2014 Scientific Advisory Committee Meeting
Courtyard Marriott Hotel, Richland, WA
September 5 – 6, 2014

2013 SAC Recommendations and 2014 Overview

Sergei Y. Tolmachev, *PhD*

USTUR Director
Associate Research Professor, College of Pharmacy
Washington State University

stolmachev@wsu.edu

"Learning from Plutonium and Uranium Workers"

WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

2013 SAC's Comments/Recommendations

- Following the 2013 Annual Meeting, the SAC made 10 comments and 8 specific recommendations

2013 SAC's Comments

- Big improvement in Registrant communications
- Good progress in analysis and database population
- Great response and implementation of previous recommendations
- Good research collaborations
- Great science on UF_6 and $Pu(NO_3)_4$
- Excellent presentations
- High quality and productive staff – great team
- Good prioritizing of analyses
- Better awareness of donor/family perspective
- Continued efforts at student involvement

Recommendation #1

Increase laboratory analysis throughput and establish higher goals

2013 Tissue Analysis

- Drying/Ashing
- Acid Digestion
- Radiochemical Separation
- Actinide Measurements

- Analysis Completed 233
- Sample Processed 319
- Completed/Processed 0.7

2014 Goals

- Analyzed: 400
- Ratio: 0.8
- Processed: 500

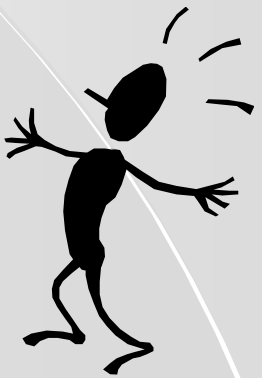
…However

- On December 2, 2013 retired from WSU

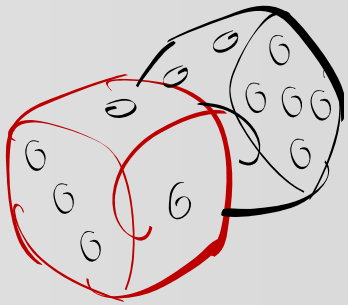
- 2014 Goals

… But

- On August 1, 2014 joined WSU/USTUR



- 2014 Goals

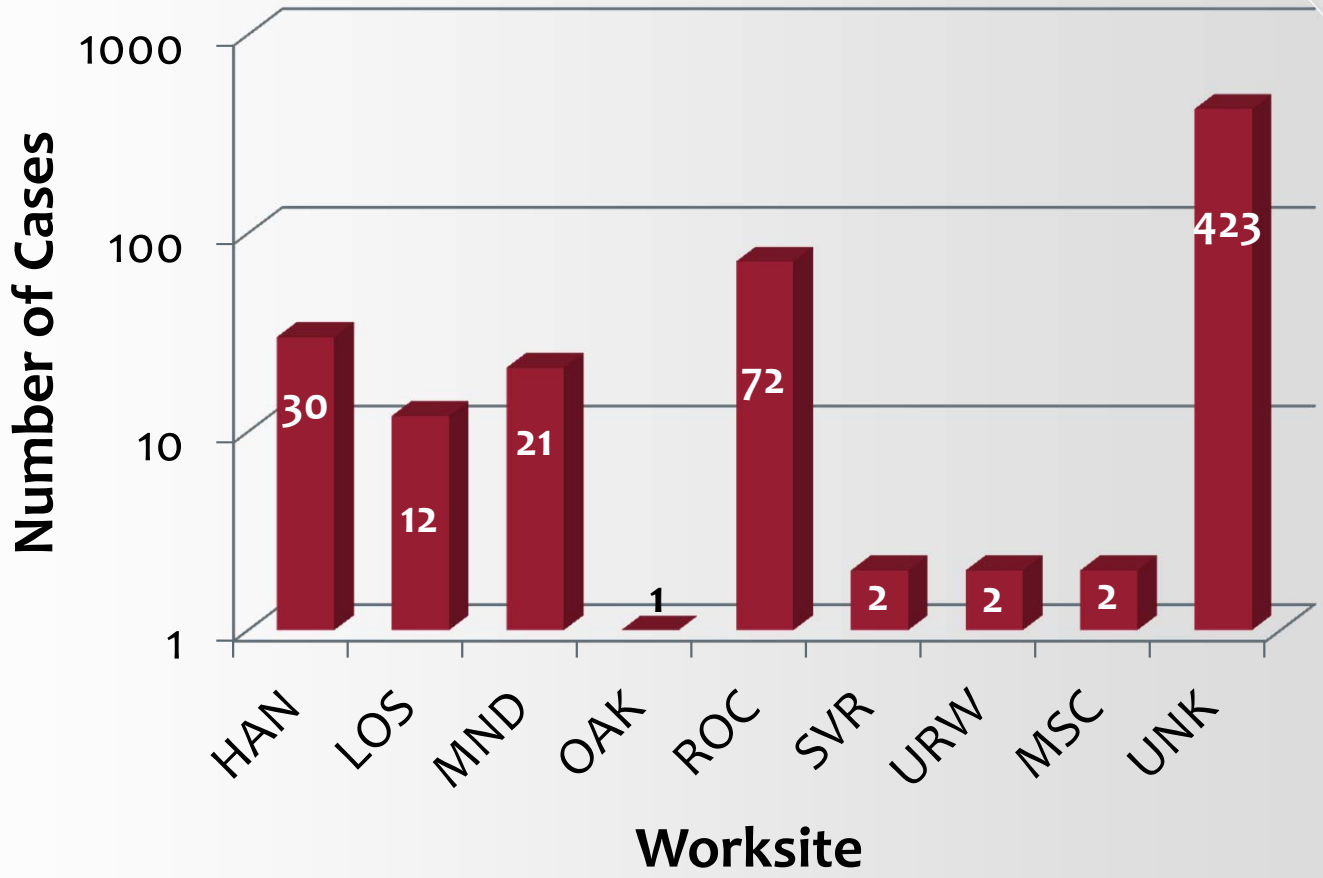


Recommendation #2

Search for and retrieve available records to reconstitute the registrant list as fully as possible (Rocky Flats)

Hanford Environmental Health Foundation Records

- Total of 565 cases were added to the USTUR database



Recommendation #3

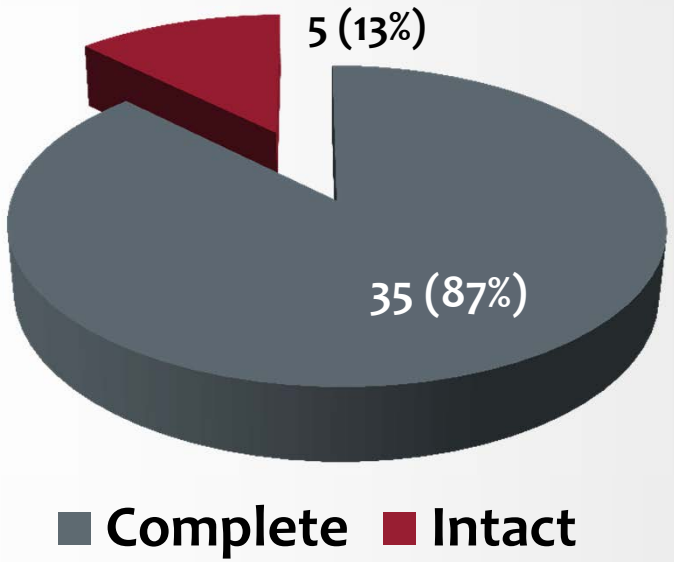
Set goals for health physics database population

2007 – 2013 Health Physics Database Progress

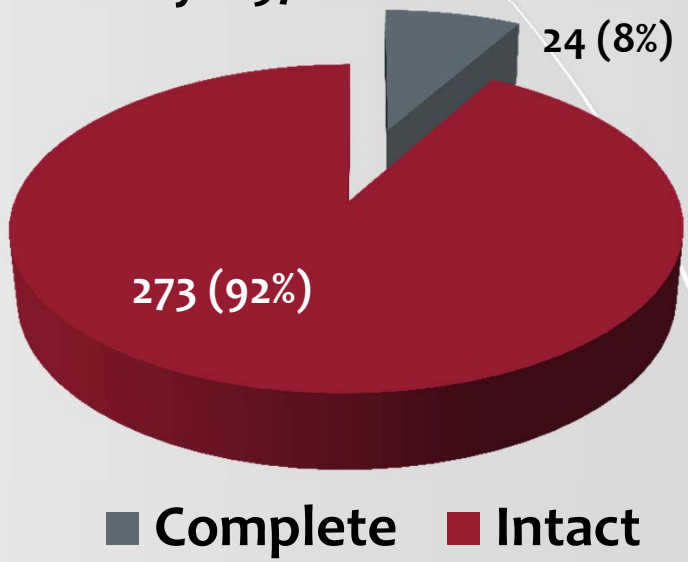
- 2007 – 2013: 59 (17%) cases were completed
- 2007 – 2013: 32,509 records were entered into the database
- 551 records per case
- 2013: 18,097 records were entered into the database
- 33 cases per year

