DEPLETED URANIUM:

INFORMATION FOR CLINICIANS

THIS DOCUMENT HAS BEEN CREATED USING MATERIALS PREVIOUSLY DEVELOPED BY THE DEPARTMENT OF VETERANS AFFAIRS. THIS MATERIAL HAS BEEN COMBINED WITH INFORMATION FOR THE CURRENT MILITARY OPERATIONS AND FOR ISSUES SPECIFIC TO THE ARMY MEDICAL DEPARTMENT.

Information about Depleted Uranium

What is Depleted Uranium?

Uranium, a weakly radioactive element, occurs naturally in soil, water and mineral deposits and is mined and processed primarily for use as fuel in nuclear power reactors. In its pure form, uranium is a silver-white heavy metal nearly twice as dense as lead. Naturally occurring uranium deposits contain over 99% ^{238}U, with small amounts of ^{235}U and ^{234}U (see table below).

Depleted uranium is made from natural uranium, by removing some of the more highly radioactive isotopes (^{235}U and ^{234}U). "Enriched uranium," that with the higher concentrations of ^{235}U and ^{234}U, is what is used in nuclear reactors. Depleted uranium is what remains after the enrichment process. It contains even less ^{235}U and ^{234}U than naturally occurring ores. The spent uranium, which is about half as radioactive as natural uranium, is the "depleted uranium" (Voelz, 1992).

	Radioactivity	**Natural Uranium**	**Depleted Uranium**
Isotope	µCi/g	Concentration of isotopes	Concentration of isotopes
^{234}**U**	6200.0	0.0058%	0.001%
^{235}**U**	2.2	0.72%	0.2%
^{238}**U**	0.33	99.28%	99.8%
Relative Radioactivity		1	.6

As one may calculate from the table, the radioactivity of natural uranium is approximately 0.70 µCi/g whereas the radioactivity of Depleted Uranium is approximately 0.40 µCi/g. ***All*** uranium, not just DU, is made up of almost all ^{238}**U**. Natural and depleted uranium differ only in their radioactivity. Depleted uranium is roughly half (60%) as radioactive as natural uranium because the more radioactive isotopes have been removed. Their chemical properties, however, are the same. It is the chemical properties that are responsible for many of the health effects of concern, such as possible kidney effects. Depleted uranium also contains trace amounts of ^{236}**U** and other trace substances such as plutonium, americium and technetium. These amounts are so small that they are very difficult to measure and have no affect on health or the environment

What is Depleted Uranium used for?

Depleted uranium (DU) has a wide variety of civilian and military uses. It is used in radiation detection devices and radiation shielding for medicine and industry, for components of aircraft ailerons, elevators, landing gear, and rotor blades (AEPI, 1995).

The United States Armed Forces have used DU in the manufacture of munitions, armor and armor-piercing projectiles. DU's high density, self-sharpening qualities, and pyrophoric, or easily combustible, properties make it, in projectiles, capable of readily penetrating armor made with less dense metals. Conversely, armor constructed with DU provides a high degree of shielding and resistance to penetration. During the Gulf War (GW), depleted uranium containing munitions were used on a large scale for the first time. In the manufacture of projectiles and armor, depleted uranium is alloyed with small amounts of other metals. (DoD, 1998)

How are soldiers exposed to DU?

When a vehicle is impacted and penetrated by a DU projectile, the projectile splits into small shards, bursts into flames, and fills the insides of the vehicle with flying metal, fumes, and particulates. The bulk of a round may pass directly through the vehicle. The inside of the damaged vehicle remains contaminated with particles of DU and its oxides after the impact. In the event of a vehicular fire, the heat of the fire can cause any onboard DU ammunition to oxidize. Soldiers in struck vehicles may inhale airborne DU particles (or other combustion products), ingest DU particles, and be wounded with DU particles or fragments. Some crew members may be left with multiple tiny fragments of uranium scattered through their muscle and soft tissue. Other soldiers may be exposed to DU during operations to salvage tanks that have been disabled by DU rounds or be potentially exposed from brief "sightseeing" entry into damaged vehicles.

