U.S. NUCLEAR REGULATORY COMMISSION

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MEDICAL EVENT EVALUATION AND REPORTING

A. INTRODUCTION

Purpose

This regulatory guide (RG) describes an approach that is acceptable to the U.S. Nuclear Regulatory Commission (NRC) staff to meet the requirements in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 35, "Medical Use of Byproduct Material," for evaluating and reporting medical events (Ref. 1). This RG provides licensees with guidance on medical event report filing, creation, and content. In addition, this RG provides guidance on procedures for administrations of byproduct material for medical procedures requiring a written directive and on procedures for evaluating and reporting extravasation events.

Applicability

This RG applies to all NRC medical licensees authorized to administer byproduct material subject to 10 CFR Part 35.

Applicable Regulations

- 10 CFR Part 35 includes requirements and provisions for the radiation safety of workers, the public, patients, and human research subjects.
    - 10 CFR 35.2, "Definitions," defines the terms "authorized user," "extravasation," "patient intervention," "physician," "prescribed dosage, "prescribed dose," "radiation injury," "treatment site," and "written directive."
    - 10 CFR 35.27, "Supervision," provides the requirements for individuals supervised by an Authorized User (AU). This regulation requires the supervised individuals to be instructed in and to follow the licensee's written radiation protection and written directive procedures.
    - 10 CFR 35.40, "Written directives," states when written directives are required and what information they must contain.

- 10 CFR 35.41, "Procedures for administrations requiring a written directive," provides the requirements for procedures to provide high confidence that the patient's or human research subject's identity is verified before each administration and that each administration is in accordance with the written directive. This regulation requires all licensees to develop, implement, and maintain written procedures to determine whether a medical event has occurred, as well as to determine, for permanent implant brachytherapy, the total source strength administered outside of the treatment site compared to the total source strength documented in the post implantation portion of the written directive.

- 10 CFR 35.42, "Procedures for evaluating and reporting extravasations," provides the requirement for licensees to develop, implement, and maintain procedures to provide high confidence that an extravasation that has resulted in, or has the potential to result in, a radiation injury will be detected promptly and reported in accordance with 10 CFR 35.3045, "Report and notification of a medical event."

- 10 CFR 35.2041, "Records for procedures for administrations requiring a written directive," requires licensees to retain a copy of procedures required by 10 CFR 35.41 for the duration of the license.

- 10 CFR 35.2042, "Records for procedures for evaluating and reporting extravasations," requires licensees to retain a copy of procedures required by 10 CFR 35.42 for the duration of the license.

- 10 CFR 35.3045 requires licensees to report medical events that meet certain. The regulation specifies when and how to report a medical event and what information a medical event report needs to include.

- 10 CFR 35.3047, "Report and notification of a dose to an embryo/fetus or a nursing child," requires licensees to report an unplanned dose to an embryo or fetus from administration to a pregnant individual, or a dose to a nursing child as a result of administration to a breastfeeding individual. The regulation specifies when and how to report these exposure events and what information a medical event report needs to include.

Related Guidance

NUREG-1556, "Consolidated Guidance about Materials Licenses," Volume 9, "Program -Specific Guidance about Medical Use Licenses," (Ref. 2), includes program -specific guidance and information intended to help applicants and licensees prepare applications for materials licenses for the medical use of byproduct material.

Purpose of Regulatory Guides

The NRC issues RGs to describe methods that are acceptable to the staff for implementing specific parts of the agency's regulations, to explain techniques that the staff uses in evaluating specific issues or postulated events, and to describe information that the staff needs in its review of applications for permits and licenses. Regulatory guides are not NRC regulations and compliance with them is not required. Methods and solutions that differ from those in RGs are acceptable if supported by a basis for the issuance or continuance of a permit or license by the Commission.

Paperwork Reduction Act

This RG provides voluntary guidance for implementing the mandatory information collections in 10 CFR Part 35 that are subject to the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et seq.). These information collections were approved by the Office of Management and Budget (OMB), under control number 3150-0132. Send comments regarding this information collection to the FOIA, Library, and Information Collections Branch (T6-A10M), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by email to Infocollects.Resource@nrc.gov, and to the OMB reviewer at: OMB Office of Information and Regulatory Affairs, NEOB-10202 (3150-0132), Attn: Desk Officer for the Nuclear Regulatory Commission, 725 17th Street, NW, Washington, 20503.