2013 Health Physics Database Status

Whole-Body: 40



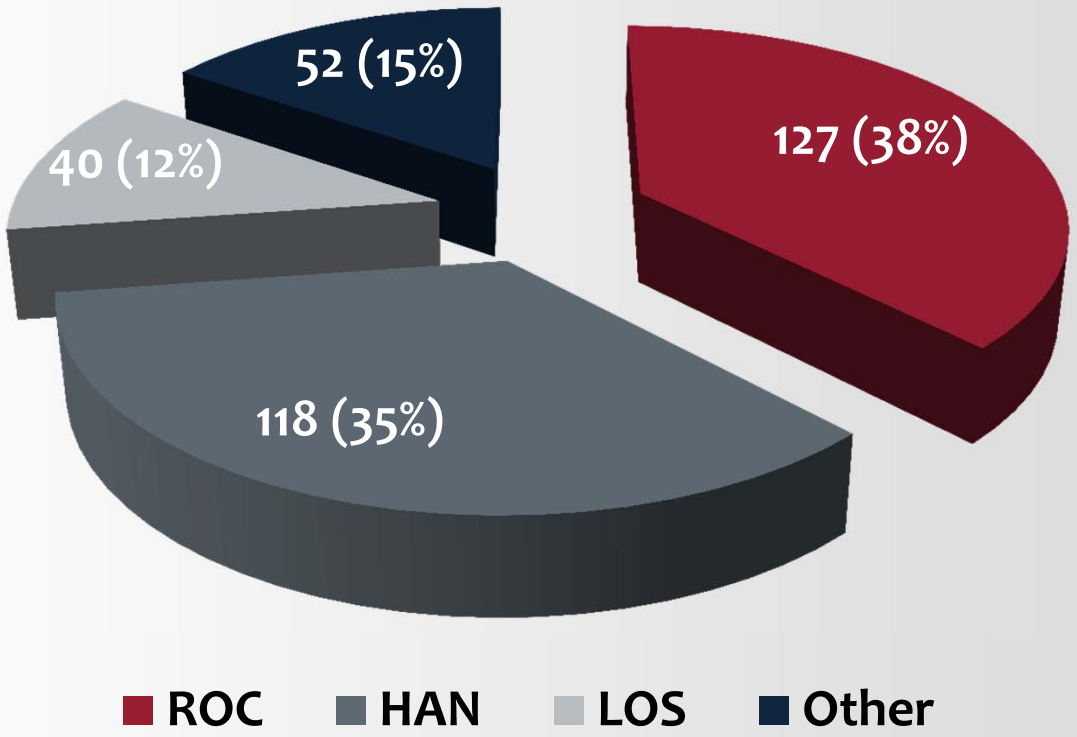
Partial-Body: 297



2014 Goals

- To complete:
  - ✓ all whole-body cases (5)
  - ✓ 40 cases per year

2013 Donation Statistics by Major Sites



Goals 2017 and Beyond

- To complete:
  - ✓ all Rocky Flats cases (2017)
  - ✓ 50% of the entire database (2017)
  - ✓ Health Physic database (2022)

Recommendation #4

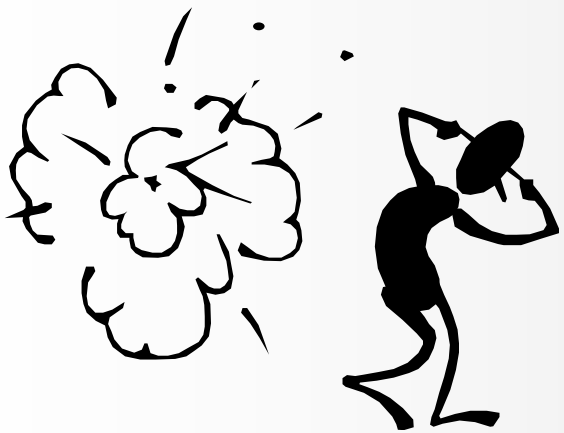
Look at feasibility of obtaining work histories, including jobs held prior to employment at a nuclear facility

For Living Registrants

- Send one-time questionnaire (IRB modification)
- Modify medical history form (IRB modification)

Recommendation #5

Complete Data Quality Objective (DQO) documentation



Recommendation #6

Continue and expand student involvement

WSU College of Nursing

- Case 0804 (3)
- Case 0814 (3)
- Case 0343 (3)

WSU Department of Physics

- Veronica Ruiz: MS level graduate student
- Fulbright-LASPAU Scholarship: 2012 – 2013
- Graduate Program in Physics (Astrophysics)
- Interest: PhD in Medical or Health Physics
- Visited USTUR in September 2013
- Met with M. Avtandilashvili and S. Tolmachev
- Several research topics were proposed for PhD thesis
- Dr. Avtandilashvili agreed to serve on Advisory Committee

Immanuel Lutheran School

12/08/2013

Dr. Tolmachev:

My name is Mary Kate Baughman and I am an eighth grade student at Immanuel Lutheran School in Palatine Illinois. I am researching the Radium Girls for my history fair project and see that Washington State University has the Radium Girls' tissue samples from Argonne Laboratory.

I would like to include in my report how the Radium Girls are helping scientists today. Could you tell me what kind of scientist would be asking for the bone samples and what they use them for? Also, could you give me a one or two sentence quote for my report because I hope to show that these girls' suffering helped future workers.

Thank you for your time.

Mary Kate Baughman

Chicago Regional Competition

5/18/2014

...In March I went to the Chicago regional competition and then last week I went to the Illinois state competition and I won! I will be going to Washington DC in June for the National competition and will represent Illinois. Only two Junior High exhibit projects from each state get to go to Nationals so I am very excited.

Thank you so much for your help. It made my project very special.

Mary Kate Baughman

National History Day

6/20/2014

Dr. Tolmachev:

I am so excited to tell you that my daughter, Mary Kate Baughman, won first prize at the National History Day competition yesterday. Thank you so much for your contributions - I'm convinced that your input made all the difference.

Last month we sent you a copy of her state winning board and word files, and she has since changed the exhibit to conform with the National rules. You are quoted on the revised project! Please let us know if you would like pictures of this project. We would love to share it with you.

Thanks again for showing an interest in an eighth grade girl from Illinois. You have helped make a memory that will last a lifetime.

Kathleen Coyle
Mary Kate's mom

Recommendation #7

Prioritize travel to promote the USTUR

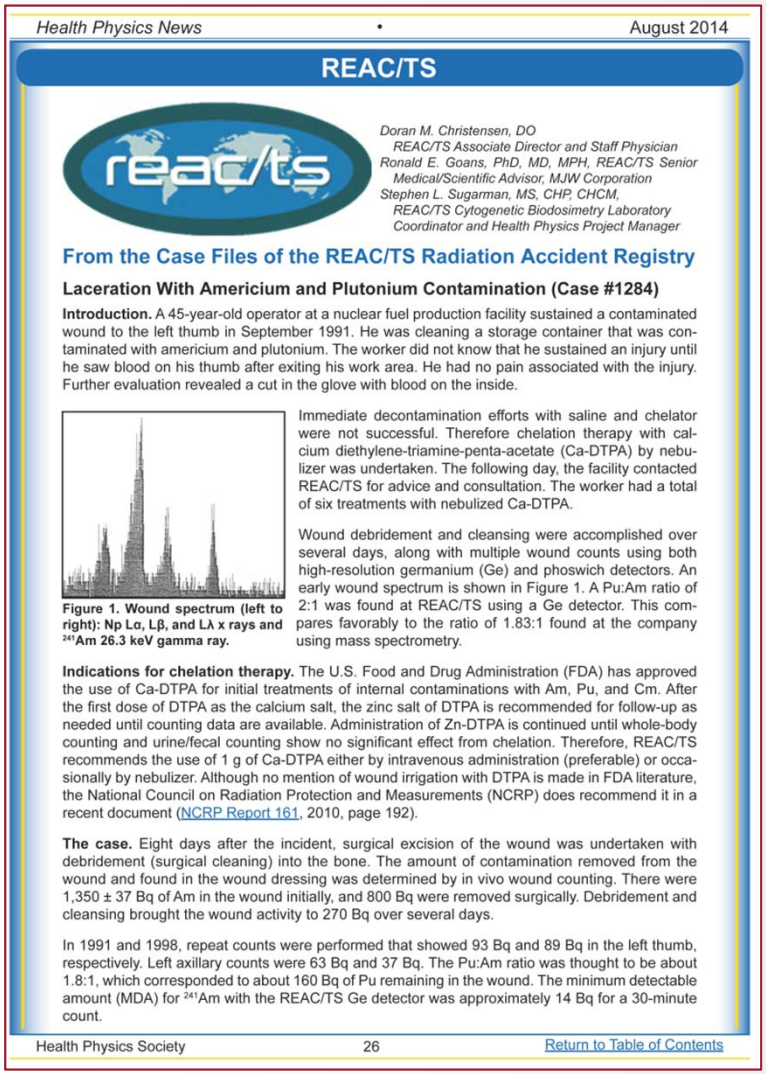
Conference Attendance

- Plenary Meeting of the European Radiation Dosimetry Group (EURADOS) on Internal Dosimetry
- 11th International Conference on the Health Effects of Incorporated Radionuclides
- 59th Annual Meeting of the Health Physics Society
- 60th Annual Conference of the Radiation Research Society (Invited)
- Beryllium Health and Safety Committee Fall Meeting 2014 (Web)
- 60th Radiobioassay and Radiochemical Measurements Conference

Recommendation #8

Investigate other avenues for former worker communication and recruitment

REAC/TS Radiation Accident Registry



Health Physics News • August 2014

REAC/TS

Doran M. Christensen, DO
REAC/TS Associate Director and Staff Physician
Ronald E. Goans, PhD, MD, MPH, REAC/TS Senior Medical/Scientific Advisor, MJW Corporation
Stephen L. Sugarman, MS, CHP, CHCM, REAC/TS Cytogenetic Biodosimetry Laboratory Coordinator and Health Physics Project Manager

From the Case Files of the REAC/TS Radiation Accident Registry

Laceration With Americium and Plutonium Contamination (Case #1284)

Introduction. A 45-year-old operator at a nuclear fuel production facility sustained a contaminated wound to the left thumb in September 1991. He was cleaning a storage container that was contaminated with americium and plutonium. The worker did not know that he sustained an injury until he saw blood on his thumb after exiting his work area. He had no pain associated with the injury. Further evaluation revealed a cut in the glove with blood on the inside.