Simply riding in a vehicle with DU weapons or DU shielding will not expose a soldier to DU. Exposure by breathing fumes of burning DU metal only occurs if the vehicle is hit or if the soldier is near a target hit by DU munitions.

How does DU get into the body?

Natural uranium is ingested and inhaled every day from the natural uranium in our air, water, and soil. The amount varies depending upon the natural levels found in the geographic area in which one lives and the levels in the food and water from that area. On average in the U.S., an individual's daily intake of uranium is approximately 1.9 micrograms by ingestion and 0.007 micrograms by inhalation. This intake results in a natural level of uranium in the body of approximately 90 micrograms. It also gives an approximate urine uranium concentration of 0.01 to 0.1 micrograms of uranium per liter of urine. In areas where the natural uranium in the soil or water is high, these levels can be substantially higher (AEPI, 1995). The uptake and distribution of uranium is in some ways analogous to other heavy metals, such as lead, mercury, arsenic, and cadmium and can enter the body through any of the three common routes of absorption.

DU can be inhaled, swallowed, or even enter the body through cuts or abrasions on the skin, or through embedded metal fragments. Through proper field and personal hygiene, most possible exposure to DU can be avoided. The principal entry route during on-going exposure is through inhalation of DU vapor and fine dust contamination with DU. Dermal exposure as a result of DU dust contamination of skin or a wound is also possible, however, DU would not be expected to likely penetrate intact skin. Imbedded, retained DU shrapnel may be dissolved, absorbed, and distributed throughout the body. Depleted uranium dust can be ingested as well, but is not a likely significant exposure route unless exposure is on-going. Additionally, particles that enter the lungs during inhalation may be incorporated into sputum or phlegm that is raised into the throat and swallowed.

What are the health effects of exposure to DU?

Research on the human health effects of depleted uranium exposure in military occupations is limited, especially regarding DU's potential chemical (rather than radiologic) toxicity. There are, for example, no published epidemiological studies of soldiers exposed to depleted uranium dust or vapor in wartime settings prior to the Gulf War experience. Most of the knowledge about human effects is derived from studies of uranium miners and associated occupations, which is not precisely, but only generally relevant to DU exposed veterans. For example, uranium miners and millers have exposure to uranium but also possibly to radon as well as other toxic substances present in the mines or the ores that are milled, making their health effects experience not directly comparable to those DU exposed. Additionally, exposure intensity and duration of these other occupations are not directly comparable to exposure scenarios in military settings, limiting the applicability of observed health effects in the DU exposure setting.

Acute toxic effects of uranium exposure are manifested primarily in the respiratory system and kidneys. In wartime situations, there is the possibility of acute exposure to personnel on, inside, or near (less than 50 meters) vehicles when DU penetrators strike the vehicles or when DU munitions or shielding explode and burn. It is theorized that soldiers, particularly those inside tanks, may inhale excessive amounts of DU vapor and dusts raising the question about local effects in the lung as well as systemic effects incurred through an inhalation exposure. The internalization is high enough that it raises the possibility of local irritant effects in the lungs as well as systemic effects following absorption.

Chronic exposure is thought to affect primarily the kidney. The few chronic studies in the literature (as summarized by Voelz, 1992) document renal tubular changes without clear clinical implications. Other epidemiological studies of uranium millers and miners show an increased risk of renal disease. Animal studies have documented both tubular and glomerular lesions in rats given uranium compounds orally. These lesions increased with higher doses of uranium. (ATSDR, 1999). This finding is consistent with the known health effects of other heavy metals. It is unknown if low level, chronic exposure to depleted uranium will cause renal disease, although up to now, no renal abnormalities have been seen in the DU-exposed friendly fire cohort being followed at the Baltimore VA.

Chronic exposure by inhalation presents a potential radiologic hazard to the **lung and thoracic lymph nodes**. Uranium miners have a long occupational history of inhaling uranium dust in closed spaces. There is an increased risk of lung cancer among uranium miners but this is thought to be due to the simultaneous exposure to radon. The animal data are insufficient to determine whether inhalation of natural uranium causes lung cancer in animals.

