



U.S. Army Public Health Command (Provisional)

# USAPHC

# **SOLDIER EXPOSURE TO DEPLETED URANIUM AND HUMAN HEALTH RISK ASSESSMENT METHODOLOGY UPDATE - 2010**

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DEPLETED URANIUM (DU) HEALTH EFFECTS AND POLICY WORKSHOP

AFRRI, Bethesda, Maryland

4 November 2010



**UNCLASSIFIED**

# INTRODUCTION

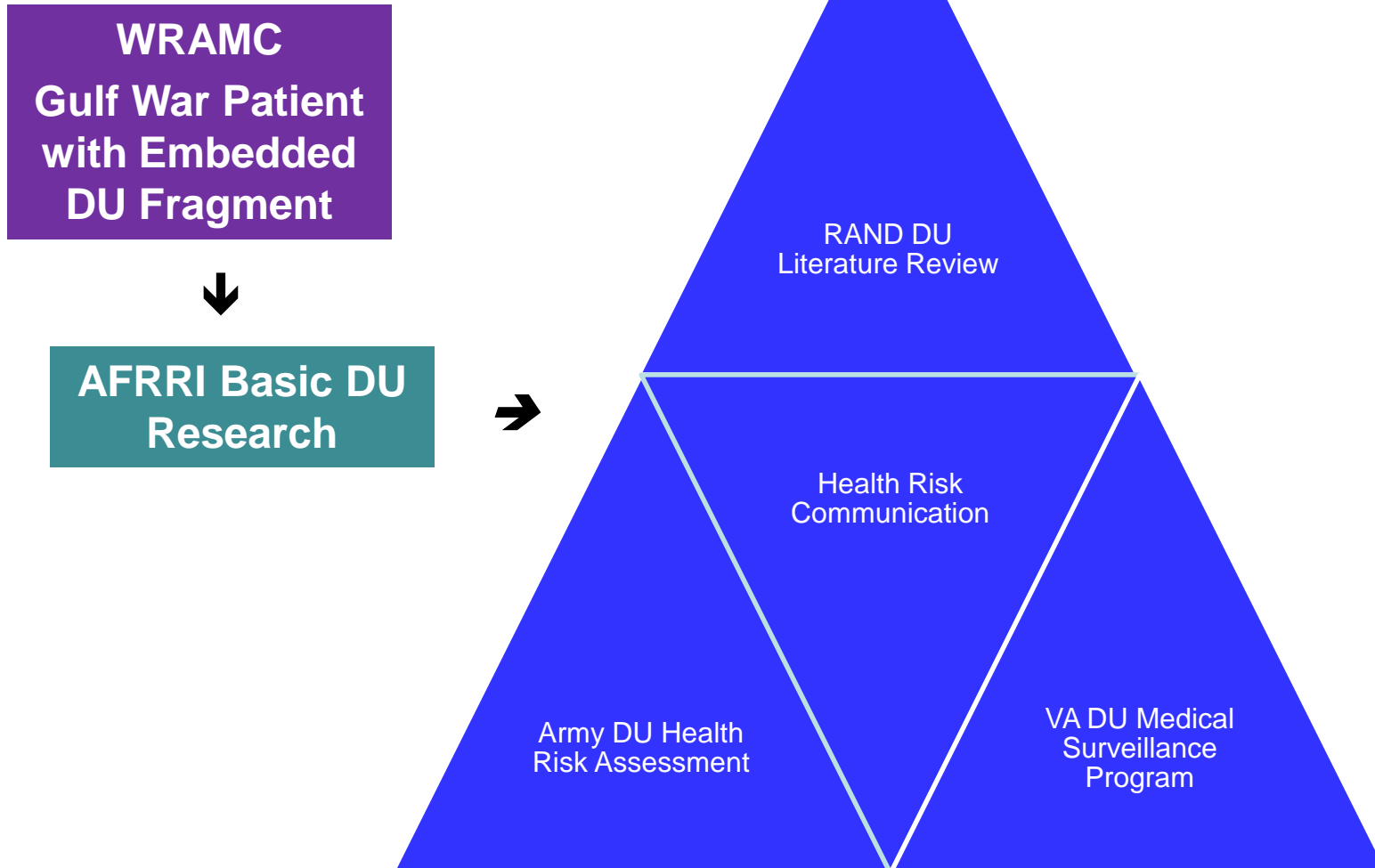


- Assessment of depleted uranium (DU) use on the battlefield and potential adverse health effects is a sentinel event in addressing all battlefield environmental and occupational hazards
- Experience with DU to be used for developing policy and procedures for assessing other environmental chemical and embedded metal fragment injuries from combat

## BACKGROUND (I)

- Operation Desert Storm – First combat use of DU munitions by U.S. Military (1991)
  - Walter Reed Army Medical Center – First patient identified with embedded DU metal fragment
  - OTSG Consultants identified through medical records review first 35 patients with fragments from fratricide (“friendly-fire”) incidents
  - Initial urine bioassay program to identify patients with undiagnosed, embedded metal fragments

# OSAGWI Vision (1998) for DU Issue



## BACKGROUND (II)

- MOA between Army OTSG and VA for DU Medical Surveillance and Follow-UP Program (1993)
- Interpretation of laboratory results develops into formal Health Risk Assessment (HRA) Program
- HRA is bridge between lab results and clinical guidance for healthcare provider
- Archiving of letter reports for potential future use in patient assessments
- Determination of what is best for Soldier-patient with potential DU exposure

# APPLICATION TO AN INTEGRATED ARMY HEAVY METALS PROGRAM

Experience gained in the DU Health Risk Assessment Process is being used as a model for addressing issues with other heavy metals



- Assessment of retained metal fragments in Servicemembers and Veterans
- Awareness Training and Effective Risk Communication for Servicemembers, their Families, and their Healthcare Providers