Public Protection Notification

The NRC may not conduct or sponsor, and a person is not required to respond to, a collection of information unless the document requesting or requiring the collection displays a currently valid OMB control number.

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B. DISCUSSION

Reason for Issuance

This RG provides guidance to licensees for complying with and implementing the requirements associated with medical event evaluation and reporting in 10 CFR Part 35. The RG also includes guidance for reporting extravasation events, a new requirement included in 10 CFR Part 35 which was developed in conjunction with this RG as described in SRM-SECY-22-0043, "Staff Requirements—SECY-22-0043—Petition for Rulemaking and Rulemaking Plan on Reporting Nuclear Medicine Injection Extravasations as Medical Events (PRM-35-22; NRC-2020-0141)," dated December 12, 2022 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML22346A112) (Ref. 3).

Background

The NRC's policy statement on the medical use of byproduct material (65 FR 47654; August 3, 2000) (Ref. 4) specifies that the NRC will not intrude into medical judgments affecting patients, except as necessary to provide for the radiation safety of workers and the general public. The policy statement also specifies that the NRC will regulate the radiation safety of patients, when this is justified by the risk to the patients, primarily to ensure that the use of radionuclides is in accordance with the physician's directions.

To meet this intent, the NRC also established regulations to ensure that physicians who use byproduct material in medicine are adequately trained in radiation safety.[1] Physicians with this training are known as Authorized Users (AUs). When justified by the risk of use, AUs are required to provide written directives for the medical use of byproduct material. Finally, NRC regulations require licensees to develop, implement, and maintain written procedures to provide high confidence that administrations of byproduct material are in accordance with these written directives. If an administration is not in accordance with the physician's directions and meets specific criteria listed in 10 CFR 35.3045, the NRC requires the reporting of the administration as a medical event.

Medical event reports provide the NRC with operational experience to ensure that the medical use of byproduct material is in accordance with physicians' directions and that corrective actions are taken to prevent recurrence when possible. Medical events do not necessarily result in harm to the patient or mean an error in standard of care occurred during treatment. However, while some medical events cannot be prevented because of current limitations in the practice of medicine, a medical event may indicate a problem in a medical facility's use of radioactive materials. Medical event reporting also allows the NRC to follow up on events and determine whether other licensees might be experiencing similar challenges. The NRC assesses trends or patterns, identifies generic issues or concerns, and evaluates any inadequacy or unreliability in specific equipment or procedures. When the NRC identifies similarities in the root causes of medical events reported from multiple facilities, it may issue a generic communication to help prevent additional incidents. Generic communications related to medical events are listed in appendix A. The NRC also provides information about medical events to the industry through presentations, communication with professional societies, and direct communication with manufacturers and other

[1] Regulations are contained within 10 CFR 35.190, "Training for uptake, dilution, and excretion studies," 10 CFR 35.290, "Training for imaging and localization studies," 10 CFR 35.390, "Training for use of unsealed byproduct material for which a written directive is required," 10 CFR 35.490, "Training for use of manual brachytherapy sources," 10 CFR 35.590, "Training for use of sealed sources and medical devices for diagnosis," 10 CFR 35.690, "Training for use of remote afterloader units, teletherapy units, and gamma stereotactic radiosurgery units," and 10 CFR 35.1000, "Other medical uses of byproduct material or radiation from byproduct material."

regulators to minimize the risk of recurrence and to ensure that the use of byproduct material in medicine is in accordance with the physician's directions.

Consideration of International Standards

The International Atomic Energy Agency (IAEA) works with member states and other partners to promote the safe, secure, and peaceful use of nuclear technologies. The IAEA develops Safety Requirements and Safety Guides for protecting people and the environment from harmful effects of ionizing radiation. This system of safety fundamentals, safety requirements, safety guides, and other relevant reports reflects an international perspective on what constitutes a high level of safety. To inform its development of this RG, the NRC considered IAEA Safety Requirements and Safety Guides pursuant to the Commission's International Policy Statement (Ref. 5) and Management Directive and Handbook 6.6, "Regulatory Guides" (Ref. 6).

The following IAEA Safety Requirements and Guides were considered in the update of this RG:

- IAEA Specific Safety Guide No. 46, "Radiation Protection and Safety in Medical Uses of Ionizing Radiation," issued 2018 (Ref. 7), provides IAEA recommendations for investigating and reporting unintended and accidental medical exposures and discusses how regulators can use the reports to disseminate information to avoid future events at other licensees.