Figure 1. Wound spectrum (left to right): Np Lα, Lβ, and Lλ x rays and ^{241}Am 26.3 keV gamma ray.

Immediate decontamination efforts with saline and chelator were not successful. Therefore chelation therapy with calcium diethylene-triamine-penta-acetate (Ca-DTPA) by nebulizer was undertaken. The following day, the facility contacted REAC/TS for advice and consultation. The worker had a total of six treatments with nebulized Ca-DTPA.

Wound debridement and cleansing were accomplished over several days, along with multiple wound counts using both high-resolution germanium (Ge) and phoswich detectors. An early wound spectrum is shown in Figure 1. A Pu:Am ratio of 2:1 was found at REAC/TS using a Ge detector. This compares favorably to the ratio of 1.83:1 found at the company using mass spectrometry.

Indications for chelation therapy. The U.S. Food and Drug Administration (FDA) has approved the use of Ca-DTPA for initial treatments of internal contaminations with Am, Pu, and Cm. After the first dose of DTPA as the calcium salt, the zinc salt of DTPA is recommended for follow-up as needed until counting data are available. Administration of Zn-DTPA is continued until whole-body counting and urine/fecal counting show no significant effect from chelation. Therefore, REAC/TS recommends the use of 1 g of Ca-DTPA either by intravenous administration (preferable) or occasionally by nebulizer. Although no mention of wound irrigation with DTPA is made in FDA literature, the National Council on Radiation Protection and Measurements (NCRP) does recommend it in a recent document (NCRP Report 161, 2010, page 192).

The case. Eight days after the incident, surgical excision of the wound was undertaken with debridement (surgical cleaning) into the bone. The amount of contamination removed from the wound and found in the wound dressing was determined by in vivo wound counting. There were 1,350 ± 37 Bq of Am in the wound initially, and 800 Bq were removed surgically. Debridement and cleansing brought the wound activity to 270 Bq over several days.

In 1991 and 1998, repeat counts were performed that showed 93 Bq and 89 Bq in the left thumb, respectively. Left axillary counts were 63 Bq and 37 Bq. The Pu:Am ratio was thought to be about 1.8:1, which corresponded to about 160 Bq of Pu remaining in the wound. The minimum detectable amount (MDA) for ^{241}Am with the REAC/TS Ge detector was approximately 14 Bq for a 30-minute count.

Health Physics Society 26 Return to Table of Contents

The Radiation Emergency Assistance Center/Training Site (REAC/TS) at the Oak Ridge Institute for Science and Education (ORISE) maintains a number of radiation accident registries that provide medical professionals with up-to-date radiation accident information.

Information for these accident registries is gathered from many sources, including the World Health Organization, International Atomic Energy Agency, U.S. Nuclear Regulatory Commission, state radiological health departments, as well as medical and health physics literature.

2014 Activities Overview

USTUR Core Functions (DOE)

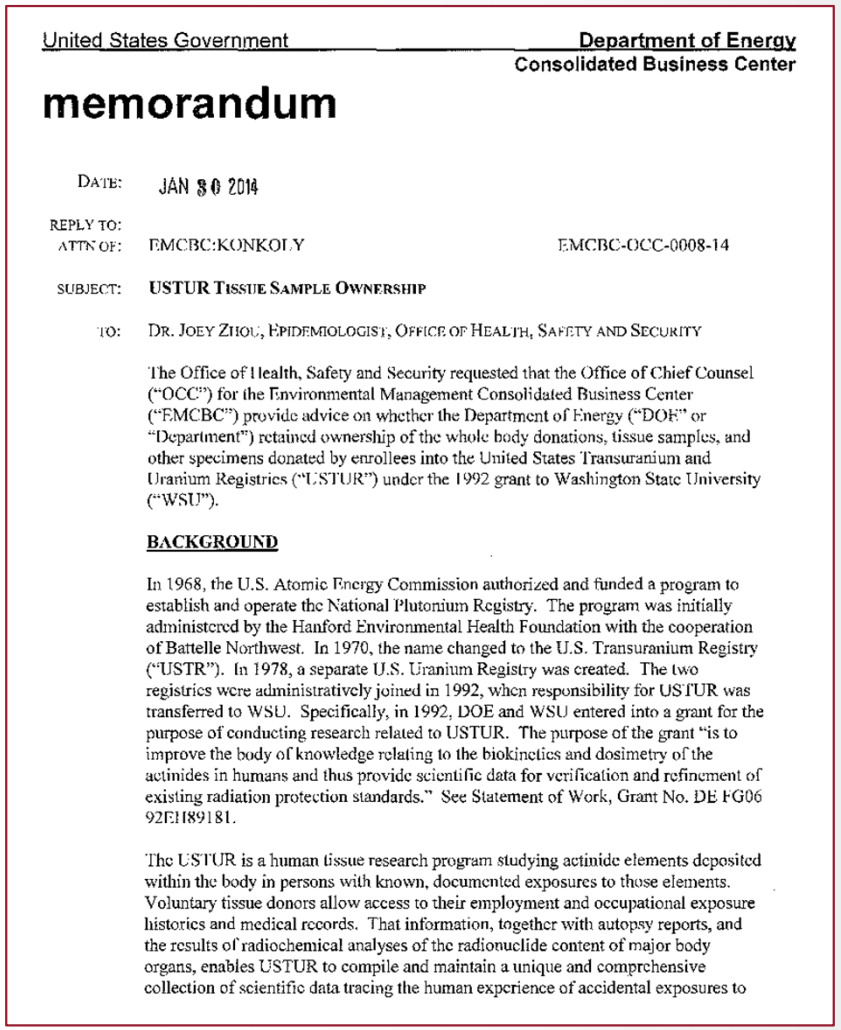
- Accepting and processing future Registrant donations
- Completing radiochemical analysis of previous Registrant donations
- Completing the development and population of USTUR databases

USTUR Materials Ownership

"…since the grant did not specify in the General or Specific Terms and Conditions of the grant that ownership would transfer to WSU, DOE inherently retained the ownership of these samples."

General Attorney
Office of Chief Counsel
Department of Energy
8/16/2013

Resolving Material Ownership Issue



United States Government — Department of Energy
Consolidated Business Center

memorandum

DATE: JAN 30 2014

REPLY TO ATTN OF: EMCBC:KONKOLY — EMCBC-OCC-0008-14

SUBJECT: **USTUR TISSUE SAMPLE OWNERSHIP**

TO: DR. JOEY ZHOU, EPIDEMIOLOGIST, OFFICE OF HEALTH, SAFETY AND SECURITY

The Office of Health, Safety and Security requested that the Office of Chief Counsel ("OCC") for the Environmental Management Consolidated Business Center ("EMCBC") provide advice on whether the Department of Energy ("DOE" or "Department") retained ownership of the whole body donations, tissue samples, and other specimens donated by enrollees into the United States Transuranium and Uranium Registries ("USTUR") under the 1992 grant to Washington State University ("WSU").

BACKGROUND

In 1968, the U.S. Atomic Energy Commission authorized and funded a program to establish and operate the National Plutonium Registry. The program was initially administered by the Hanford Environmental Health Foundation with the cooperation of Battelle Northwest. In 1970, the name changed to the U.S. Transuranium Registry ("USTR"). In 1978, a separate U.S. Uranium Registry was created. The two registries were administratively joined in 1992, when responsibility for USTUR was transferred to WSU. Specifically, in 1992, DOE and WSU entered into a grant for the purpose of conducting research related to USTUR. The purpose of the grant "is to improve the body of knowledge relating to the biokinetics and dosimetry of the actinides in humans and thus provide scientific data for verification and refinement of existing radiation protection standards." See Statement of Work, Grant No. DE FG06 92EH89181.