- Integration of AMEDD's Health Hazard Assessment and Human Health Risk Assessment Programs – Requirement for Communication with Munitions Developers

# POTENTIAL DU EXPOSURES FROM MILITARY OPERATIONS



- Potential for subsequent environmental exposures through resuspension of DU residues

- Hard target impact and perforation of armored vehicles by DU munitions
- Vehicle fires involving DU munitions



# DU EXPOSURE CATEGORIES



I	Soldiers in, on, or near armored vehicle struck and penetrated with DU munitions
II	Soldiers whose MOS requires entering DU-damaged vehicles
III	Soldiers with incidental DU exposure



# FACTORS AFFECTING DU TOXICITY



- Route of exposure
- Chemical form
- Amount internalized
- Solubility
- Particle size and distribution

# ARMY/BATTELLE CAPSTONE DU HUMAN HEALTH RISK ASSESSMENT FINDINGS



- Greatest potential for inhalation exposure - in, on or near an armored vehicle at time of impact by a DU penetrator (DU Exposure Level I)
- Chemical toxicity may be the more limiting factor for soluble DU forms; however, military DU sources limit the availability of the more soluble forms
- All other potentially exposed individuals received significantly less intake through inhalation (DU Exposure Levels II and III)

See [http://fhp.osd.mil/du/du\\_capstone/index.pdf](http://fhp.osd.mil/du/du_capstone/index.pdf)

# NAS COMMITTEE ON TOXICOLOGY PEER REVIEW



## ***“Review of Toxicologic and Radiologic Risks to Military Personnel from Exposure to Depleted Uranium During and After Combat” (2008)***

- Army DU Research-Integrated Process Team recommended an independent scientific peer review by the National Academy of Sciences Committee on Toxicology
- See link to the NAS-COT review of the Capstone Reports:  
[http://www.nap.edu/catalog.php?record\\_id=11979](http://www.nap.edu/catalog.php?record_id=11979)
- Findings and recommendations presented in the Academy’s report compared and contrasted with the *“Depleted Uranium Aerosols Doses and Risk: Summary of U.S. Assessments”* (2005) for close-out of project