- IAEA Human Health Series No. 33, "QUANUM 3.0: An Updated Tool for Nuclear Medicine Audits," Third Edition, issued August 2021 (Ref. 8), recommends that nuclear medicine services have procedures to prevent, monitor for, manage, and document misadministrations.[2] It also provides recommendations for classification of extravasations.

In addition, when developing specific guidance for reporting extravasation events, the NRC considered recommendations from several other sources, including the International Commission on Radiological Protection (ICRP), the IAEA, and the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA):

- According to ICRP Publication 140, "Radiological Protection in Therapy with Radiopharmaceuticals," issued September 2019 (Ref. 9), any infusion of therapeutic radiopharmaceuticals should be monitored to ensure safe administration, and the infusion should be stopped if an extravasation occurs. ICRP Publication 140 also recommends best practices for reducing dose to tissue, and therefore risk of radiation injury, by improving radiopharmaceutical uptake.

- The IAEA considers complete extravascular injections to be misadministrations by wrong route of administration. The IAEA states that an extravasation can result in a very high absorbed dose, especially if the extravasant has a long retention time and involves a high activity in a small volume. The IAEA recommends reporting of all misadministrations, regardless of the effect on the patient, to enable providers to learn from prior misadministrations and thus prevent future incidents. Reports should describe the incident, any methods used to estimate whole-body and organ doses received by the patient, medical consequences of the misadministration, and recommendations for corrective measures.

- ARPANSA 14.2, "Safety Guide for Radiation Protection in Nuclear Medicine," issued 2008 (Ref. 10), states that misadministration of diagnostic radiopharmaceuticals is unlikely to result in

[2] Although the term "misadministration" was replaced with "medical event" in 2002 (67 FR 20250; April 24, 2002), other entities still use "misadministration" to describe what the NRC refers to as a "medical event."

radiation injury or other complications. The guide calls out a possible exception for extravasations where the extravasant has a long retention time and involves a high activity in a small volume. It also states that licensees should internally investigate any misadministrations and in some cases should report them to the regulatory authority.

C. STAFF REGULATORY GUIDANCE

This section provides detailed descriptions of methods and approaches the NRC staff considers acceptable for meeting the requirements of the applicable regulations cited in the introduction.

1. Medical Event Criteria (10 CFR 35.3045)

The medical event criteria listed in 10 CFR 35.3045 are divided into four categories: (1) events not associated with permanent implant brachytherapy or patient intervention, (2) events associated with permanent implant brachytherapy but not patient intervention; (3) events associated with patient intervention, and (4) events associated with extravasations. The following sections provide guidance for each of these categories. Appendix B provides examples of medical events and events that do not meet the criteria.

1.1 Medical Events Not Associated with Permanent Implant Brachytherapy or Patient Intervention

The criteria for medical events associated with administration of byproduct material or radiation from byproduct material, except for events that result from patient intervention or are associated with permanent implant brachytherapy, are listed in 10 CFR 35.3045(a)(1). These criteria are broken down into three parts, described below.

1.1.1 Wrong Dose or Dosage

An incident associated with wrong dose or dosage should be evaluated using the criterion of 10 CFR 35.3045(a)(1)(i). This criterion requires reporting of events that involve a dose that differs from the prescribed dose, or from the dose that would have resulted from the prescribed dosage, by more than 0.05 sievert (Sv) (5 rem) effective dose equivalent, 0.5 Sv (50 rem) to an organ or tissue, or 0.5 Sv (50 rem) shallow dose equivalent to the skin; and where one of the following is true:

- The total dose delivered differs from the prescribed dose by 20 percent or more.
- The total dosage delivered differs from the prescribed dosage by 20 percent or more or falls outside the prescribed dosage range.
- The fractionated dose delivered differs from the prescribed dose for a single fraction, by 50 percent or more.

The following equation should be used to calculate the percent difference between prescribed dose and actual delivered dose:

$$\%\ difference = \frac{D - P}{P} \times 100\%,$$

where D = delivered dose or dosage, and
P = prescribed dose or dosage.

Events that meet the dose criteria and differ from the prescribed dose or dosage by more than 20 percent, whether negative or positive, must be reported in accordance with 10 CFR 35.3045.

