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Mitigating the Psychological Harm from Actinide Intakes

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ABSTRACT

Investigations into possible actinide intakes, as well as the intakes themselves, may result in significant psychological harm which should be mitigated by the internal dosimetrist. Many aspects of this psychological impact are unique to actinide intakes, and have not been discussed in the literature. This paper discusses some of these unique considerations, and describes how the Internal Dosimetry Team at Los Alamos National Laboratory (LANL) has, with input and guidance from LANL psychologists, tried to address them. We feel that much of the psychological harm can be mitigated by educating employees specifically about internal dosimetry and internal doses, and by improving communication with radiation workers.

INTRODUCTION

Historically, intakes of plutonium and americium have rarely been large enough to present a serious physical health concern. The vast majority of plutonium intakes at Los Alamos National Laboratory in the last fifteen years have resulted in 50-year Committed Effective Doses (CEDs) smaller than 10 mSv, and none have exceeded the occupational limit of 50 mSv. Even very large internal doses, estimated to be in excess of 3 Sv CED, which occurred in the early days of the weapons era, did not produce any acute radiation sickness due to the low dose rate. Moreover, a

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long-term medical follow-up of 26 workers with significant plutonium intakes found no evidence of adverse health effects due to those intakes (Voelz et al. 1997). However, many of these intakes may have resulted in serious psychological harm to the employee. In many cases the psychological impact, and hence the harm, appeared to be disproportionate to the level of risk incurred from the dose.

The psychological impacts of acute radiation exposures have been well documented (e. g., Bromet et. al. 2011, Collins et al 1993, Vyner 1988), and the challenge of managing them is similar in many ways to that of managing actinide intakes. In particular, the health physicist must contend with the inherent difficulty of communicating risk with an individual who is afraid and not necessarily trusting. It is often the case that radiation workers do not have an adequate understanding of radiation, and experience fear which is not connected to the actual risk. These problems are exacerbated by the fact that it is difficult to absorb new information when already afraid and/or stressed (Covello 2011).

In addition to the challenges of managing psychological impacts inherent to all radiation exposures, actinide intakes also result in a number of additional challenges. One significant difference with a major psychological impact is that actinide intakes usually take significant time and effort to detect. Another is that the radiation dose continues to be delivered long after the intake is discovered. In spite of this, the academic literature is largely silent on the psychological impacts of radionuclide intakes, or how to manage them. In spite of this, these psychological impacts exist, and likely represent a significant portion of the risk resulting from intakes. Indeed, the psychological consequences may be the **most serious** short- or long-term effect from a radionuclide intake.

The purpose of the internal dosimetrist is to protect radiation workers. In theory, we do so by holding accountable the people directly responsible for protecting them from intakes. However, it seems that we have not found a way to accomplish this without traumatizing the employees we are meant to protect by delivering vague, irrelevant, and alarming news without possibility of remediation. If we, as internal dosimetrists, are serious about protecting radiation workers, we have to get serious about protecting them from psychological harm. There are a number of ways to do this, both before and after an intake takes place. This paper reviews some of the psychological impacts which are specific to radionuclide intakes, and the approach taken by the Los Alamos Internal Dosimetry (ID) Team to minimize the psychological harm we cause during the course of our investigations, and to mitigate the psychological harm from the intakes themselves.

CHALLENGES UNIQUE TO ACTINIDE INTAKES

Actinide intakes present a number of challenges to mitigating psychological harm which are not an issue with external exposures. In particular, a number of factors combine to make the risk from intakes seem larger. One such factor is that, unlike external exposures, actinide intakes usually require a great deal of time and effort to detect, often requiring a months-long investigation and numerous bioassay samples. Another contributing factor is that employees may imagine that their dose is larger with each request for a new bioassay sample, when in fact more samples may indicate a smaller intake (because larger intakes are easier to detect over background). In addition, once an investigation has been concluded, the result is often presented at a meeting with the employee, radiation protection personnel, and the employee's manager, even though an external dose of similar magnitude would only be reported in the employee's annual dose report. Part of the reason these meetings happen is that the results of an intake investigation are inherently difficult to

understand, especially for nontechnical employees. For example, dose estimates usually come with a significant amount of uncertainty, stemming from uncertainty as to the time of intake, solubility characteristics of the intake, etc. Dose reports are made even more confusing by the regulatory requirement to report the equivalent dose to the most affected organ (in Sv) in addition to the committed effective dose, neither of which are intended to be used to retrospectively estimate the risk to an individual (Fisher and Fahey, 2017).

Another unique challenge is that the radiation source (e.g., plutonium) remains with the internally exposed individual throughout their life, and continues to deliver dose long after the intake is detected. Employees who have had intakes take the radionuclide home with them after work, while, for the externally exposed employee, the incident remains permanently in the past. In addition, there is usually very little to be done about an intake after it has been detected, as chelation therapy is only effective shortly after the intake occurs, and is therefore only offered when the intake is self-evident (e.g., following a contaminated wound). Paradoxically, the very low dose rate associated with actinide intakes exacerbates the psychological impact, even though it reduces the physical harm.