# THE CAPSTONE DEPLETED URANIUM (DU) AEROSOLS STUDY AND HUMAN HEALTH RISK ASSESSMENT

- Final two Data Quality Objectives for this project completed in the year 2009:
  - Review of the Capstone DU Project reports by the NRC, Council, National Academy of Sciences Committee on Toxicology
  - Publication of a series of 14 technical articles on the project in a dedicated, special issue of *Health Physics*, an independent, peer-reviewed scientific journal (Health Physics Journal, The Radiation Safety Journal, Special Issue: The Capstone Depleted Uranium Aerosol Characterization and Risk Assessment Study, ISSN 0017-9078, Vol. 96, No. 3, March 2009)

HEALTH PHYSICS The Radiation Safety Journal			
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Health Physics (ISSN 0017-9078), a peer-reviewed journal, is a publication of the Health Physics Society and is published monthly by Lippincott Williams & Wilkins, 1652 Hammers Green Parkway, Hagerstown, MD 21740-2116. Business offices are located at 530 Walnut Street, Philadelphia, PA 19106-3621. Periodical postage paid at Hagerstown, MD, and at additional mailing offices. Copyright © 2009 by the Health Physics Society. Annual subscription rates: District States - \$50.00 Individual, \$1,715.00 Institution, Rest of World - \$57.00 Individual, \$1,770.00 Institution. Single copy rate \$15.00. Subscriptions outside the United States must be prepaid. Subscriptions outside North America must add \$16.00 for airtight delivery. GST tax of 7% will be added to the subscription price of all orders shipped to Canada. (Lippincott Williams & Wilkins' GST Identification #R95524239. Publications Mail Agreement #40052291). Prices subject to change without notice. Subscriptions will begin with currently available issue unless otherwise requested. Copies will be replaced without charge if the publisher receives a request within 90 days of the mailing date. Individual subscription rates include print and access to the online version. Institutional rates are for print only; online subscriptions are available via Ovid. Please contact the Ovid Regional Sales Office near you for more information on institutional online access. Visit [www.lww.com/resources/institutions/](http://www.lww.com/resources/institutions/) for contact information. POSTMASTER: Address for nonmember subscriptions: Information, orders, or change of address: 16522 Hammers Green Parkway, Hagerstown, MD 21740-2116; phone 1-800-638-3030 or 1-301-223-2300; fax 1-301-223-5400. In Japan, contact I. W. Igaku-Shoin Ltd., 3-22-14 Hongu, Bunkyo-ku, Tokyo 113-0033; phone 81-3-5699-5400; fax 81-3-5699-5402. In Bangladesh, India, Nepal, Sri Lanka, and Pakistan, contact Globe Publications Pvt. Ltd. 18/19, P. O. Block, Shopping Complex, Naraina Vihar, Ring Road, New Delhi, 110028, India; phone 91-11-261-091211; fax 91-11-261-0876. Indexed in Current Contents (Life Sciences), Science Citation Index, Science Citation Index Expanded, Research Alert, BIOSIS, Index Medicus, MEDLINE, EMBASE/Excerpta Medica, Chem. Abstr., WRC Japn., Elsevier, Per. JICA, Cancer Journals and Services, Applied Health Phys. Abstr., Aquatic Abstr., Current Awareness in Biological Sciences, Energy Res. Abstr., Congress. Info. Serv., Index, ASSIA, Cambridge Scientific Abstracts, PASCAL-CNRS Database, INSPEC, Fish and Fisheries Worldwide, and Energy Database. Copyright © by the Health Physics Society. Unauthorized reproduction of this article is prohibited.