The USTUR is a human tissue research program studying actinide elements deposited within the body in persons with known, documented exposures to those elements. Voluntary tissue donors allow access to their employment and occupational exposure histories and medical records. That information, together with autopsy reports, and the results of radiochemical analyses of the radionuclide content of major body organs, enables USTUR to compile and maintain a unique and comprehensive collection of scientific data tracing the human experience of accidental exposures to

CONCLUSION

Individuals who donated tissues or their whole bodies to the USTUR were making donations to the Department of Energy and its predecessor agencies, the Atomic Energy Commission and the Energy Research Development Administration. The USTUR is funded by a grant from the Department and the fact that a grant was awarded does not fundamentally change the nature of the relationship between the donors and the Registry itself. Washington State University maintains the USTUR program on behalf of the Department and the *Registry's content may be considered government-owned property* for the purpose of this analysis. *It is clear that the Department retains ownership of the Registry vis-a-vis the University.*

FY2015 DOE Grant Renewal

- Grant proposal to manage and operate the USTUR Research Center in FY2015 was submitted to DOE/HS-13
- Period: 4/1/ 2014 – 3/31/2015 (Year 3)
- Requested budget: $900,000
- Granted budget: $900,000
- Year-to-date received: $675,000

External Funding: *Work for Others*

- PI: Sergei Tolmachev
- DOE: Joint Coordinate Committee on Radiation Effects Research (JCCRER)
- Period: 2/24/2014 – 9/30/2014
- Budget: $50,000
- Status: Funded
- Deliverables: Case 0745 and Case 0631 (selected tissues)

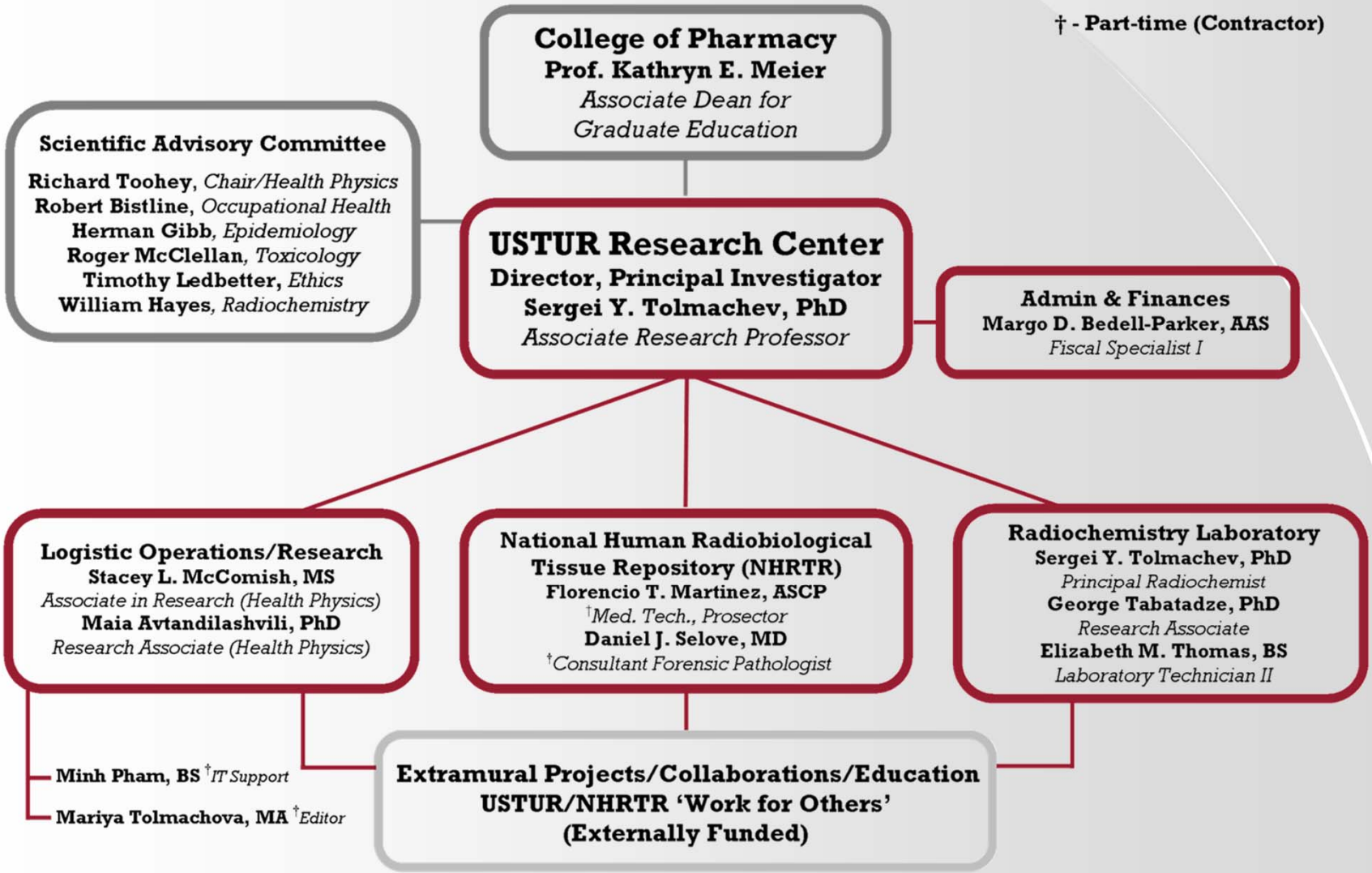
External Funding: *Travel Grant*

- PI: Maia Avtandilashvili
- WSU Office of International Programs and the Office of Research: 2014 International Research Travel Award
- Public Health England (UK): Dr. Matthew Puncher
- Application of Markov Chain Monte Carlo (MCMC) for biokinetic modeling and dose assessment
- Period: 7 days (2/1/2014 – 7/31/2014)
- Budget: $4,267
- Status: Not funded

External Funding: *International*

- PI: Prof. Francois Caron, Laurentian University (Canada)
- Partners: Laurentian, McMaster, Laval, U of Ottawa, North Ontario School of Medicine, SENES, and USTUR
- Agency: Natural Sciences and Engineering Research Council of Canada
- Program: Collaborative Research and Training Experience
- LOI: *Collaboration on Environmental Effect, Development and Radioactivity*
- Full Proposal: Not invited

USTUR Organization Structure



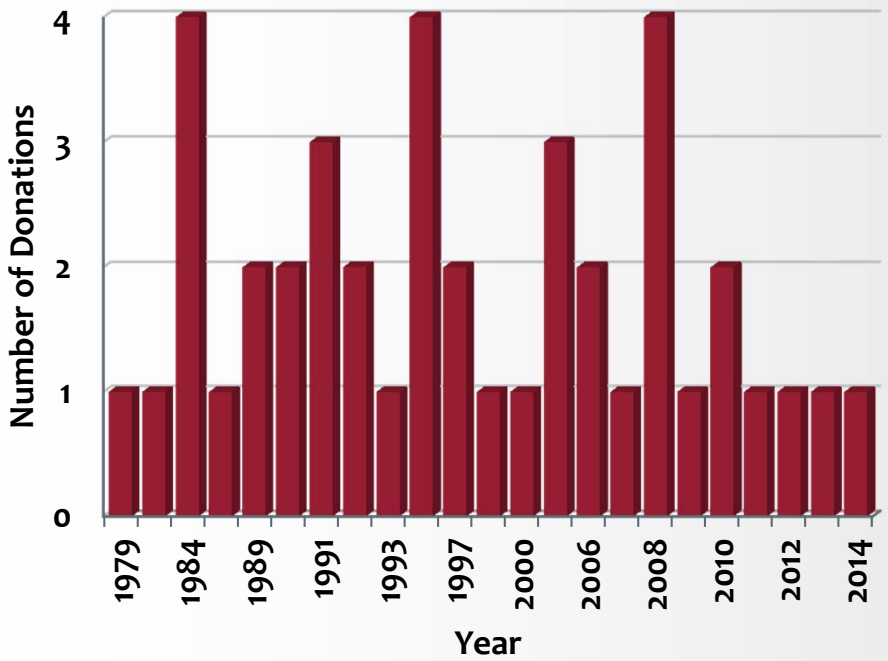
Accepting Registrant Donations

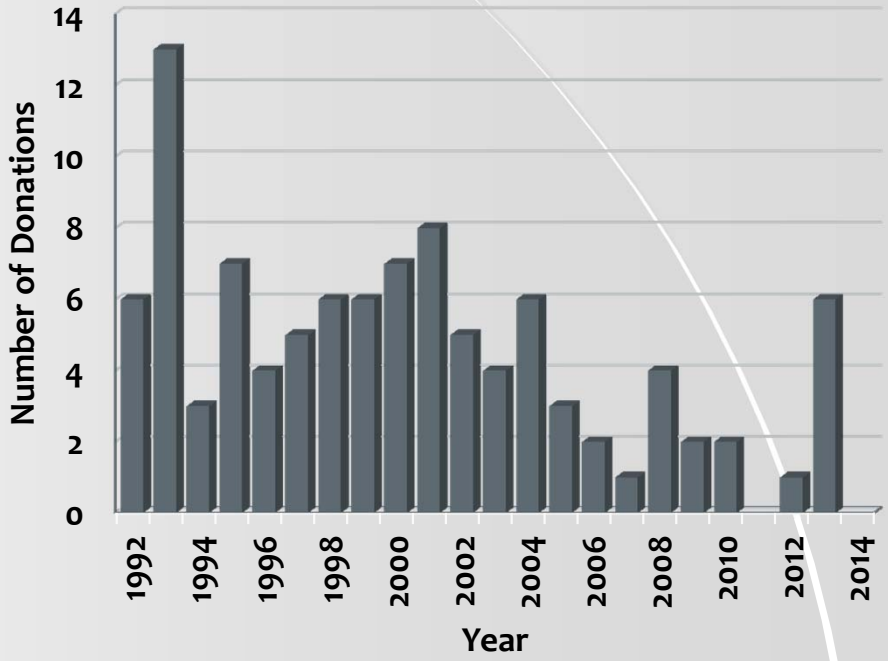
Stacey L. McComish

Registrant Donations

- Case 0804 (whole-body, 2013) – $^{239/240}Pu$
- Case 0814 (partial-body, 2013) – $^{239/240}Pu$
- Case 0343 (whole-body, 2014) – $^{239/240}Pu$

