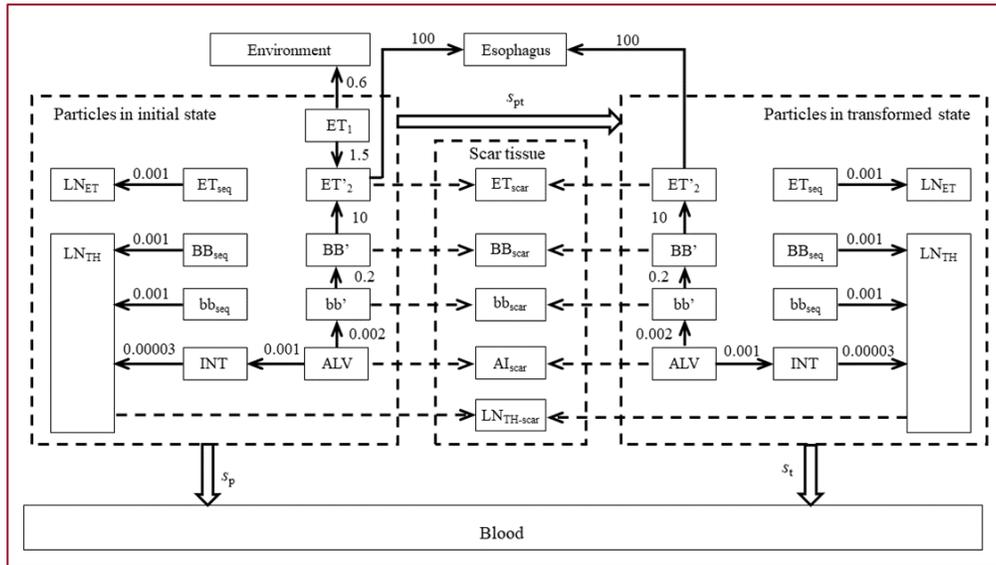
VOLUME 48 NO. 2-3, 2019 ISSN 0145-6453 • ISBN 9780203700749



Human Respiratory Tract Model: Scar Tissue



Deepesh Poudel (LANL)



IOP Publishing | Society for Radiological Protection
 Journal of Radiological Protection
 J. Radiol. Prot. 41 (2021) 940–961 (22pp)
<https://doi.org/10.1088/1361-6496/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 Avtandilashvili², John A Klumpp¹, Luiz Bertelli¹ and Sergei Y Tolmachev²

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

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. Tolmachev²

Radiation Protection Dosimetry (year), Vol. 0, No. 0, pp. 0–0
 DOI: 10.1093/rpd/nc0000

SECTION TITLE HERE

MODIFIED HUMAN RESPIRATORY TRACT MODEL TO DESCRIBE THE RETENTION OF PLUTONIUM IN SCAR TISSUES

Deepesh Poudel^{1,*}, Maia Avtandilashvili², John A Klumpp¹, Luiz Bertelli¹, Sergei Y Tolmachev²
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²Washington State University, 1845 Terminal Dr. Suite 201, Richland, WA 99354, USA

*Corresponding author: dpoudel@lanl.gov

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

Deepesh Poudel^{1,*}, Maia Avtandilashvili², John A Klumpp¹, Luiz Bertelli¹ and Sergei Y Tolmachev²
¹Radiation Protection Division, Los Alamos National Laboratory, Los Alamos, NM, USA
²United States Transuranium and Uranium Registries, Washington State University, Richland, WA, USA