"Prescribed dosage" is defined in 10 CFR 35.2 as the specified activity or range of activity of unsealed byproduct material, as documented either in a written directive or in accordance with the

directions of the AU, for procedures performed pursuant to 10 CFR 35.100, "Use of unsealed byproduct material for uptake, dilution, and excretion studies for which a written directive is not required," and 10 CFR 35.200, "Use of unsealed byproduct material for imaging and localization studies for which a written directive is not required."

The directions of an AU for procedures performed pursuant to 10 CFR 35.100 and 10 CFR 35.200 may be documented in patient-specific prescriptions, licensee standardized dosage charts, or electronic orders. If a dosage range is used, the event must be reported if the administered dosage is not within the prescribed range and the dose criteria are met. To determine the difference between the delivered dose and the dose that would have resulted from the prescribed dosage range, licensees can use the minimum dosage for an underdose event and the maximum dosage for an overdose event. While most incidents involving uses under 10 CFR 35.100 and 10 CFR 35.200 do not meet the minimum dose threshold for reporting, some could meet the threshold (e.g., if a batch dosage is inadvertently administered). Therefore, for events in which the wrong dosage is given for a diagnostic study, licensees should still evaluate whether the dose threshold for reporting is met. For most incidents, licensees can use dosimetry information provided in the package inserts approved by the U.S. Food and Drug Administration to determine whether the dose threshold for reporting is met.

"Prescribed dose" is defined differently in 10 CFR 35.2 for different modalities. For all modalities, prescribed dose relies on the information contained in the written directive. In accordance with 10 CFR 35.40(a), a written directive must be dated and signed by an AU before administration of I-131 sodium iodide greater than 1.11 megabecquerels (MBq) (30 microcuries (μCi)), any therapeutic dosage of unsealed byproduct material, or any therapeutic dose of radiation from byproduct material. Licensees should not provide any of these administrations without a written directive unless a delay to provide a written directive would jeopardize the patient's health. In that case, an oral directive is acceptable in accordance with 10 CFR 35.40(a)(1). If an administration does occur without a written or oral directive, licensees should consider the AU's intended dosage or dose to determine if a medical event occurred.

For manual brachytherapy, the total dose is given by either the total source strength and exposure time or the total dose as documented in the written directive. For temporary implant manual brachytherapy, licensees must document the prescribed dose on the written directive before implantation in accordance with 10 CFR 35.41. This dose should be used to evaluate whether an incident needs to be reported as a medical event.

For high dose-rate remote afterloader brachytherapy, the written directive contains the prescribed dose per fraction, number of fractions, and prescribed total dose. When an incident with a fraction is discovered, it should be evaluated against the criteria in 10 CFR 35.3045(a)(1)(i)(A) and (a)(1)(i)(C) to determine whether a medical event occurred. If an incident with a fraction is discovered before the entire treatment protocol is complete, the AU can revise the written directive in accordance with 10 CFR 35.40(c)(1) to modify the prescribed fraction dose for future fractions and total dose before administration of the remaining fractions. In this case, the prescribed total dose used for the medical event evaluation should be the sum of the original prescribed dose(s) of the fraction(s) where the incident occurred and the revised prescribed dose for the later fractions.

For dosages of unsealed byproduct material requiring a written directive, the prescribed dosage is defined as the specified activity or range of activity as documented in the written directive. The written directive regulation in 10 CFR 35.40 does not require fractions be included for written directives involving administrations under 10 CFR 35.300, "Use of unsealed byproduct material for which a written directive is required." Unless the written directive contains prescribed dose per fraction, incidents involving unsealed byproduct material licensed under 10 CFR 35.300 should be evaluated using the total

dosage difference described in 10 CFR 35.3045(a)(1)(i)(B), even if the administration is part of a planned multiple administration regimen.

For other medical uses of byproduct material or radiation from byproduct material licensed under 10 CFR 35.1000, the NRC provides recommended definitions for prescribed dose and dosage in respective 10 CFR 35.1000 licensing guidance documents. For example, the licensing guidance for yttrium-90 microsphere brachytherapy sources and devices TheraSphere® and SIR-Spheres® defines prescribed dose as the total dose. This guidance goes on to state that prescribed activity may be used in lieu of prescribed dose if activity is used for all documentations and evaluations. Licensees should consult their license to determine how they define prescribed dose or dosage for uses licensed under 10 CFR 35.1000.