Concerns about genotoxicity, mutagenicity and reproductive effects are only beginning to be studied, and definitive answers to these questions will almost certainly take much more work. Animal cell lines treated with uranium in one study have shown possible genotoxic and/or mutagenic changes. Measures of genotoxicity in the DUP group have met with mixed results, with some tests showing a change in results from positive for genotoxicity to negative over time. We are continuing to examine these endpoints in our ongoing surveillance. Reproductive effects in humans exposed to uranium have not been studied. To this point, there have been no birth defects in the 60 or so children born to the GW veterans in the DU Follow-up Program, including several with imbedded DU shrapnel in their bodies.

The ATSDR Toxicological Profile on Uranium summarizes the existing animal and human data on uranium. (See ordering information in the Section on Further Reading)

What is the potential for external radiation exposure?

External exposures, that is, when DU is not taken directly into the body, result in minimal radiation exposure because DU, primarily an alpha emitter, has relatively poor penetrating ability. Direct contact with bare DU for 250 hours is necessary to exceed annual occupational exposure limits. Wearing gloves provides effective protection against this type of exposure. Crewmembers inside an M1 or M1A1 tank fully uploaded with intact DU munitions experience average dose rates far below annual occupational whole-body exposure limits.

What is the potential for internal radiation exposure?

Internal exposure to DU, whether via inhalation, ingestion, wound contamination or retained fragments warrants concern. An assessment of whether DU exposure is internal and a commitment to regular medical follow-up for heavily exposed persons are prudent clinical and public health activities. Natural uranium's main radioactive emissions (i.e., alpha particles) "…are unable to penetrate skin, but can travel short distances in the body and cause damage…" (ATSDR Toxicological Profile, 1999). However, concern about cell damage due to radiation exposure from DU should be tempered with the knowledge that depleted uranium is less radioactive than the naturally occurring uranium found in soil and water.

Radiation dose assessments conducted after the 1991 Gulf War indicate that the internal radiation exposure to the most highly exposed group (personnel in or on a vehicle when it was struck by DU munitions) were less than the annual occupational exposure limit. Personnel in on or near an armored vehicle at the time the vehicle was struck by DU munitions may internalize enough DU through fragments, wound contamination, ingestion, embedded fragments and inhalation to exceed the annual occupational whole body exposure limit. All other potentially exposed personnel received radiation doses significantly less than the highest exposed group. Nonetheless, an assessment of whether DU exposure is internal and a commitment to regular medical follow-up for heavily exposed persons are prudent clinical and public health activities.

Looking at the natural background radiation exposure is one method of placing the radiation exposure from DU into perspective. Ionizing radiation exposure to the U.S. population comes from a variety of sources. The total ionizing radiation exposure that a resident of the U.S. receives on average is about 0.3 rem per year from natural and man-made sources. This is in the range of the exposures received by the most highly exposed population. The largest single source (inhalation) is primarily due to indoor radon. Natural background levels vary with geographic location and may be significantly higher.

The risk from this exposure is well below the risk of other commonly accepted risk factors as shown in the table below. The information is from the Nuclear Regulatory Commission Regulatory Guide 8.29.

Health Risk	Life Expectancy Loss
Smoking 20 cigarettes per day	6 years
Overweight by 15%	2 years
Alcohol consumption (U.S. average)	1 year
All accidents combined	1 year
All natural hazards combined	7 days
Medical radiation	6 days
Occupational exposure	
0.3 rem/yr (18 to 65 yrs)	15 days
1.0 rem/yr (18 to 65 yrs)	51 days

The DoD has described the following scenarios and their associated radiation dosages:

- A driver inside a fully loaded "heavy armor" tank, which uses DU armor panels, for 24 hours a day, 365 days a year would receive a dose of less than 25% the current occupational limit of 5 rems.
- The current dose limit for skin (50 rems in a year) would only be exceeded if unshielded DU remained in contact with bare skin for more than 250 hours. (DoD, 1998)

Are there other toxic effects of exposure to DU?