Registrant Donation Profiles





Total: 42 whole-body donations

Since 1992: 101 partial-body donations

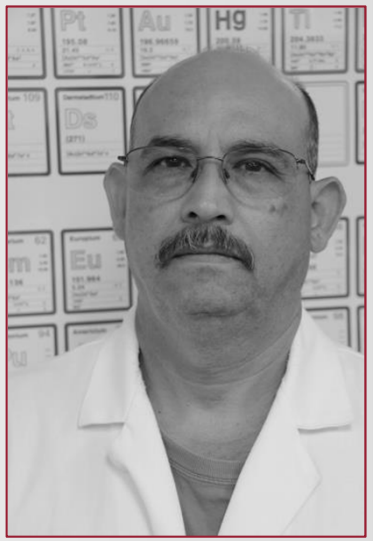
WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

National Human Radiobiological Tissue Repository (NHRTR)

Florencio Martinez, Colette Gable, Diana McGlynn, & Stacey L. McComish

NHRTR: Tissue Samples Inventory

- Collection: USTUR
- Inventory: Dissection/THEMIS
- Status: Completed
- Started: 2007
- Completed: 2014



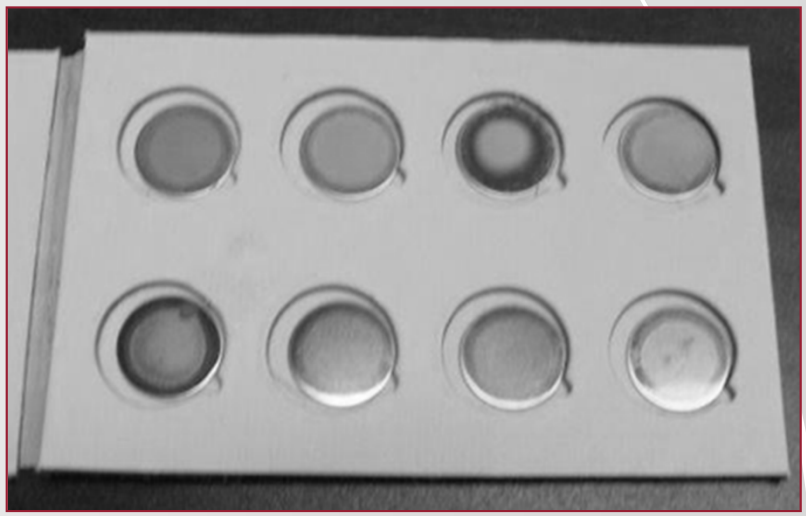
From black bags to vacuum-sealed packages and THEMIS inventory

NHRTR: Acid Solutions Inventory

- Collection: USTUR
- Acid solutions: Digested tissue samples (analyzed)
- Status: In progress
- Started: 2012

NHRTR: Planchets Inventory

- Collection: USTUR
- Planchet: α-counting source
- Status: In progress
- Started: 2014
- Completed: 2015 (anticipated)



Coin-holder with 8 individual planchets

In-house Radiochemistry

Elizabeth M. Thomas, Fredrick L. Miller & George Tabatadze

2013 Prioritization Plan

- Avoid accumulation of intact cases
- Elimination of intact/incomplete cases
  - ✓ 'Old' : 1992 – 2005
  - ✓ 'New' : 2006 – present

Analyzed 1 'old' case per every 3 'new' cases in 2014

2014 Tissue Analysis

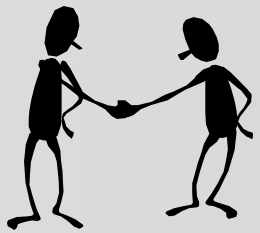
- Number of cases: 13
  - ✓ 1991 – 2005: 3
  - ✓ 2006 – 2013: 10
  - ✓ 'Old-to-New' ratio: 1:3

- Whole-body: 0343, 0456, 0631, 0745, 0804, 1007, 1060
- Partial-body: 0375, 0691, 0785, 0803, 0814, 0861
- Analyzed by: AS (11)/ICP-MS (2)

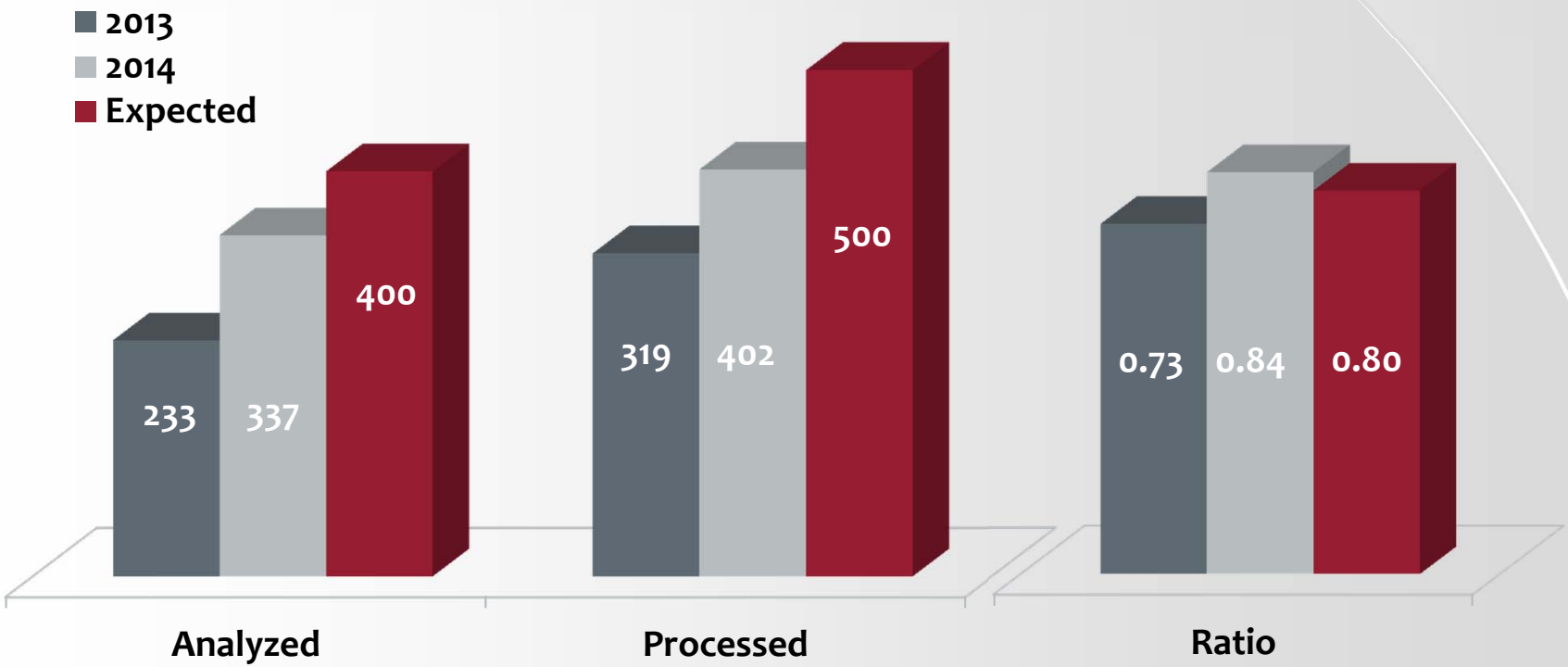
2014 Tissue Analysis

- Drying/Ashing
- Acid Digestion
- Radiochemical Separation
- Actinide Measurements

- Analysis Completed 337 (400)
- Sample Processed 402 (500)
- Completed/Processed 0.84 (0.8)