1.1.2 Wrong Treatment

An incident associated with an administration that was not performed as intended by the AU should be evaluated using the criteria of 10 CFR 35.3045(a)(1)(ii), as described in the subsections below.

1.1.2.1 Wrong Radioactive Drug or Radionuclide

An incident involving the administration of the wrong radioactive drug or wrong radionuclide for a brachytherapy procedure, excluding permanent implant brachytherapy, should be evaluated using the criterion of 10 CFR 35.3045(a)(1)(ii)(A). If the incident involved the administration of the wrong radioactive drug or radionuclide and resulted in a dose exceeding 0.05 Sv (5 rem) effective dose equivalent, 0.5 Sv (50 rem) to an organ or tissue, or 0.5 Sv (50 rem) shallow dose equivalent to the skin, it must be reported as a medical event.

When the dose criteria are met, a report is required if a radioactive drug or radionuclide was administered that was not directed or intended by the AU. This includes incidents where the intended radioactive drug or radionuclide administration would not require a written directive if the dose criteria are met. For example, under this criterion, a licensee would need to report an incident in which an AU intended to give a patient a diagnostic drug that did not require a written directive, but a different therapeutic drug was administered to the patient. In addition, if the dose criteria are met, an incident in which the written directive inadvertently specified the wrong drug or radionuclide must be reported if the administration was not given as intended. For example, an incident where a patient was intended to receive a diagnostic dosage of I-123 but instead received a therapeutic dosage of I-131 under written directive created in error would be a medical event if the dose criteria were met. An AU's intent is based on their medical judgment; deviation from the usage described in a package insert is not considered a medical event if the administration was in accordance with the AU's intent.

1.1.2.2 Wrong Route of Administration

In accordance with 10 CFR 35.40, the written directive must include the AU's intended route of administration.[3] Examples of routes of administration include oral, intravascular, intravascular bolus, intravascular drip, parenteral, intrapleural, and intraperitoneal. If a radioactive drug containing byproduct material is administered by the wrong route, the incident should be evaluated using the criterion of 10 CFR 35.3045(a)(1)(ii)(B). If the incident resulted in a dose exceeding 0.05 Sv (5 rem) effective dose

[3] Licensees should use medically appropriate terms for routes of administration. At the time of publication of this document, the FDA has defined various routes of administration at https://www.fda.gov/drugs/data-standards-manual-monographs/route-administration.

equivalent, 0.5 Sv (50 rem) to an organ or tissue, or 0.5 Sv (50 rem) shallow dose equivalent to the skin, it must be reported as a medical event.

Incidents should be reported as medical events under this criterion even if no written directive was required, or the written directive specified the wrong route of administration, if the dose criteria was met and the route of administration was not as intended by the AU. Deviation from the usage described in a package insert is not considered a medical event if the administration was in accordance with the AU's intended route of administration.

1.1.2.3 Wrong Individual

An incident involving the administration of a dose or dosage to the wrong individual or human research subject should be evaluated using the criterion of 10 CFR 35.3045(a)(1)(ii)(C). If the incident resulted in a dose exceeding 0.05 Sv (5 rem) effective dose equivalent, 0.5 Sv (50 rem) to an organ or tissue, or 0.5 Sv (50 rem) shallow dose equivalent to the skin, it must be reported as a medical event. Incidents should be reported as medical events under this criterion in cases where there is no written directive, or the written directive specified the wrong patient or human research subject, if the administration was not intended by the AU.

1.1.2.4 Wrong Mode of Treatment

An incident involving the administration of a dose or dosage delivered by the wrong mode of treatment should be evaluated using the criterion of 10 CFR 35.3045(a)(1)(ii)(D). If the incident resulted in a dose exceeding 0.05 Sv (5 rem) effective dose equivalent, 0.5 Sv (50 rem) to an organ or tissue, or 0.5 Sv (50 rem) shallow dose equivalent to the skin, it must be reported as a medical event. Examples of modes of treatment include gamma stereotactic radiosurgery therapy versus linear accelerator therapy, high-dose-rate versus pulsed-dose-rate brachytherapy, and rotational versus fixed teletherapy.

1.1.2.5 Leaking Sealed Source

An incident involving a leaking sealed source should be evaluated using the criterion of 10 CFR 35.3045(a)(1)(ii)(E). If the incident resulted in a dose exceeding 0.05 Sv (5 rem) effective dose equivalent, 0.5 Sv (50 rem) to an organ or tissue, or 0.5 Sv (50 rem) shallow dose equivalent to the skin, it must be reported as a medical event.