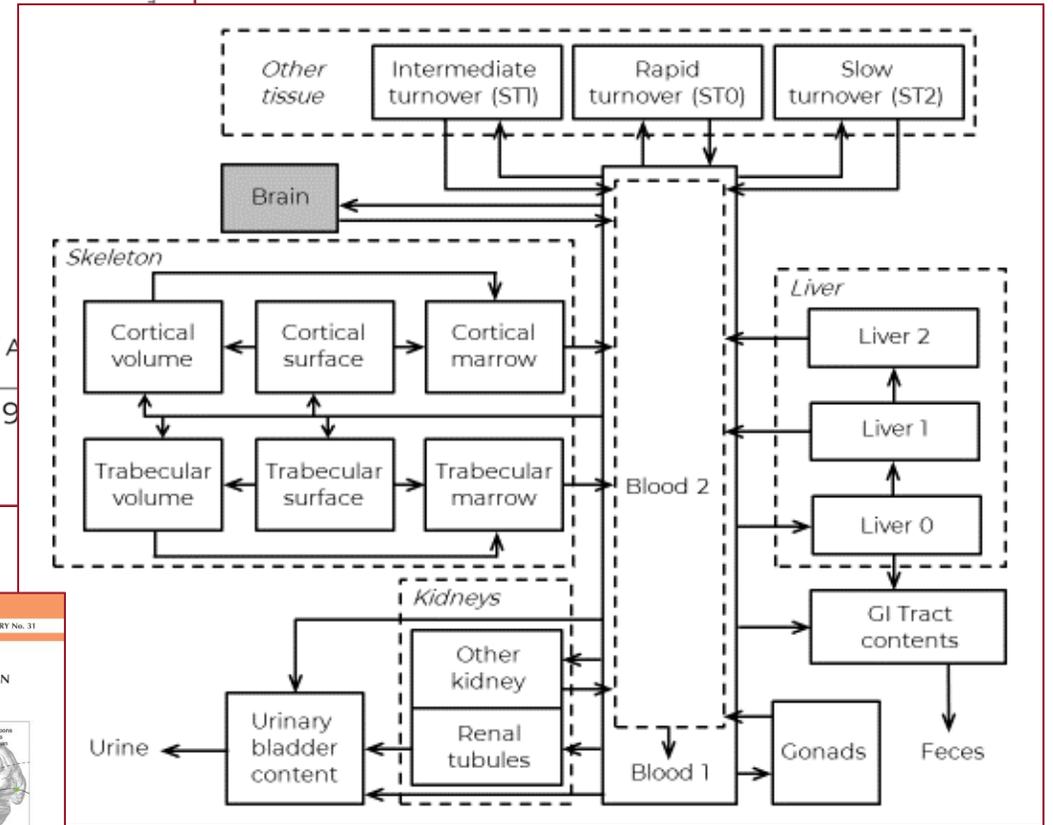
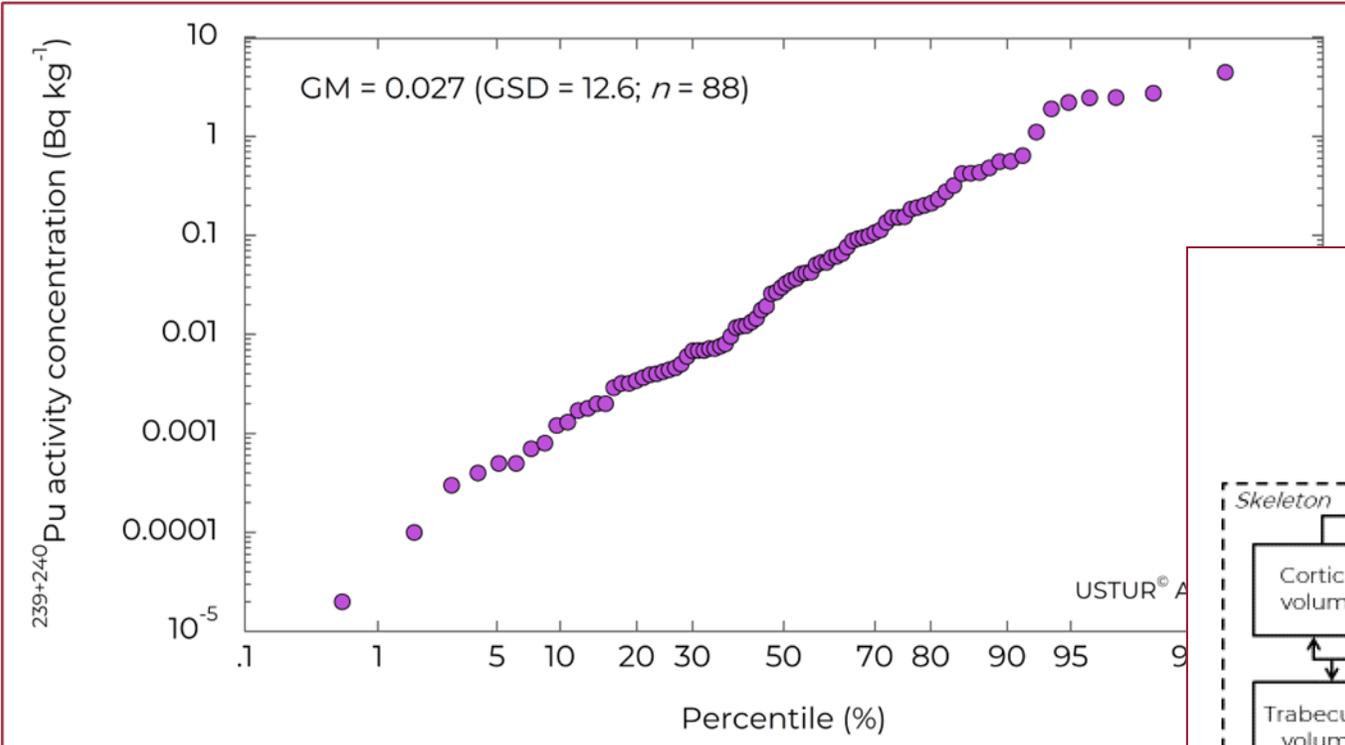
*Corresponding author: dpoudel@lanl.gov