# LESSONS LEARNED

## CAPSTONE DU STUDY AND HUMAN HEALTH RISK ASSESSMENT

Information from the Capstone DU reports applied almost daily to current military operations regarding occupational and environmental health issues

- Army Training Ranges
- Historical weapon systems with DU
- Southwest Asia military operations
- Radioactive waste clean-up and disposal
- BRAC installations and environmental issues
- Soldier Post-Deployment Health Assessments
- DU Activist challenges

# OVERVIEW

## DEPLETED URANIUM (DU) AND ITS HEALTH EFFECTS (I)

- An overview of uranium health effects may be found in the US Agency for Toxic Substances and Disease Registry (ATSDR) Toxicological Profile for Uranium (see <http://www.atsdr.cdc.gov/toxprofiles/tp150.html>, a 1999 update to the original profile published in May 1989)
- Quote: "While natural and depleted uranium are considered chemically toxic, they are not considered a [significant] radiation hazard"
- Discussions are currently ongoing among several Federal Agencies to fund ATSDR to produce an updated addendum to this Uranium Toxicological Profile

# OVERVIEW

## DEPLETED URANIUM (DU) AND ITS HEALTH EFFECTS (II)

- The International Agency for Research on Cancer (World Health Organization) Monographs, Volume 78, Ionizing Radiation, and Volume 78, Part 2: Some Internally Deposited Radionuclides (2001), are another basic source of information on radiological effects
- See <http://monographs.iarc.fr/ENG/Monographs/vol78/mono78.pdf>
- M. A. McDiarmid, et. al., Surveillance Results of Depleted Uranium –Exposed Gulf War I Veterans: Sixteen Years of Follow-Up, Journal of Toxicology and Environmental Health, Part A, 72: 14–29, 2009

# OVERVIEW

## DEPLETED URANIUM (DU) AND ITS HEALTH EFFECTS (III)

- “As part of a longitudinal surveillance program, 35 members of a larger cohort of 77 Gulf War I veterans who were victims of depleted uranium (DU) "friendly fire" during combat underwent a 3-day clinical assessment at the Baltimore Veterans Administration Medical Center (VAMC)”
- “Sixteen years after first exposure, this cohort continues to excrete elevated concentrations of urine U as a function of DU shrapnel burden. Although subtle trends emerge in renal proximal tubular function and bone formation, the cohort exhibits few clinically significant U-related health effects.”

# OVERVIEW

## DEPLETED URANIUM (DU) AND ITS HEALTH EFFECTS (IV)

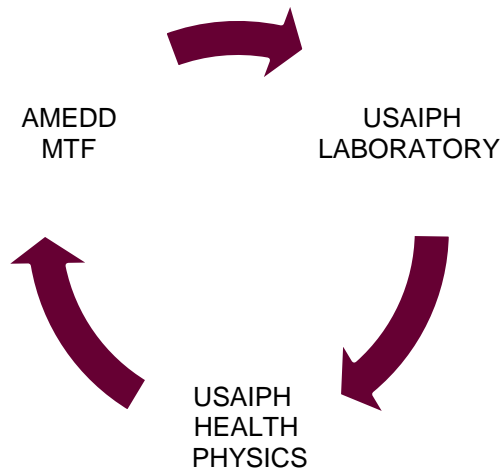
- The National Academy of Sciences Institute of Medicine recently updated its literature review on the health effects of DU and other Gulf War environmental hazards:
  - "Gulf War and Health - Volume 8 - Update of Health Effects of Serving in the Gulf War" (IOM, NAP, April 2010)"
  - In this report, the IOM determines that DU is not a significant source of occupational exposure
- The Department of Veterans Affairs (VA) published a notice in the Federal Register (FRN) in March 2010 on its decision related to a 2006 Institute of Medicine (IOM) report on the potential health effects of DU (IOM, NAP, Report, Gulf War and Health, Volume 4: Health Effects of Serving in the Gulf War, 2006) and the Volume 8 Update