1.1.3 Wrong Treatment Site

An incident involving a dose to the wrong treatment site should be evaluated using the criterion of 10 CFR 35.3045(a)(1)(iii). The incident must be reported as a medical event if both of the following are met:

- The wrong treatment site receives 0.5 Sv (50 rem) or more than the expected dose to that site from the procedure if the administration had taken place in accordance with the written directive prepared or revised before administration.

- The dose is 50 percent or more than the expected dose to that site from the procedure if the administration had taken place in accordance with the written directive prepared or revised before administration.

"Treatment site" is defined in 10 CFR 35.2 as the anatomical description of the tissue intended to receive a radiation dose, as described in a written directive. As 10 CFR 35.40 does not require a treatment site to be defined for administrations of unsealed byproduct material, incidents involving

radiopharmaceuticals used under 10 CFR 35.300 cannot meet this criterion. For extravasation events, see section 1.4 below.

For uses where a treatment site is documented in the written directive, this criterion may be met if the treatment location shifts significantly, as well as if the dose is delivered to a completely different site. If the treated site is located a significant distance away from the intended treatment site—for example, on the wrong side of the body or of a larger organ—the expected dose to that wrong treatment site can likely be assumed to be minimal, and any incident leading to a dose of 50 rem or more must be reported.

To determine whether an incident is reportable when the treatment was administered close to the expected treatment site, or even with a small shift in treatment site, licensees should determine what the expected dose to the wrong treatment site would have been if the administration had taken place in accordance with the written directive. Licensees should report an event if any volume of tissue received sufficient dose to meet the criteria for a medical event.

1.2 Medical Events Associated with Permanent Implant Brachytherapy

The criteria for medical events associated with permanent implant brachytherapy, except for events that result from patient intervention, are listed in 10 CFR 35.3045(a)(2). Unlike medical events for other modalities described above, there is no dose threshold for permanent implant brachytherapy medical events except in the case of a leaking source. The medical event criteria for permanent implant brachytherapy are broken down into three parts, described below.

1.2.1 Incorrect Source Strength to Treatment Site

An incident associated with incorrect total source strength should be evaluated using the criterion of 10 CFR 35.3045(a)(2)(i). This criterion requires reporting of events involving an administration where the total source strength administered differs by 20 percent or more from the total source strength documented in the post-implantation portion of the written directive. In accordance with 10 CFR 35.40, the post-implantation portion of the written directive must be completed after implantation, but before the patient leaves the post-treatment area. It must include the treatment site, the number of sources implanted, the total source strength implanted, and the date.

1.2.2 Incorrect Source Strength outside Treatment Site

In accordance with 10 CFR 35.41, licensees must develop, implement, and maintain written procedures for determining the total source strength administered outside the treatment site, compared to the total source strength documented in the post-implantation portion of the written directive, within 60 calendar days from the date of implantation, unless a written justification of patient unavailability is documented. If the licensee determines that the total source strength administered outside the treatment site exceeds 20 percent of the total source strength documented in the post-implantation portion of the written directive, the licensee must report the incident as a medical event in accordance with 10 CFR 35.3045(a)(2)(ii). However, under 10 CFR 35.3045(a)(2), the reporting criteria exclude permanent implant brachytherapy events associated with sources that were implanted into the correct site but migrated outside the treatment site.

1.2.3 Wrong Treatment

An incident associated with an administration of permanent implant brachytherapy that was not performed as intended by the AU should be evaluated using the criteria in 10 CFR 35.3045(a)(2)(iii). All administrations of a wrong radionuclide and all administrations to the wrong individual or human research subject must be reported in accordance with 10 CFR 35.3045(a)(2)(iii)(A)–(B). In accordance

with 10 CFR 35.3045(a)(2)(iii)(D), licensees must also report incidents of a leaking sealed source that results in a dose exceeding 0.5 Sv (50 rem) to an organ or tissue. These incidents should be evaluated against both the pre- and post-implantation portions of the written directive.

In addition, in accordance with 10 CFR 35.3045(a)(2)(iii)(C), licensees must report incidents where a sealed source is implanted directly into a location discontiguous from the treatment site, as documented in the post-implantation portion of the written directive. Licensees should report such incidents even if only one seed is implanted into a location discontiguous from the treatment site, as this criterion does not have a minimum dose or percent difference threshold. In general, the term discontiguous describes things that are not adjacent or touching, or that are disconnected or have a gap between them. In the context of the medical event criteria for permanent implant brachytherapy, a discontiguous location is one that is not physically adjacent to or touching the treatment site.