The original concern about health effects from DU exposure was primarily the potential radiologic hazard that exists. Separate from its radiologic properties however, uranium is also a heavy metal, a chemical toxicant that exhibits some adverse health effects similar to other heavy metals, such as lead and cadmium. Any kidney effects, for example (proximal tubular and, possibly, glomerular) are likely a result of the chemical toxicity of uranium, rather than its radiologic toxicity. The mutagenicity data, although extremely limited, are also probably due to uranium's chemical properties. This distinction is important because it suggests possible health outcomes in an affected population, as well as a knowledge base (which exists for other heavy metals) with which to compare the extremely limited findings observed in the DU exposed participants.

Insights into successful interventions, treatment strategies and refined prognoses may also be gained from the heavy metal literature. The chemical nature of DU will thus be an additional focus for the on-going follow-up program.

Guidelines for Clinicians

Tips for taking the history of a patient with suspected DU exposure

Listen for the patients concerns about their Gulf War exposures and experiences. Veterans are hearing information and advice from a wide variety of sources. Encourage the patient to ask questions and express their concerns. Given the amount of public discussion of possible sequelae, it is not surprising that veterans will wonder about the possible significance and prognosis of any type of new symptom in themselves or their family members. In the first round of evaluations we uncovered serious concerns about the possible deeper meaning of problems as common and generally benign as otitis media in toddlers, and tinea versicolor. Such concerns and apprehensions won't be relieved if they don't get discussed.

Ask the patient to provide a **detailed description** of all occupations including the current occupation. Focus on the situation that had the **potential DU exposure**. Probe for specific details about job duties, the equipment used, the nature of the site, the protective equipment worn, the training required and the hazard information provided. Obtain information about how and why the veteran believes he or she was exposed to Depleted Uranium. Patients can often provide quite accurate and detailed exposure information and, may, even have been provided hazard communication training and materials.

It is always important to determine **the length of time** the patient may have been exposed. For example, how many hours did the soldier spend cleaning tanks potentially contaminated with DU dust? Determine if the exposure occurred via inhalation, ingestion or dermal (wound contamination). The clinician can reassure most concerned patients by pointing out that in the cohort with imbedded, retained DU fragments, so far, no adverse health conditions have been detected. The clinician should emphasize that retained shrapnel represents continuous, internal exposure and, as such, is more potentially hazardous than other military exposures as currently understood. The clinician can further re-assure the patient by assessing uranium excretion. (See next section.)

When evaluating any symptoms or abnormal lab values that the veteran or soldier has, **be sure to include a complete discussion of any present exposures, whether occupational or environmental in the differential diagnosis.** For example, if the individual complains of shortness of breath, has he/she had a **recent exposure** to any pulmonary toxicants? If there are CNS symptoms, has there been **recent contact** with solvents, paints, degreasers, etc. A present occupational or environmental exposure is more likely to be causing current problems than a previous exposure to DU in the Gulf.

What are the health effects from exposure to Depleted Uranium?

The major health concerns about internalized depleted uranium relate to its chemical properties as a heavy metal rather than to its radioactivity, which is very low. As with all heavy metals, the hazard depends mainly upon the chemical form, the amount taken into the body, and the solubility of the DU particles within the body fluids. It has been recognized that very high uranium intakes can cause kidney damage.

Since 1993, the Department of Veterans Affairs has been following 35 Gulf War veterans who were seriously injured in friendly fire incidents involving depleted uranium. These veterans are being monitored at the Baltimore VA Medical Center. Many of these veterans continue to have medical problems relating to the physical injuries they received during these incidents. About half of this group still has depleted uranium metal fragments in their bodies.

Those veterans with retained depleted uranium fragments have shown higher than normal levels of uranium in their urine since monitoring began in 1993. These veterans are being followed very carefully and numerous medical tests are being done to determine if the depleted uranium fragments are causing any health problems.

For all 35 veterans in the program (including those with retained depleted uranium fragments), all tests for kidney function have been normal. In addition, the reproductive health of this group appears to be normal in that all babies fathered by these veterans between 1991 and 1997 had no birth defects.

How should personnel wounded by Depleted Uranium be treated?

Casualties may have depleted uranium contamination on their clothing and skin. **Under no circumstances should casualty extraction, treatment, or evacuation be delayed due to the presence of depleted uranium**. Standard procedures for treating wounded personnel should be followed.