# OVERVIEW

## DEPLETED URANIUM (DU) AND ITS HEALTH EFFECTS (V)

- The VA's FRN states that the IOM also concluded there was limited or suggestive evidence of no association between uranium and clinically significant renal dysfunction and between uranium and lung cancer at specified cumulative internal doses
- Therefore, the VA has decided NOT to service-connect any diseases related to DU, as listed in the IOM report
- See Federal Register/Vol. 75, No. 45 /VA /Notice , 9 March 2010
- <http://edocket.access.gpo.gov/2010/pdf/2010-4882.pdf>

# SCREENING BIOASSAY DATA QUALITY OBJECTIVES



- Laboratory performs urine uranium analysis using Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS) on MTF urine specimens
- Laboratory determines isotopic ratios for DU in urine specimen at detection limits as low as possible with laboratory method
- Health Physics Program reviews laboratory results and prepares a health risk assessment report for requesting healthcare provider at MTF
- AMEDD, through the DoD Deployment Health Clinical Center, refers patients with elevated urine uranium levels indicative of DU to VA Medical DU Follow-Up Program

## PROGRAM GOAL

Identify all personnel with elevated levels of DU and embedded fragments that contain DU (and tungsten composites) for referral to the VA Medical DU Follow-Up Program

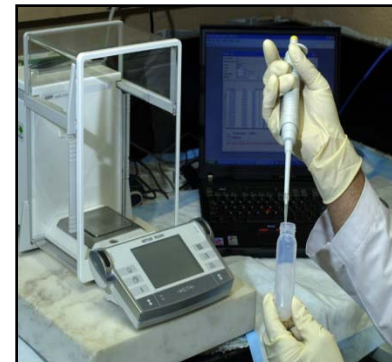
# AMEDD DU POLICY

## Policy for DU Bioassay and Fragment Analysis:

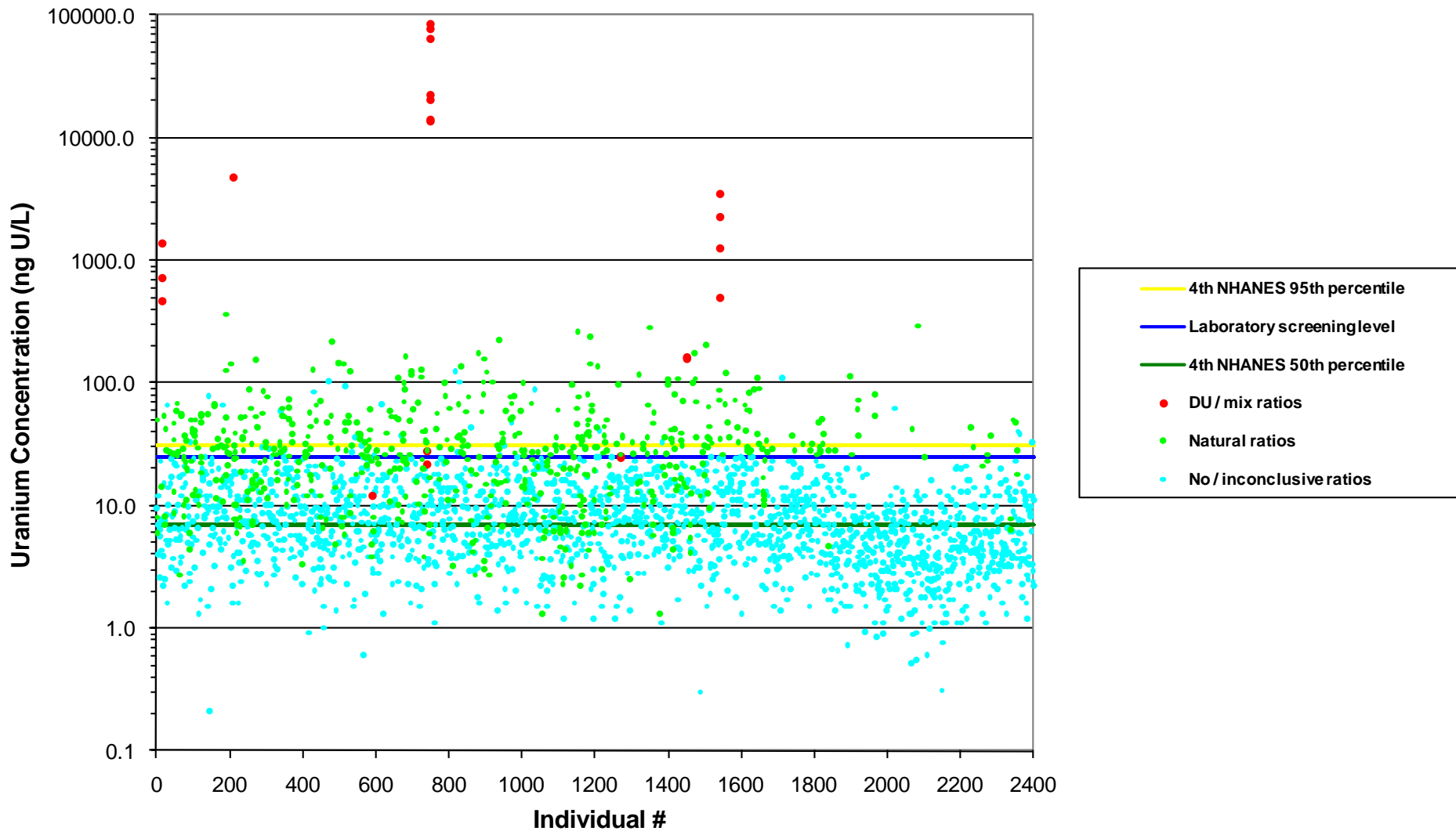
- Memorandum, U.S. Army Medical Command, MCPO-SA, OTSG/MEDCOM Policy Memo 09-038, 18 June 2009, subject: Medical Management of Army Personnel Exposed to Depleted Uranium (DU).
- Supersedes OTSG/MEDCOM Policy 07-022, 26 June 2007).