1.3 Medical Events Associated with Patient Intervention

In accordance with 10 CFR 35.3045, events due to patient intervention must be reported if the administration results or will result in unintended permanent functional damage to an organ or a physiological system, as determined by a physician. "Patient intervention" is defined in 10 CFR 35.2 as an action by the patient or human research subject, whether intentional or unintentional.

Emergent patient conditions that do not result from an action by the patient are not considered patient intervention. For example, if a patient experiences a medical emergency and the AU decides to stop treatment, this would not be considered patient intervention. Instead, the licensee should evaluate this event against other medical event criteria and report it accordingly. The NRC is aware that in many cases of emergent patient conditions, necessary medical actions could result in a dose being less than intended, leading to a medical event. However, as stated earlier, the occurrence of a medical event does not necessarily mean a patient was harmed or there was an error in standard of care. The purpose of medical event reporting is to minimize recurrence of events. Therefore, in its report of a medical event, the licensee should include any actions the licensee identified that could prevent recurrence, so the NRC can share this information with the medical community as necessary.

Examples of patient intervention are when a patient dislodges or removes a treatment device or prematurely terminates the administration. Patient intervention does not include cases in which a device is not appropriately fixed into place and therefore becomes dislodged by patient movement, or in which administration continues after noticeable patient movement. Information Notice 2006--11, "Applicability of Patient Intervention in Determining Medical Events for Gamma Stereotactic Radiosurgery and Other Therapy Procedures," dated June 12, 2006 (ML061360026) (Ref. 11), provides more information on determining whether an event is due to patient intervention.

1.4 Medical Events Associated with Extravasations

An administration that results in, or has the potential to result in, a radiation injury from an extravasation should be evaluated using the criterion in 10 CFR 35.3045(a)(3). "Extravasation" is defined in 10 CFR 35.2 as the unintentional presence of a radiopharmaceutical in the tissue surrounding the blood vessel following an injection. While some amount of a radiopharmaceutical is expected to remain in the tissue around an administration site following all injections because of the nature of vascular injections, extravasations occur when there is an unintended amount of radiopharmaceutical surrounding the blood vessel. For example, an extravasation could occur if a blood vessel is missed during injection or is blown or ruptured after needle insertion.

"Radiation injury" is defined in 10 CFR 35.2 as a deterministic health effect to the area around an administration site that can be attributed to radiation. The deterministic effects of radiation to the tissue

around an administration site are well known; they range from severe ulceration and necrosis from high exposures to erythema from low exposures. For the purposes of this proposed rule, all deterministic effects reasonably attributable to radiation as determined by a physician must be reported, including radiation -induced erythema. Although deterministic effects near the site of the administration could be caused by many different factors, to determine whether the reporting criterion is met, licensees should evaluate such effects to determine whether they can be attributed to an extravasation. The regulations require reporting of extravasation events with potential deterministic effects, as well as effects that have already appeared. This enables licensees to report extravasation events promptly, without having to wait for symptoms to appear; to provide appropriate medical care to patients as quickly as possible; and to take corrective actions, as necessary, to prevent recurrence. It also minimizes the burden on the affected patient, relieving them of the need to return to a healthcare provider solely for reporting purposes. While not all extravasations are severe enough for a physician to make a determination of the potential for radiation injury before an injury actually develops, this provision allows for expediting of the reporting process.

The determination of whether an extravasation has the potential to result in a radiation injury is a medical determination. Any physician, as defined in 10 CFR 35.2, who has the proper medical knowledge and has experience with radiation injuries should be able to make this determination, regardless of AU status or licensee affiliation. If a physician not affiliated with a licensee notifies the licensee of an extravasation meeting the reporting criterion, then the licensee must report the event. If a physician notifies the licensee of an extravasation that may meet the reporting criteria, but for which the physician has not made a determination, the licensee should evaluate the incident further to determine if it is reportable.

Notably, an extravasation is not necessarily reportable under 10 CFR 35.3045 if it does not have the potential to result in a radiation injury. There are several case-specific factors that affect the potential for radiation injury from an extravasation, including the type (i.e., alpha, beta, or gamma) and amount of radiation, actions taken to reduce the dose to the affected area, and patient-specific conditions that affect radiosensitivity. Licensees should take these factors into account when determining whether an extravasation is reportable.