Plutonium in Human Brain



National Council on Radiation Protection and Measurements



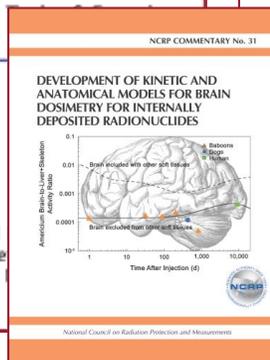
INTERNATIONAL JOURNAL OF RADIATION BIOLOGY
2022, VOL. 98, NO. 4, 644-656
<https://doi.org/10.1080/09553002.2018.1554923>

ORIGINAL ARTICLE

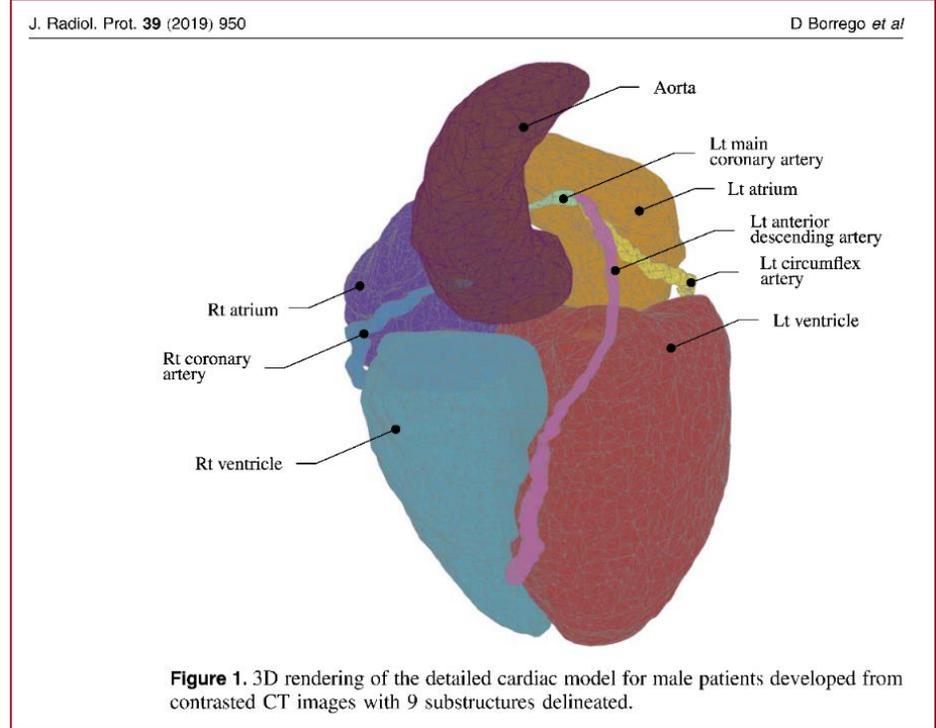
Potential improvements in brain dose estimates for internal emitters