- See <http://www.pdhealth.mil/du.asp#army>

## OIF DU Results Summary (as of 30 Sep 10)

- **Urine bioassay specimens**
  - Over 2350 individuals screened
  - Over 2750 analyses
  - 8 individuals with DU in specimen
    - 5 elevated above NHANES, 3 in NHANES range
  - Preliminary dose estimates for 6 Soldiers
    - E(50) range: 0.00001Sv (0.001 rem) to 0.012 Sv (1.2 rem)
    - U kidney concentration: 0.003 to 11.1  $\mu\text{g U}$  per gram kidney tissue
  - 4 Soldiers referred to VA DU Follow-Up Program
- **Fragment analyses**
  - 80 fragments from 69 individuals
  - 3 fragments from 2 individuals positive for U
- **Urine uranium results consistent w/ CDC 3rd NHANES data/higher than 4<sup>th</sup> NHANES data**



### Comparison of Uranium Specimen Values to 4th NHANES Data and Laboratory Screening Level (as of 30 September 2010)



# New Metal Fragment Policy

- Memorandum, Assistant Secretary of Defense for Health Affairs, HA Policy 07-029, 18 December 2007, subject: Policy on Analysis of Metal Fragments Removed from Department of Defense Personnel
- Memorandum, U.S. Army Medical Command, MCPO-SA, OTSG/MEDCOM Policy Memo 10-041, 29 June 2010, subject: Management of Metal Fragments Removed from Army Personnel
- Application of lessons learned from DU Policy experiences
  - Eventual integration of two policies into a Heavy Metals Policy
  - Eventual electronic patient records

# Metal Fragment Policy

- Specifically, as part of the new DOD and Army MEDCOM embedded metal fragment policies, USAIPH received 235 embedded metal fragments from 147 patients from 1 October 2009 through 30 September 2010
- Cumulative analysis results (under the embedded metal fragment policies) are provided in the following table and graph