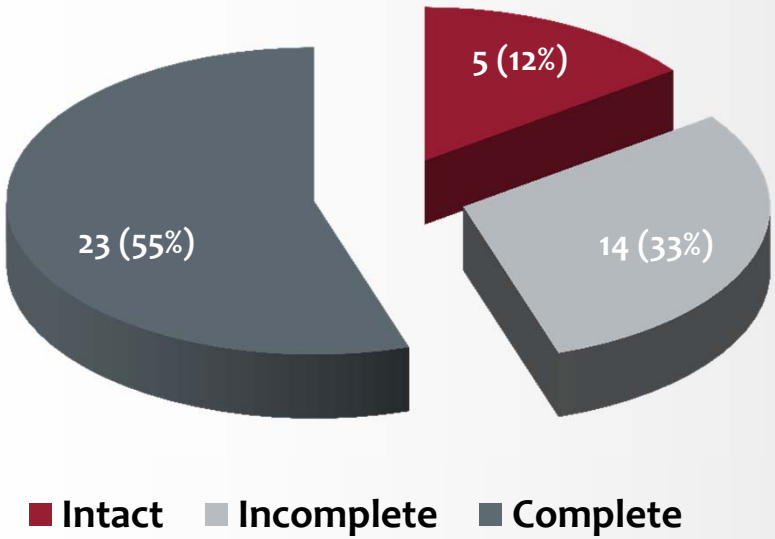


2013 – 2014 Tissue Analysis

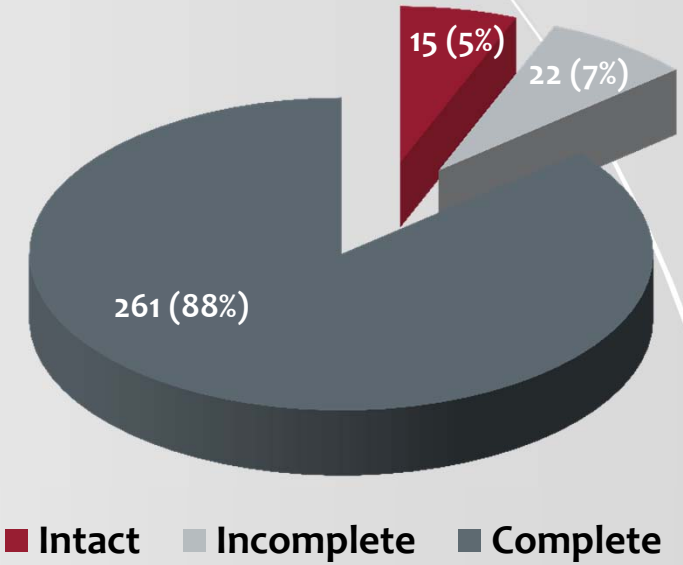


Tissue Analysis Status 2014

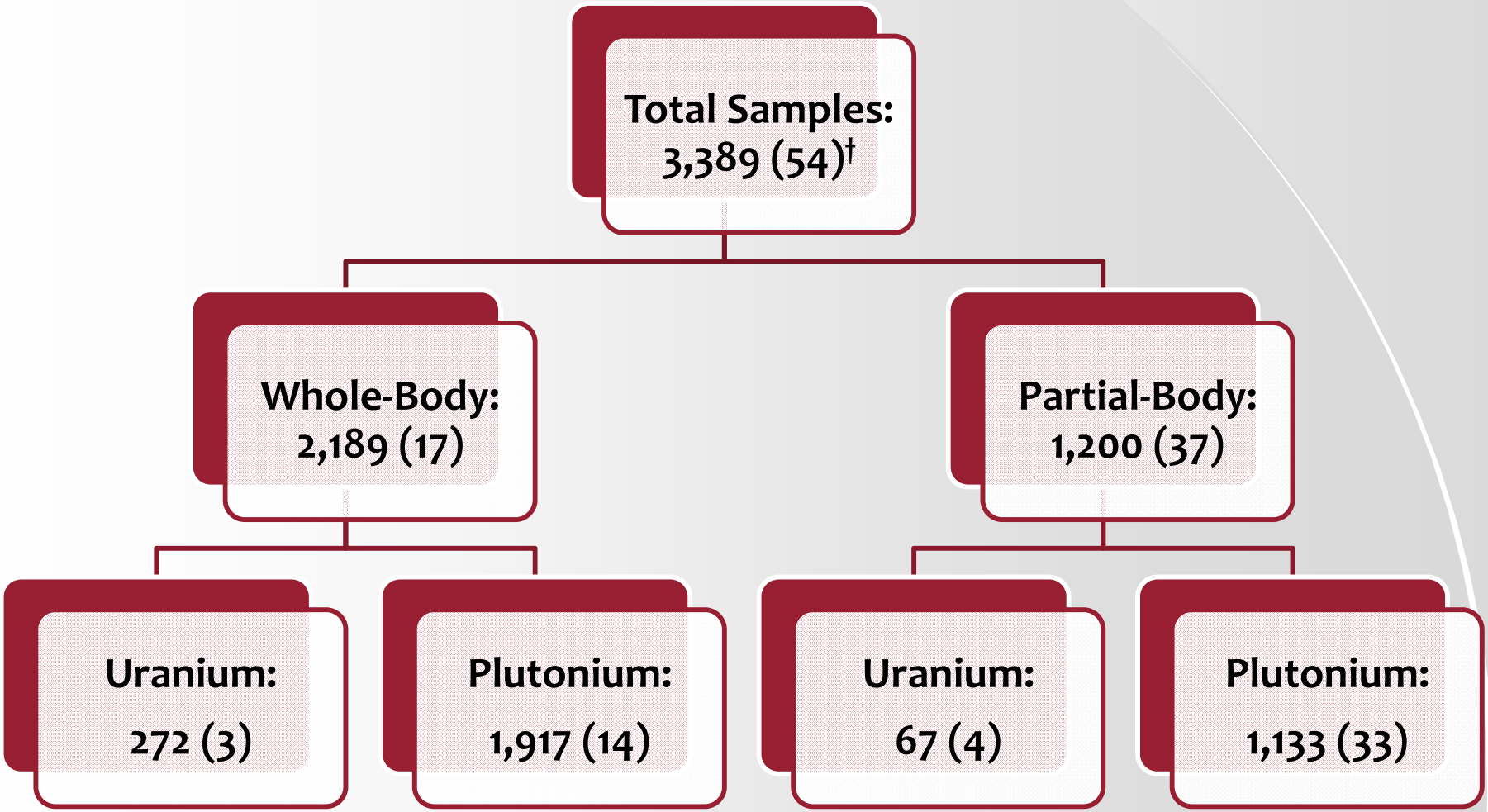
Whole-Body: 42



Partial-Body: 298



Radiochemistry Tissue Sample Backlog

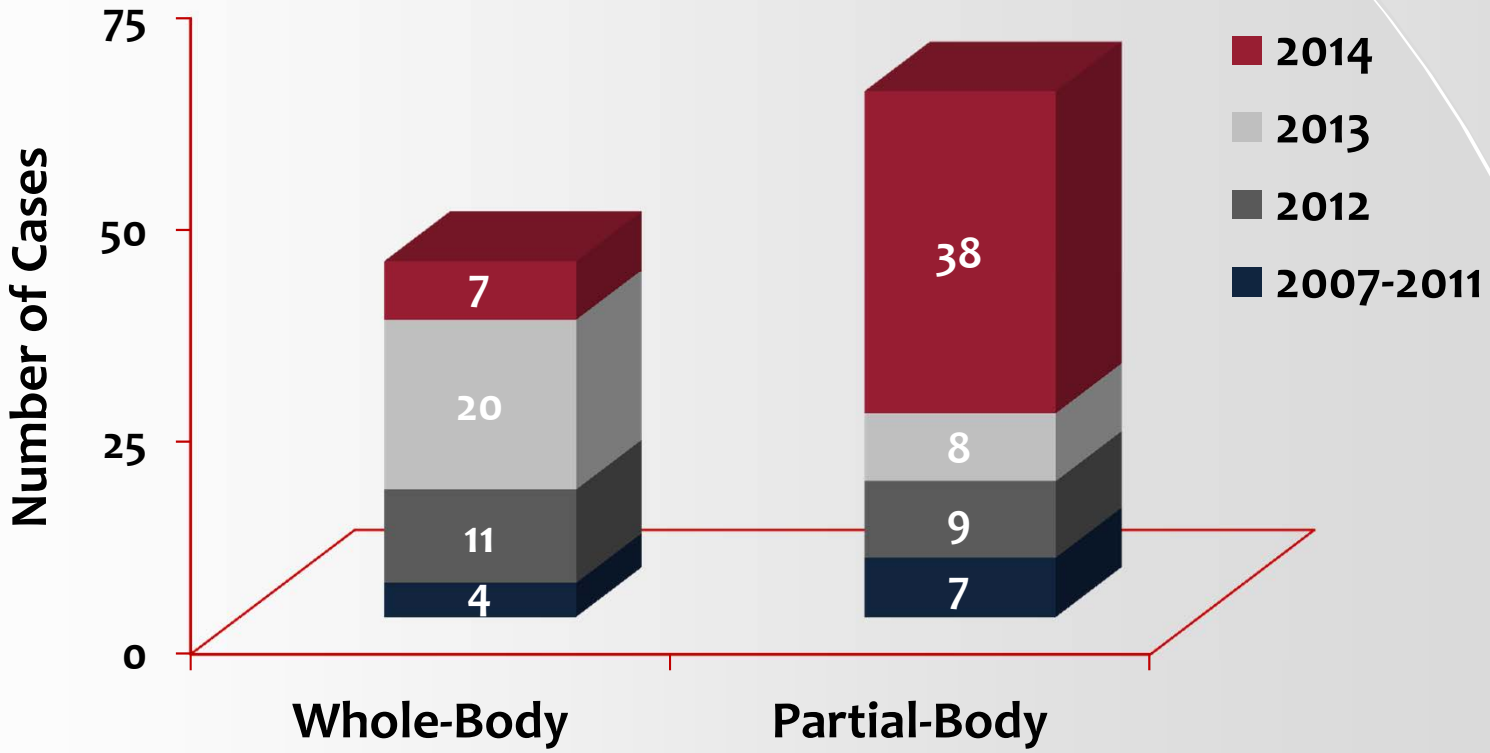


† - number of cases excluding Thorotrast cases

Health Physics Database

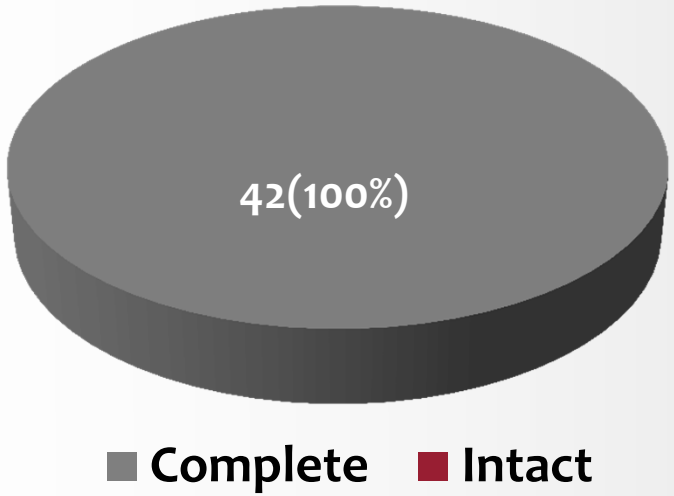
Maia Avtandilashvili

Health Physics Database Progress

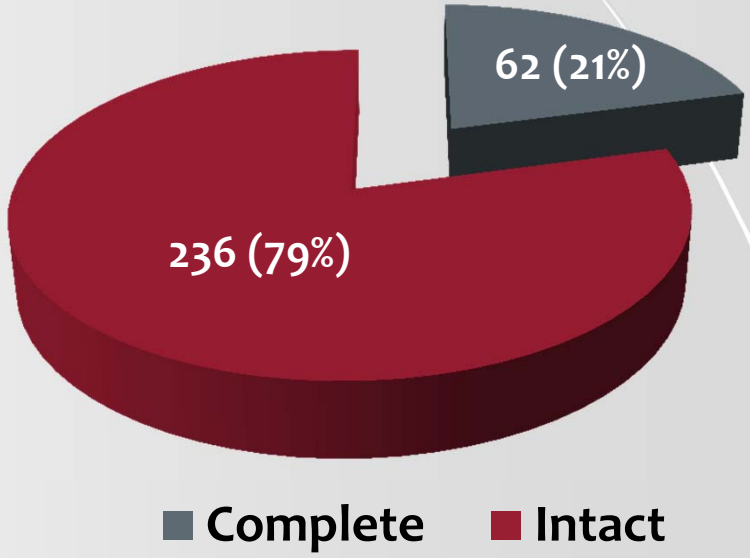


Health Physics Database Status 2014

Whole-Body: 42



Partial-Body: 298



- Data entry completed for 104 of 340 deceased Registrants (30.6%)

Internal Research: Uranium in Human

Roland L. Kathren & Sergei Y. Tolmachev

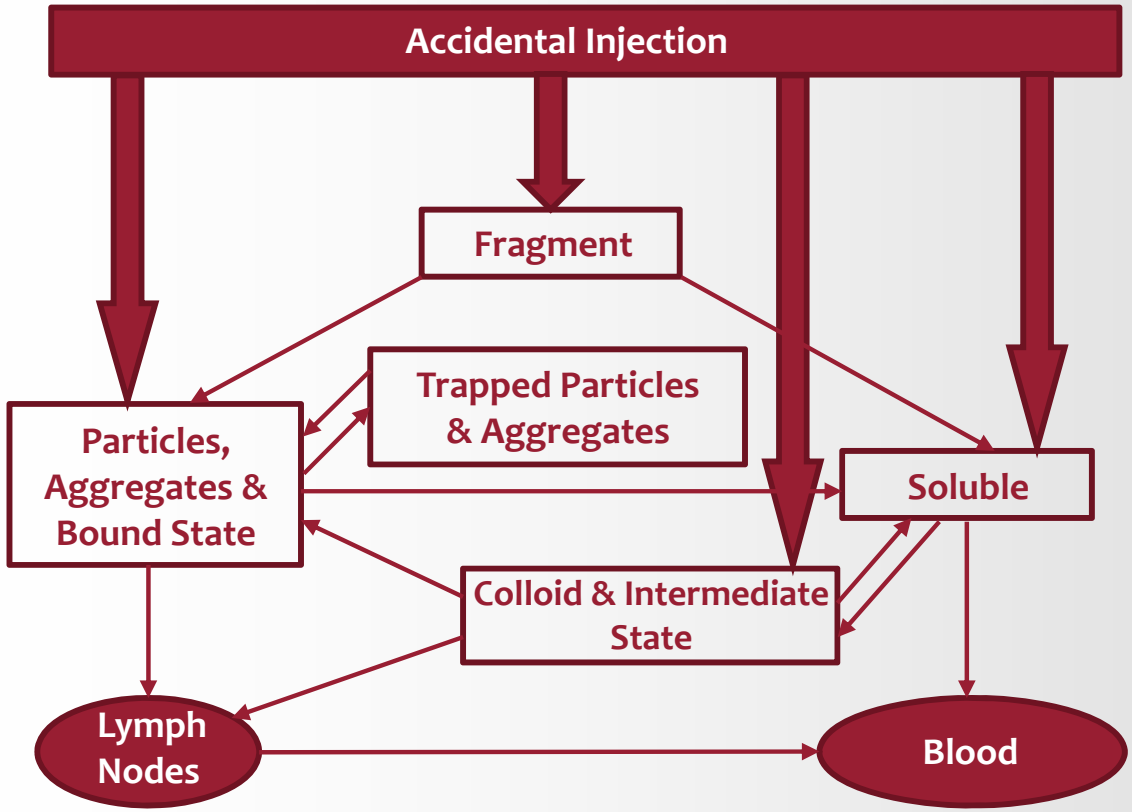
Publishing Uranium Data

- Initiator: Ronald L. Kathren
- Whole-body donors with no history of exposure to U
  - ✓ Case 0213 (1984)
  - ✓ Case 0242 (1987)
  - ✓ Case 0425 (1994)
- Analyzed for U (natural)
- Results were reported in 1997 (Annual Report, Case 0213 and Case 0242) and 2001 (PhD Dissertation, Case 0425)
- No peer-review publications
- Data revised and summarized in 2012 – 2014

Internal Research: Case 0212

Maia Avtandilashvili, Stacey L. McComish & Sergei Y. Tolmachev