Richard W. Leggett^a, Sergei Y. Tolmachev^b, and John D. Boice, Jr.^{c,d}

^aOak Ridge National Laboratory, Oak Ridge, TN, USA; ^bU.S. Transuranium and Uranium Registries, College of Pharmacy and Sciences, Washington State University, Richland, WA, USA; ^cNational Council on Radiation Protection and Measurements, Bethesda, MD, USA; ^dDivision of Epidemiology, Department of Medicine, Vanderbilt Epidemiology Center and Vanderbilt-Ingram Cancer Center, Nashville, TN, USA



^{239}Pu and ^{226}Ra Distribution in Human Heart



National Council on Radiation
Protection and Measurements



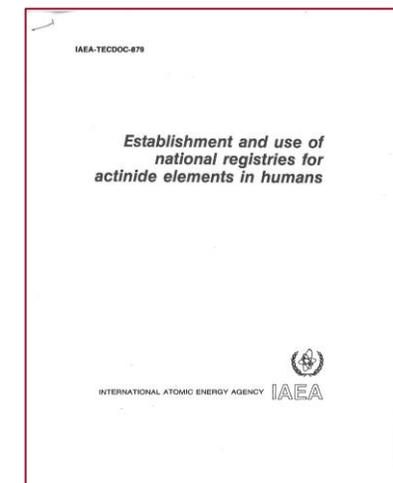
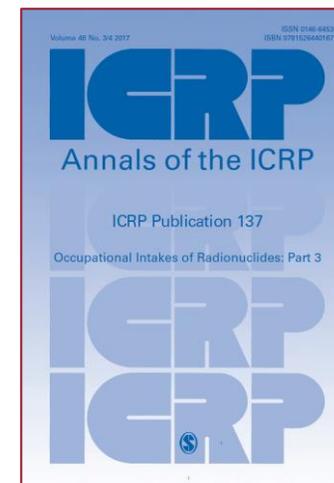
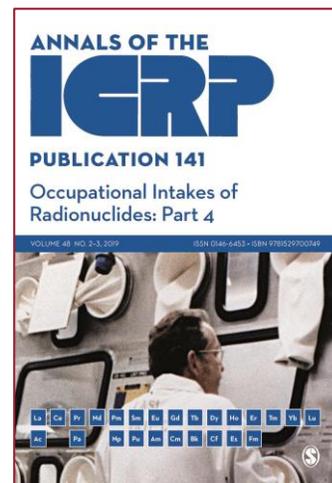
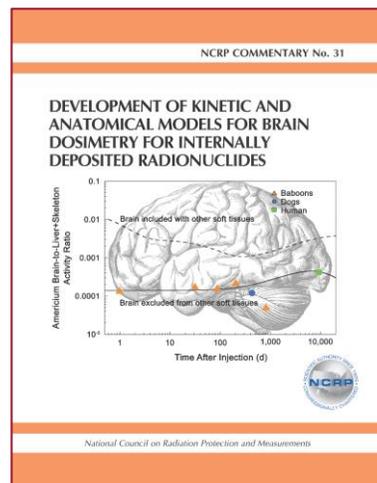
- Systemic Pu (n=7): <2 – 33 nCi
- Ra uptake (n=2): <0.004, 272.7 μCi