Wounds and burns should be cleaned and debrided using standard surgical procedures. Normal "universal precautions" (surgical gloves, surgical mask, and throwaway surgical gowns) are more than adequate to protect medical personnel from accidental contamination with depleted uranium. Items contaminated with depleted uranium should be disposed of using standard universal precaution procedures. The use of a sensitive radiation meter may assist in wound debridement and cleaning. The AN/VDR-2 RADIAC meter with the beta window open may assist in locating depleted uranium contamination in the wound or burn. **Under no circumstances should required treatment be delayed to perform this monitoring**.

Embedded depleted uranium fragments should be removed using standard surgical criteria (reference 1.a, above, provides guidance) except that large fragments (greater than 1 cm) should be more aggressively removed unless the medical risk to the patient is too great. The short-term consequences of retained DU fragments do not justify an aggressive approach during the early treatment of wounds. Appropriate treatment of the wound with removal of any easily accessible fragments should be performed. In the care of acute wounds, surgical judgment should avoid the risk of harm in removal of other fragments -even when known to be DU. DU fragments may always be removed at a later date.

Monitoring of kidney function is recommended for these patients who have contaminated wounds or embedded depleted uranium fragments. The monitoring should follow the current protocol in use by the Baltimore Veterans Affairs (VA) Depleted Uranium Program. As with all heavy metals, the kidney is one of the organs most sensitive to uranium toxicity. Recommended tests include urinalysis, 24-hour urine for uranium bioassay, BUN, creatinine, beta-2-microglobulin and creatinine clearance. Chelation therapy is not recommended based upon current estimates of depleted uranium exposure health effects.

It is important to not the presence of retained fragments in the medical records and on the Patient Movement Request if the patient requires evacuation.

How does one determine the presence of Depleted Uranium in a wound?

Suspected wounding with depleted uranium or inhalation of aerosolized depleted uranium during combat should always be recorded on the patient's field medical card. Indicators that may be obtained from the patient or the patient's field medical card include:

- Patient's vehicle was struck by a Kinetic Energy (KE) munition. KE munitions are made from either tungsten or depleted uranium.

- Patient's vehicle was struck by friendly fire either from US tanks or aircraft.

- Patient reports he saw burning fragments (like a Fourth of July sparkler) while the vehicle was being penetrated. Depleted uranium is pyrophoric and will ignite under high pressure and temperatures.

Because of depleted uranium's high density, fragments are readily visible radiographically and will appear similar to steel or lead fragments in the body.

- Radiography alone, however, is not sufficient to determine the presence or absence of depleted uranium. ODS experience found that there were soldiers in vehicles struck by depleted uranium munitions that had retained fragments that were not depleted uranium.

- In addition, KE penetrators made out of tungsten will cause similar wounds and will appear radiographically the same. A large number of countries are using tungsten penetrators.

If readily available, a RADIAC meter (AN/VDR-2 with the beta shield open or equivalent) may be used to monitor wounds, burns, or suspected sites with embedded fragments. This can assist in wound cleaning and may confirm the presence of depleted uranium. **Under no circumstances should treatment be delayed to obtain an AN/VDR-2**.

What is the best method of determining if Depleted Uranium has been internalized?

The most sensitive indicator for the internalization of depleted uranium is a uranium urine bioassay. The policy for this bioassay is discussed below. In general, patients with retained depleted uranium fragments will excrete uranium in the urine. ODS experience showed that, like lead, depleted uranium from the fragments will dissolve and be transported into the blood.

- The fragments serve as a source of depleted uranium and the level of excretion will remain constant for long periods of time. Once in the blood stream, the depleted uranium will be metabolized in the same way that natural uranium is by the body. Depleted uranium is excreted in the urine.

- Results of the medical monitoring of patients from ODS indicate that the highest uranium urine levels were on the order of 30 to 40 micrograms of total uranium per gram of creatinine. This monitoring was initiated in 1993 and the levels have remained more or less constant. In all likelihood, the levels were higher sooner after the soldiers were wounded. How much higher is not known.