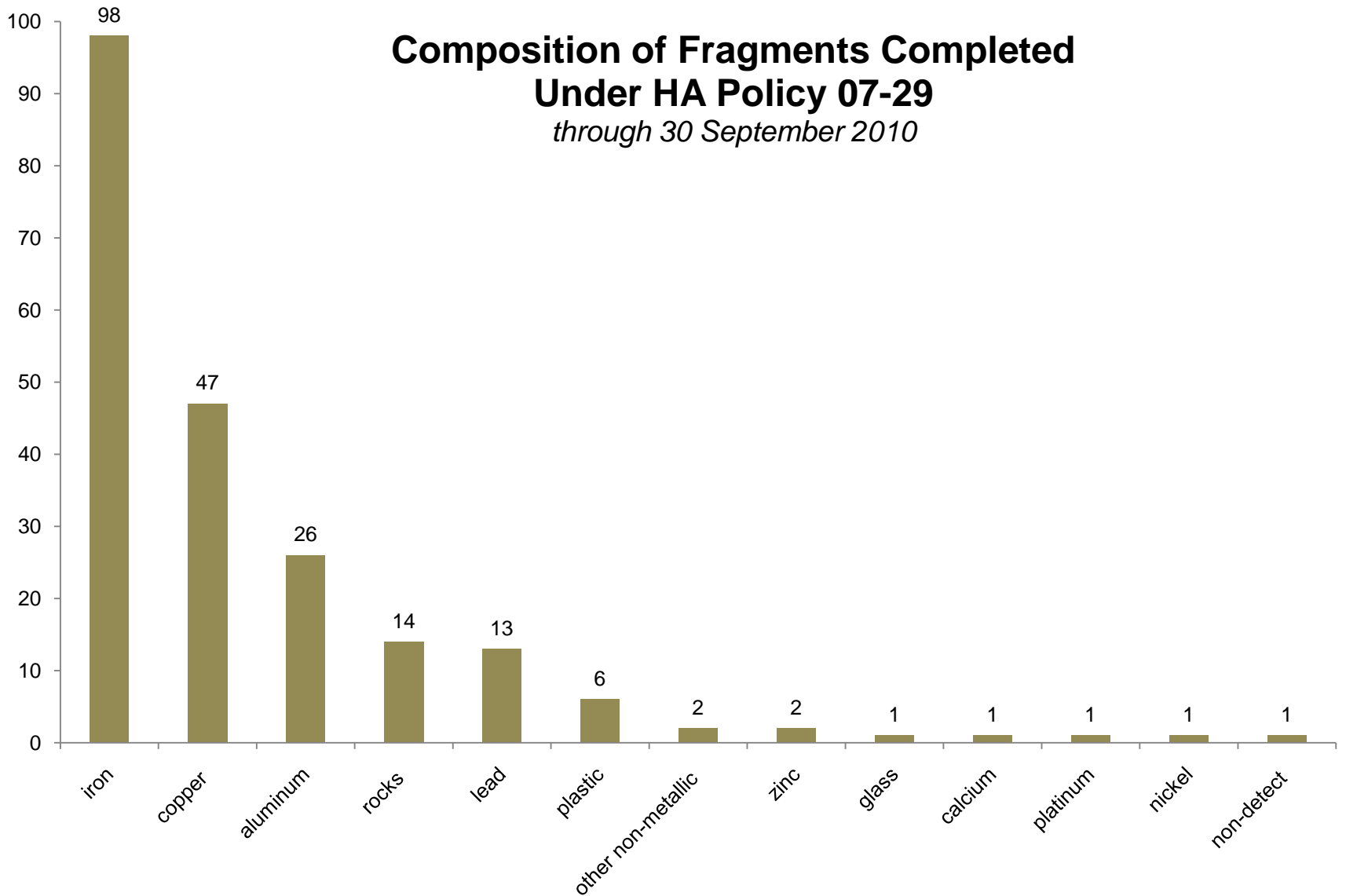
# Summary of Laboratory Results Removed Embedded Metal Fragments Cumulative Reporting Period: 18 September 2008 – 30 September 2010