Contributions to ICRP, NCRP and IAEA

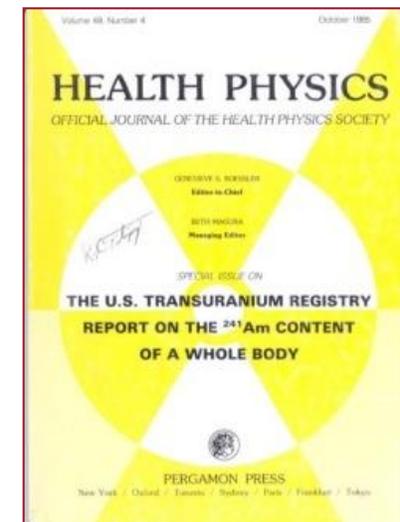
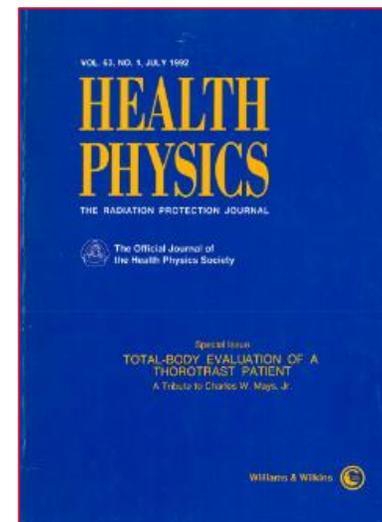
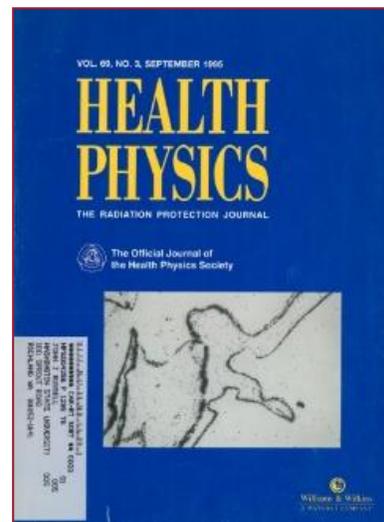
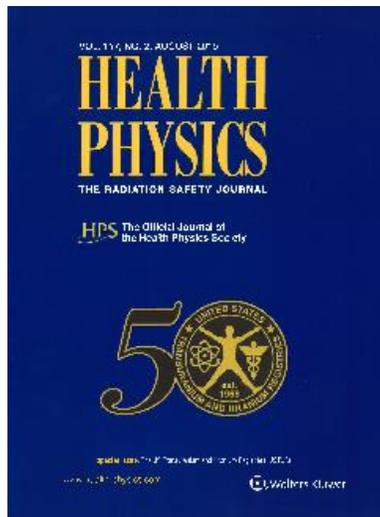
Eight ICRP, six NCRP, and one IAEA documents, including:

- 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)
- IAEA-TECDOC-879: Establishment and Use of National Registries for Actinide Elements in Humans (1996)



Health Physics Journal's Special Issues

- 2019, 117 (2): The United States Transuranium and Uranium Registries (USTUR): Five Decade Follow-up of Plutonium and Uranium Workers
- 1995, 69 (3): 1976 Hanford Americium Exposure Incident: Update
- 1992, 63 (1): Total-body Evaluation of a Thorotrast Patient
- 1985, 49 (4): The U.S. Transuranium Registry Report on the ^{241}Am Content of a Whole Body





Collaborative Network



National Council on Radiation Protection and Measurements



UK Health Security Agency



Northwestern University



PHYSICS & ENGINEERING FRANCIS MARION UNIVERSITY



Memorial Sloan Kettering Cancer Center



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Thank you for your attention