In our experience, friends and family can sometimes also worsen the psychological impact if they are anxious or afraid – especially if they are afraid to be close to a ‘contaminated’ employee. One employee, who received a significant internal dose (between 3 – 10 Sv CED(50) according to early estimates) from a wound in the early 1980’s, underwent two surgical excisions and multiple chelation therapies following his accident. Years later, the employee recalled that, for months following the accident, his best friend was too afraid to come close to him or shake his hand (Inkret and Miller 1995). These types of incidents can be remembered and cause pain years or even decades after the intake occurred.

Finally, we have found that a lack of education contributes to and exacerbates all of the other problems. While radiation workers are always given some education in radiation safety, we find that this education is insufficient, especially with regards to internal doses. As a result, employees do not know what to expect following an incident or an elevated routine bioassay. They do not know how to interpret the results of an intake report, whether they can expect to get cancer as a result of an intake, or, in some cases, whether they are a danger to their friends and loved ones. While large intakes of plutonium have not been observed to prevent individuals from going on to live long, health lives, the psychological trauma from those intakes can persist for years or decades.

MITIGATING HARM BEFORE AN INTAKE

Although the Internal Dosimetry team at Los Alamos National Laboratory (LANL) is composed of physicists, not psychologists, we are nevertheless obligated to minimize as much as possible the psychological harm to our employees from actinide intakes. We therefore worked closely with LANL psychologists towards that goal. Our efforts can be divided into two broad categories – education and communication.

Radiation protection is a complex and often confusing topic, which can take a good deal of time and effort to learn. Internal dosimetry is particularly confusing, because some understanding of statistical uncertainty is needed to grasp why there is such a high frequency of false positives, and why so many samples are needed to characterize an intake. In our experience, the employees and family members who are the most emotionally affected by an intake also have the most difficulty in learning about these topics. For that reason, we feel that the best time to educate employees

about radiation, radiation safety, and bioassay monitoring is before an incident occurs, ideally at the time they begin radiation work.

Working with LANL psychologists and communications experts, we have developed a number of educational materials intended to benefit employees and their families. These include a small trifold pamphlet and a much more detailed booklet, both intended to be delivered whenever an employee is enrolled in routine bioassay monitoring and annually thereafter. These resources present information about radiation, radiation protection, internal dosimetry, and health effects. They were carefully developed so as to be understandable by family members who were not previously familiar with the topic, as well as the employees. We also give periodic presentations to radiation workers, giving them an opportunity to ask questions.

When explaining the risk from actinide intakes, reassuring facts may not always be effective. For example, one might tell an employee who had a 5 mSv CED that, according to theory, their cancer risk has been increased by 0.0005%, but that the Health Physics Society (HPS) has stated that no effects will ever be observed for acute doses less than 100 mSv (HPS 2016), and that the extremely low dose rate mitigates the small residual risk, if only because susceptibility decreases as one ages. However, an employee may consider those facts “too good to be true.” As an alternative, we often find it helpful to put an employee’s dose in terms of the differences in natural background between states. For example, the natural background in Los Alamos is estimated to be 5.2 mSv/year, while in Florida is closer to 1 mSv/year, so a 4 mSv CED would be “offset” by one year in Florida.

We also feel it is important to develop rapport and trust with radiation workers before intakes happen. In addition to the regular Q&A presentation, we also make an effort to visit the workplace

to get to know the employees and gain some understanding of what they do. Understanding the types of work individual employees do is also extremely helpful in the dose assessment process.

Because our workplace is unique, and because there is little precedent that we know of for a focused attempt to mitigate the psychological impact from actinide intakes, we do not imagine that we have developed a complete or perfect system. With that in mind, we feel it is appropriate to meet annually to formally discuss our experiences with affected employees. In addition, we regularly seek feedback from employees to find out how they feel we have done and if we could have done better. These experiences feed back into the revision of templates and communications protocols, and may lead to new resources being developed.

MITIGATING HARM WHILE INVESTIGATING POSSIBLE INTAKES

In our experience, investigations into possible intakes can cause significant anxiety in employees and their families, irrespective of whether we ultimately conclude that in intake actually occurred. At this stage, different employees have significantly different needs. For example, some may not be concerned at all, others may be alarmed but easily reassured, while still others will experience growing anxiety while the investigation proceeds. Some employees (and their loved ones) may be too frightened to learn any new facts, while others will want to learn as much as possible. Covello (2011) mentions that “people under stress typically want to know that you care before they care about what you know.” With that in mind, our focus is on sustaining high quality communication with employees throughout investigations.