Testing NCRP Wound Model



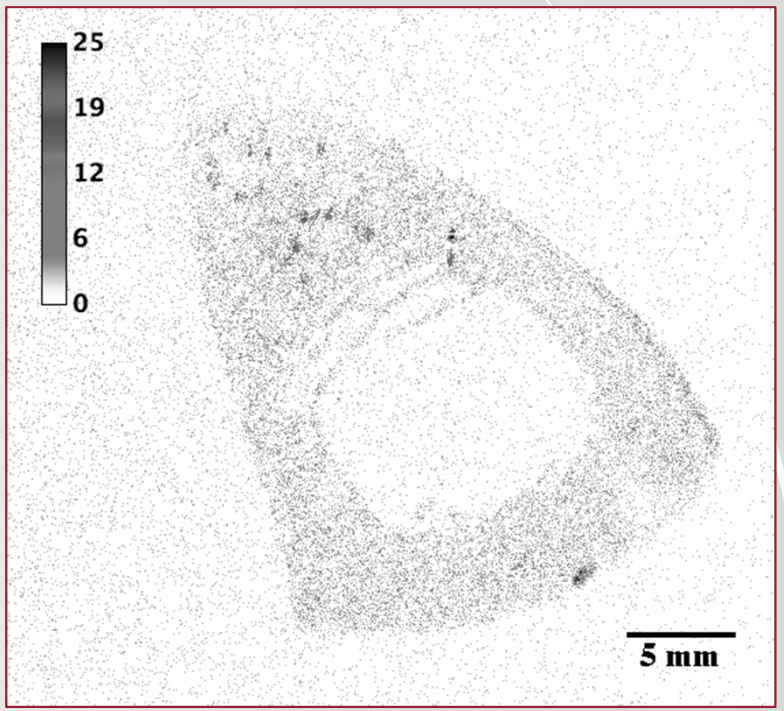
- Default material types:
  - Soluble
    - ✓ Weak
    - ✓ Moderate
    - ✓ Strong ← $Pu(NO_3)_4$
    - ✓ Avid
  - Colloid
  - Particle
  - Fragment

External Collaboration: PNNL

Brian W. Miller, William F. Morgan & Bruce A. Napier

Digital Autoradiography

- iQID: ionizing-radiation Quantum Imaging Detector
- Features
  - ✓ α/β, γ-rays, neutrons
  - ✓ Real-time imaging
  - ✓ Large-area detector
- Application
  - ✓ Radionuclide distribution
  - ✓ Microdosimetry
  - ✓ QA/QC of α-sources



^{226}Ra therapeutic injection (bone)

External Collaboration: SUBI

Alexandra B. Sokolova, Elena A. Burikova & Klara G. Suslova

Estimation of Skeleton Activity

- Facilitator: Southern Urals Biophysics Institute (Ozyorsk, Russia)
- Task: Estimation of total skeletal Pu activity from the analysis of limited number of bones (2 – 8)
- SUBI: Development of the algorithm
- Validation: USTUR data
- USTUR: 12 whole-body cases

K. G. Suslova, V. Yu. Salamatova, I. A. Orlova, E. A. Burikova, A. B. Sokolova, S. Yu. Tolmachev, S. C. Miller. ***Estimation of plutonium skeletal burden based on measurements of a limited bone set of the Mayak PA workers***. For submission to *Radiation Protection Dosimetry*.