Does the presence of Depleted Uranium fragments pose any risk to family members or others who come in contact with the patient?

The presence of depleted uranium fragments in the service member's body presents no risks to family members. As with other heavy metals retained in the body, the depleted uranium in body fluids (blood, urine, sweat, saliva, and semen) and/or feces, present absolutely no hazard to the soldier or the people he has contact with. No special precautions are required by anyone having contact with the patient.

Who Should Have a Urine Uranium Bioassay?

The DU guideline states that DU urine bioassays are required for Category I and II personnel as described below:

Category I: Personnel Who Were In, On, or Near (less Than 50 Meters) An Armored Vehicle at the Time the Vehicle Was Struck. These personnel may exceed peacetime occupational exposure standards. Based upon field environmental measurements, research results and dose assessments during combat or deployment operations, depleted uranium may be internalized in sufficient amounts to exceed current peacetime depleted uranium occupational standards in three exposure scenarios:

(1) Personnel who are in, on, or near (within 50 meters) an armored vehicle at the time the vehicle is struck by depleted uranium munitions. These personnel can internalize depleted uranium through inhalation, wound contamination, ingestion and embedded depleted uranium fragments.

(2) Personnel who are in, on, or near (within 50 meters) a vehicle with depleted uranium armor at the time the armor was breached by DU or non-DU munitions. These personnel

can internalize depleted uranium through inhalation, wound contamination, ingestion and embedded depleted uranium fragments.
(3) First responders who entered struck vehicles to perform evacuation, first-aid/buddy-aid for the personnel in the struck vehicle. These personnel may internalize depleted uranium through inhalation and ingestion.

Level II: Personnel Who May Exceed Peacetime Exposure "Action" Levels that Require Biomonitoring. During combat (or deployment) operations, depleted uranium may be internalized in amounts that are below occupational exposure standards, but at levels that the Nuclear Regulatory Commission (NRC), the Occupational Safety and Health Administration (OSHA), or Army policy requires a bioassay for peacetime operations in the following scenarios:
(1) Personnel who are in, on, or near (within 50 meters) a fire involving depleted uranium munitions. These personnel can be exposed through inhalation and ingestion.
(2) Personnel who routinely enter vehicles with DU dust to perform maintenance, recovery operations, battle damage assessment and intelligence gathering operations. These are personnel who, as a result of their military occupation, are required to routinely enter vehicles with DU dust and spend more than 800 hours inside a vehicle.

Level III: Personnel in the vicinity of an event involving DU munitions or armor and receive "incidental exposure" (e.g., downwind from a tank fire involving DU, but greater than 50 meters distance). Personnel in this category should only have the DU bioassay performed if, in the physician's opinion, the patient or patient's family would benefit from the process. **The VA/DOD Post-Deployment Clinical Practice Guidelines will be used for this assessment.**

What is the Bioassay Policy for Depleted Uranium?

Depleted Uranium Urine Bioassay Procedures. The following are the ideals. Bioassays for wounded personnel should be taken as soon as the person is at hospital with the capability to do so. For the remainder, the outline below is ideal but as bioassay can be taken up to 120 days post exposure.

1. Depleted Uranium Urine Specimens. The primary bioassay technique to assess and document depleted uranium internalization is the collection of 24-hour urine specimens at specified times.

a. If a 24-hour collection is not feasible for either clinical or operational reasons, a spot urine sample with 120 mL of urine or as much urine as can be collected should be taken. While not optimal, it can provide useful information about depleted uranium intake. If urine creatinine levels are to be measured, the patient's age, sex, height, and weight must be provided on the laboratory request, Miscellaneous Standard
Form 557.

b. The 24-hour total urine sample provides for more accurate uranium determinations, positive identification of depleted uranium in the urine, and data for direct dose assessment. The

24-hour urine specimen should be handled according to routine procedures established by the laboratory doing the analysis.

2. Collection Procedure, 24-Hour Urine Sample. **Unlike standard procedures** do not discard the urine from the first void. Collect as much urine as is possible or at least 120 mLs of the first void as a spot sample and submit it for analysis. Document the date and time of the spot sample. Continue with then collecting all successive voids over the next 24-hour period as the 24-hour urine sample. Document the beginning time (same as the spot sample's) and the ending time of this 24-hour collection. Indicate whether or not this sample was a complete 24-hour collection.