We have developed (with input from LANL psychologists) templates for phone and e-mail communications. We now call employees at the onset of an investigation, introduce ourselves,

explain the situation, let them know to expect an e-mail asking for a follow-up bioassay sample, and make it clear that they can call or visit our offices any time for consultation. We also call employees before sending them their final dose report. When making calls, we strive to acknowledge and respect employees' emotions while avoiding using abstract language. In addition, we now send detailed and personable e-mails containing the same information as is provided over the phone. As mentioned earlier, we are also preparing a booklet specifically for employees and their family members to be distributed during intake investigations.

Receiving repeated requests for bioassay samples over the course of many months can cause anxiety by inflating the employee's notion of their dose. To avoid this, we remind employees that large intakes are much easier to detect and characterize, so a large number of requests likely indicates a smaller intake or no intake at all. We also send monthly progress reports letting employees know the progress of the investigation, upper and lower limits on the dose (if available), and the estimated amount of time until the investigation will be completed.

One particular concern during the course of an investigation involves the choice of words used to describe the process. For example, the term "investigation," while standard in the field, may imply to an employee that they are suspected of wrongdoing, or that they will experience negative consequences if the investigation concludes that an intake has occurred. Another word which we seek to avoid when communicating with employees is "contamination." While the DEA, CDC, FDA, the IAEA, and the media commonly refer to radionuclide intakes as "internal contamination," (e.g., Bhattacharyya et al. 1992; CDC 2014; FDA 2006; IAEA 1996) we feel that the word carries an undesirable stigma which implies that the employee is somehow unclean or unsafe to be close to. Finally, the field of radiation protection, and internal dosimetry especially, has a great deal of nomenclature which can be daunting for the uninitiated. For example, we have

absorbed dose, equivalent dose, effective dose, and committed effective dose, where the latter three, all of which are quite distinct, may all be given units of rem or Sieverts, or derivatives thereof (e.g., millirem). Confusion can also be created with the internal dosimetrist uses colloquial terms according to their strict scientific meaning (e.g., “exposure”). These problems can be reduced by deciding in advance which terms to use with employees, and using them exclusively and consistently (Covello 2011).

MITIGATING HARM FOLLOWING INTAKES

Although rare, intakes do happen. While some employees take this news in stride, others exhibit significant anxiety. Delivering the final written dose report is typically the last formal interaction we (the internal dosimetrists) have with the employee, so we are not well positioned to provide support. However, there are some things which can be done. First, it is important that the dose report be presented in such a way that the information and concepts are accessible to nontechnical employees. At the same time as delivering the report, it is important to make the employee aware of resources available moving forward. At LANL, this includes the educational resources we have provided, as well as free counseling for employees and their families provided through the Employee Assistance Program. In addition, we let the employee know that we will continue to be available to answer any questions they might have. We speculate that some internally exposed employees might benefit from organized social gatherings, but this involves privacy concerns which we have not yet overcome. However, in the early days of the nuclear weapons program a group of significantly exposed employees formed a social group, calling themselves the “U-P-P-U” club (indicating that their urine contained detectable quantities of Pu-239) (Inkret and Miller 1995).

Extremely rarely, incidents are significant enough that medical intervention such as chelation therapy or wound excision is considered. Given that medical interventions such as chelation and surgical excision carry their own risks, the decision to provide treatment must be based on a careful assessment of the risk and benefit to the employee. This decision is ultimately between the employee and the physician, while the health physicist's role is simply to provide information regarding the radiological risk. Nevertheless, we can observe that some of the risks and benefits of medical intervention are psychological. For example, some individuals may feel better if they receive treatment, even if the reduction in dose is minor. Conversely, for other employees the treatment may add to the emotional trauma (Poudel et al. 2017). In addition, there are physical risks associated with chelation therapy and skin excision which could carry their own psychological impacts. Finally, the risk of repercussions from exceeding a regulatory dose limit creates an incentive which is separate from that of reducing risk to the employee. Because the regulation exists to limit employees' exposure to risk, it would be easy to confuse this incentive with the incentive to protect its employees. Institutions must diligently avoid this confusion lest they, through their advice, pass that confusion along to their employees.

CONLCUSION

Investigations into possible actinide intakes, as well as the intakes themselves, may result in significant psychological harm which should be mitigated by the internal dosimetrist. Many aspects of this psychological impact are unique to actinide intakes. For example, internal doses take a relatively large amount of time and effort to detect, and the radiation dose continues to be delivered long after the intake is discovered. However, the psychological impacts from radionuclide intakes has not been discussed in the literature. With input and guidance from LANL

psychologists, the LANL Internal Dosimetry Team has tried to address the psychological impacts from actinide intakes. We have done this by providing education to radiation workers which is specific to internal dosimetry, and by improving our communication throughout the process of investigating and reporting internal doses.

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