External Collaboration: EURADOS

Pedro M. Nogueira, Maria Antonia Lopez & Clemens Woda

^{241}Am Skull Measurements Intercomparison

- Coordinator
  - ✓ Institute of Radiation Protection (Germany)
- Participants
  - ✓ 13 in-vivo counting laboratories from 11 countries (Europe, USA, Canada)

P. Nogueira, W. Rühm, T. Vrba, W. Buchholz, P. Fojtík, G. Etherington, D. Broggio, J. Huikari, O. Marzocchi, T. Lynch, A. Lebacq, C. Li, J. Ośko, I. Malátova, D. Franck, B. Breustedt, D. Leone, J. Scott, A. Shutt, B. Hauck, K. Capello, B. Pérez-López, J. Francisco Navarro-Amaro, T. Pliszczyński, K. Fantínová, S. Tolmachev, M. López-Ponte. ***EURADOS Am-241 in-vivo skull measurements intercomparison***. For submission to *Radiation Protection Dosimetry*.

Biodosimetry of Internal Radionuclides

- Facilitator:
  - ✓ Multidisciplinary European Low Dose Initiative (MELODI)
- Coordinator:
  - ✓ Public Health England (PHE, UK)
- Developers:
  - ✓ EURADOS WG10 (Retrospective Dosimetry) and WG-7 (Internal Dosimetry)

Active Collaborations

EURADOS

Pacific Northwest NATIONAL LABORATORY

Health Canada

AREVA

ЮУрИБФ

KIT Karlsruhe Institute of Technology

UNIVERSITÉ LAVAL

Public Health England

Data/Tissue Request

Sergei Y. Tolmachev & Stacey L. McComish

Data/Tissue Users

- Idaho State University (Pocatello, ID)
  - ✓ Data on chelation cases
- University of Cincinnati (Cincinnati, OH)
  - ✓ Tissues from Thorotrast cases
- Radiation Emergency Assistance Center/Training Site (Oak Ridge, TN)
  - ✓ Blood smears from the radium dial painters

Professional Activities/Services

- Adjunct Professor: *Laval University, Department of Chemistry (2014 – 2017)*
- Advisory Board Member: *WSU Graduate Certificate Program in Radiation Protection*
- Editorial Board Member:
  - ✓ *Japanese Journal of Health Physics (2013 – 2015)*
  - ✓ *Austin Biometrics and Biostatistics (2014 – 2016)*
- Member:
  - ✓ *International Radiation Protection Association (IRPA) Societies Admission and Development Committee*
  - ✓ *European Radiation Dosimetry Group (EURADOS) on Internal Dosimetry*
  - ✓ *US Environmental Protection Agency (EPA) Science Advisory Board Radiation Advisory Committee (nominee)*
- *Ad-hoc* Reviewer:
  - ✓ *Journal of Radioanalytical Nuclear Chemistry*
  - ✓ *International Journal of Radiation Biology*

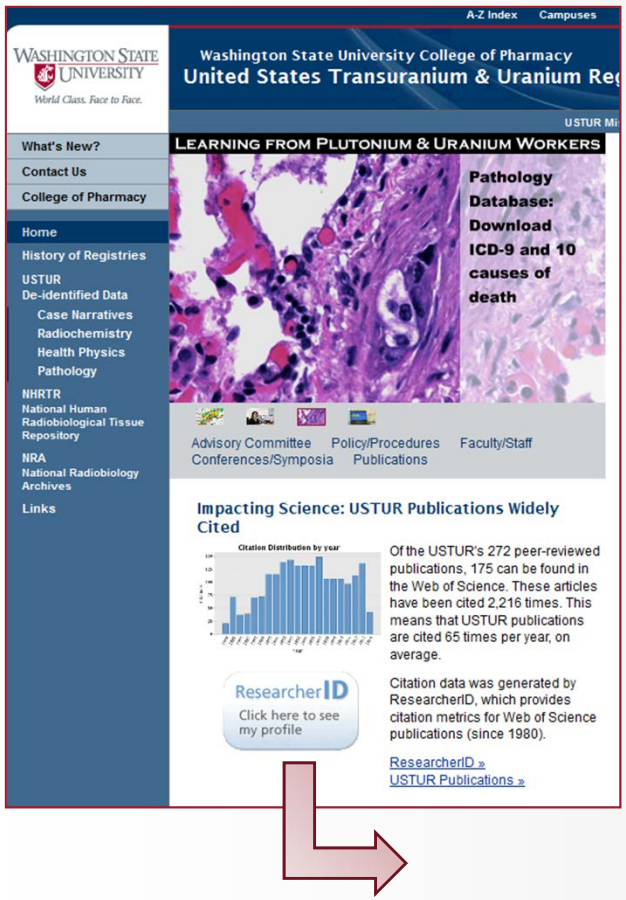
Publications/Presentations

- Journal
  - ✓ Int J Radiation Biology — 2 (Paper)
  - ✓ Am J Public Health — 2 (Editorial)
  - ✓ Health Physics (Suppl.) — 3 (Abstract)
- Podium
  - ✓ EURADOS WG-7 Plenary Meeting — 1
  - ✓ 59th Annual Meeting of the Health Physics Society — 2
  - ✓ 11th International Conference on the Health Effects of Incorporated Radionuclides — 1
  - ✓ *5th International MELODI Workshop* — *1*
- Poster
  - ✓ 11th International Conference on the Health Effects of Incorporated Radionuclides — 1

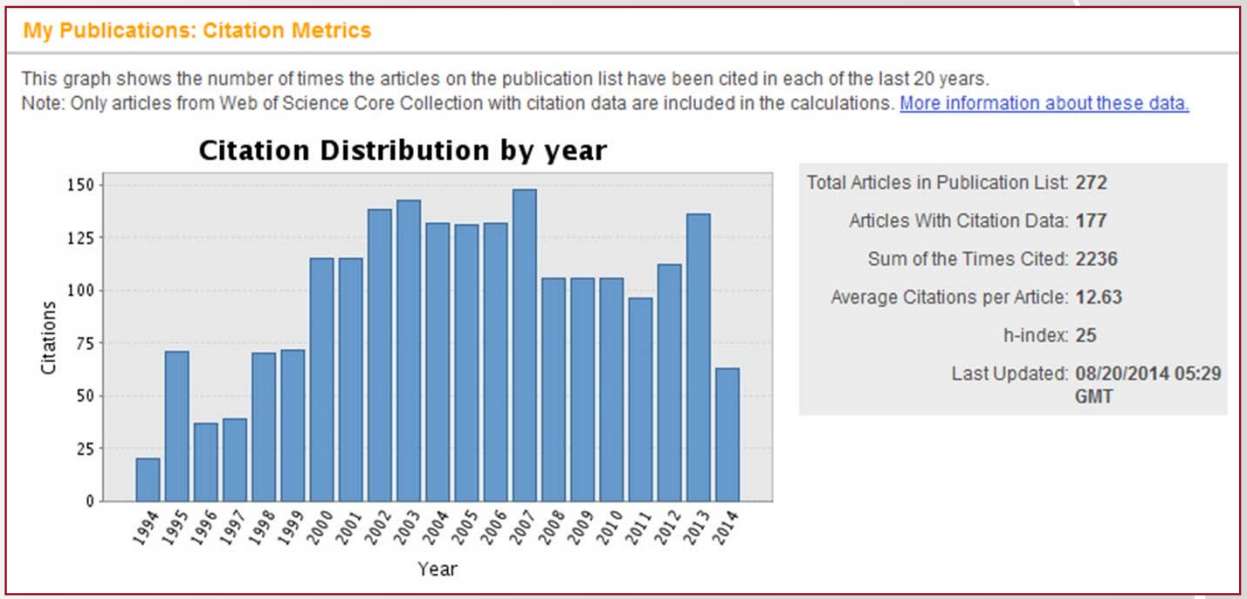
Data Users Publications

- Idaho State University (Pocatello, ID)
  - ✓ Khalaf, M., et al. (2013) Health Phys 105(3): 227-235
  - ✓ Khalaf, M. (2014) Health Phys 106(3): 427-428
  - ✓ *Konzen, K., et al.: Plutonium-DTPA Model Verification with USTUR Case 0269 (in preparation)*

ResearcherID: I-1056-2013



- Publication period: 1968 - 2014
- Total articles: 272
- Articles with citation data: 177 (since 1980)
- Average citations per article: 12.63
- H-index: 25



2014 Take Home Message

- Acceptance of three (3) new donations
- Analysis of 337 tissue samples
- Elimination of four (4) intact cases: 24(2013) *vs* 20(2014)
- Completion of USTUR tissue samples inventory
- Resolving tissue samples ownership issue
- Completion of HP database for all whole-body donations
- Involvement of eleven (11) students
- Seven (7) publications and five (5) presentations
- Elimination of negative carry-overs

Questions?