Timelines for Bioassay Collection

Under no circumstances should required treatment or evacuation be delayed for bioassay. Urine uranium bioassays should be taken when operationally feasible and when the patient's clinical condition permits. Timelines for optimal urine uranium bioassay collection are as follows:

1. **Baseline 24-Hour Urine Specimen**. This is not an essential specimen. The purpose for this specimen is to determine the natural level of uranium in the patient's urine that will aid in the specificity and accuracy of the measurement.

a. Under normal conditions, internalized uranium will not appear in the urine for 24 hours after internalization. A baseline specimen should not be taken if more than 24 hours has passed since the exposure or if the patient has had an intravenous infusion (I.V.) or a significant blood volume loss or replacement. In this case, the depleted uranium may appear in the urine before the 24-hour point.

b. If a baseline specimen is taken, it should be started as soon as is possible after the injury and stopped 24 hours after the injury occurred.

2. **Initial Depleted Uranium Urine Specimen**. The purpose for this specimen is to obtain data for use in estimating the amount of soluble depleted uranium internalized. Collection should begin **not earlier** than 24 hours after the exposure event and continue for a full 24 hours. This specimen is needed in order to calculate the intake estimate and the radiation dose estimation. If a hospital's resources cannot support the logistics of an optimal 24-hour urine collection, then a spot-sample should be taken.

3. **Seven to Ten Day Urine Specimen**. This specimen (and subsequent specimens, if required) provides the data required to estimate the amount of insoluble depleted uranium internalized. If the patient is returned to duty from a Level III or IV MTF, at least a urine spot sample should be obtained from the patient before his departure.

4. **Subsequent Bioassay Procedures**. The need for further urine uranium bioassays will be based upon the depleted uranium levels found in the specimens noted above. Guidance from OTSG/MEDCOM consultants may be used to assist in patient assessment.

5. **Results Reporting**. All results should be reported **NORMALIZED TO CREATINE** (e.g., nanograms of depleted uranium per gram creatinine) and normalized to the volume of the urine sample (nanograms depleted uranium per liter of urine).

Where can I get support for bioassay analysis and dosimetry?

Specimens should be forwarded to US Army Medical Department-specified Department of Defense clinical laboratories such as the US Army Center for Health Promotion and Preventive Medicine (USACHPPM). Use the procedures outlined in reference 1.f, above.

Additional consultation on bioassay measurement is obtainable from the Radiologic, Classic and Clinical Chemistry Division, USACHPPM at (410) 436-3983 or DSN 584-3983.

Additional consultation on ionizing radiation dosimetry and health risk assessment is obtainable from the Health Physics Program, USACHPPM, at (410) 436-3502 or DSN 584-3502.

During non-duty hours, USACHPPM assistance may be obtained using the USACHPPM Emergency Contact Numbers (800) 222-9698 or (888) 786-8633.

Who are the points of contact for Depleted Uranium medical issues?.

The point of contact for the Office of the Surgeon General for clinical treatment issues is the Chief, Clinical Services Division, DSN 471-6616 or commercial (210) 221-6616.

The point of contact for radiation protection issues is the Radiation Protection Staff Officer, DSN 471-6612 or commercial (210) 221-6612.

References and Further Reading
Update in progress

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Additional Resources

Agency for Toxic Substances and Disease Registry (ATSDR). U.S. Public Health Service. Toxicological Profile for Uranium (Update). Can be ordered from:

National Technical Information Service
5285 Technical Information Road
Springfield, VA 22161
Phone: (800) 553-6847 or (703) 605-6000

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DeploymentLINK (http://www.deploymentlink.osd.mil/) is the World Wide Web information system of the Deployment Health Support Directorate that provides the public with information concerning the health of servicemembers . Information is updated periodically and covers a wide range of topics.

* These citations can be found on the DeploymentLINK web site described above.

† Journal articles written by the DUP staff and program collaborators. URLs for the article abstracts are listed below the citations if available.