Report Period	# of personnel	# fragments received	# fragments analyzed*	# packages sent out <sup>1</sup>	Content: common metals <sup>2</sup>	Content: lead <sup>3</sup>	Content: any tungsten <sup>4</sup>	Content: tungsten-nickel-cobalt	Content: High content Nickel
18 Sep 08 through 30 Sep 10	147	235	207	137	182	15	2	0	0

**Notes:**

\* One fragment not analyzed due to fragment size and composition

1. "Packages Sent" listed by # of fragments, but actually are combined per person when sent.
2. "Common Metals" are considered anything other than lead, tungsten or high content nickel. There are no separate packages (with Cover Memo interpretation and fact sheet) to separate out these metals for special consideration
3. Thirteen (13) fragments with primary content lead. There are 2 more with small to trace amounts of lead on common metals.
4. "Any Tungsten" often includes surface tungsten only. Tungsten content analyzed through 30 September 2010 has been considered minor and is counted under "Common Metals."



# Embedded Metal Fragment Assessment

For the 207+ fragments analyzed since implementation of HA Policy 07-029:

- None are depleted uranium (several fragments submitted previously were identified as DU)
- None are radioactive
- Tungsten has been detected, but in relatively low concentrations; primary tungsten alloy (composite) of concern has not been identified

## PROPOSED DISCUSSION TOPICS

DU researchers , medical planners, and combat operations staff are suggesting follow-up:

- Additional follow-up studies of exposed populations have the potential to improve knowledge of the health effects of DU. To permit an adequate assessment of the risks of cancer, renal toxicity, and other possible health effects faced by DU-exposed soldiers, a careful follow-up of the exposed groups should be continued, including the cohort now being followed by the Department of Veterans Affairs.
- An examination of subgroups of Soldiers with high, medium, and low exposure to uranium, with appropriate matching on other risk factors, should be implemented for selected health-related end points and biomarkers.
- The DU researchers should ask the military medical planners and combat operations staff what information is still needed to protect the Soldier and other Servicemembers on the battlefield.

## References

- Memorandum, Assistant Secretary of Defense for Health Affairs, HA Policy 03-012, 30 May 2003, subject: Policy for the Operation Iraqi Freedom Depleted Uranium (DU) Medical Management. ([www.ha.osd.mil/policies/2003/03-012.pdf](http://www.ha.osd.mil/policies/2003/03-012.pdf))
- Memorandum, U.S. Army Medical Command, MCPO-SA, OTSG/MEDCOM Policy Memo 09-038, 18 June 2009, subject: Medical Management of Army Personnel Exposed to Depleted Uranium (DU). (Supersedes OTSG/MEDCOM Policy 07-022, 26 June 2007). (<http://www.pdhealth.mil/du.asp#army>)
- Centers for Disease Control and Prevention, National Center for Environmental Health, *Fourth National Report on Human Exposure to Environmental Chemicals*, National Health and Nutrition Examination Surveys (NHANES), December 2009 ([www.cdc.gov/exposurereport](http://www.cdc.gov/exposurereport))
- DU Questionnaire: DD Form 2782 Test, Feb 2004 and DD Form 2782-1 Test, Feb 2004. Available at: [www.pdhealth.mil/du.asp](http://www.pdhealth.mil/du.asp)
- DU information available at: <http://fhp.osd.mil/du/>
- National Council on Radiation Protection and Measurements (NCRP) Report 156, Development of a Biokinetic Model for Radionuclide-Contaminated Wounds for Their Assessment, Dosimetry and Treatment, 2006. (<http://www.ncrponline.org/Publications/156press.html>)



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