2. Embryo and Fetus Events (10 CFR 35.3047)

In accordance with 10 CFR 35.3047(a), licensees must report any dose to an embryo/fetus exceeding 50 mSv (5 rem) dose equivalent that results from an administration of byproduct material or radiation from byproduct material to a pregnant individual, unless the AU specifically approved the dose to the embryo/fetus prior to the administration. Moreover, a licensee must report a discovered event that meets these criteria even if the licensee could not have known at the time of administration that the individual was pregnant. Licensees can use RG 8.36, “Radiation Dose to the Embryo/Fetus (Ref. 12),” or manufacturer dosimetry information to determine the dose to the embryo/fetus.

In accordance with 10 CFR 35.3047(b), licensees must report any dose to a nursing child that results from an administration of byproduct material to a breastfeeding individual, if it exceeds 50 mSv (5 rem) total effective dose equivalent or has resulted in unintended permanent functional damage to an organ or a physiological system of the child, as determined by a physician. A licensee must report any event that meets these criteria, even if the licensee provided guidance on to interrupt or discontinue breastfeeding at the time of the patient’s release, as required by 10 CFR 35.75, “Release of individuals containing unsealed byproduct material or implants containing byproduct material.” In accordance with 10 CFR 35.75(b), upon releasing a patient from its control, a licensee must provide certain instructions to the patient if the total effective dose equivalent to a nursing child could exceed 1 mSv (0.1 rem). These

instructions must include guidance on the interruption or discontinuation of breastfeeding and information on the potential consequences, if any, of failure to follow the guidance.

In accordance with 10 CFR 35.3047(c), the licensee must notify the NRC Operations Center by telephone no later than the next calendar day after discovery of a dose to an embryo/fetus or nursing child that meets the criteria in 10 CFR 35.3045(a) or (b). In accordance with 10 CFR 35.3047(d), licensees must submit a written report to the appropriate NRC regional office within 15 days after discovery of the event by the appropriate method listed in 10 CFR 30.6(a). The written report must include the licensee's name; the name of the prescribing physician; a brief description of the event; why the event occurred; the effect, if any, on the embryo/fetus or nursing child; what actions, if any, have been taken or are planned to prevent recurrence; and either certification that the licensee notified the pregnant individual or mother (or the mother's or child's responsible relative or guardian), or an explanation of the reason if the licensee did not do so.

While some events of this type are unavoidable, licensees should still perform evaluations after such events to determine actions to be taken to prevent recurrence. For example, licensees could consider instructing patients to avoid sexual activity for a specified period of time before treatment, to prevent the possibility that an embryo too young to be detected will receive a dose from a patient's administration.

3. Procedures for Administrations

3.1 Procedures for Administrations That Require a Written Directive

In accordance with 10 CFR 35.41, for any administration requiring a written directive, licensees must develop, implement, and maintain written procedures to provide high confidence of the following:

- The identity of the patient or human research subject is verified before each administration.
- Each administration is in accordance with the written directive.

The regulation at 10 CFR 35.41(b) lists items that these procedures must address at a minimum. In addition to steps to prevent medical events, the procedures must address how the licensee will determine whether a medical event has occurred. Licensees' procedures should be specific to the treatment they are performing, their staffing, and facilities, to ensure that the licensee can implement them. Appendix S of NUREG-1556, Volume 9, Revision 3, provides guidance and model procedures for administrations that require written directives.

3.2 Procedures for Evaluating and Reporting Extravasations

In accordance with 10 CFR 35.42, for any administration in which an extravasation could occur, licensees must develop, implement, and maintain written procedures to provide high confidence that an extravasation that results in, or has the potential to result in, a radiation injury will be detected in a timely manner and reported in accordance with 10 CFR 35.3045. These written procedures must address how the licensee will determine whether an extravasation results in, or has the potential to result in, a radiation injury. Serial imaging of the area surrounding the administration site, physical examination, and dosimetric assessment can aid in characterizing an extravasation. Model procedures for evaluating and reporting extravasations are part of the implementation guidance for the extravasations rule. The model procedures are currently available at ML24047A272 and will be added as a new appendix to NUREG-1556, Volume 9, when NUREG-1556 is next revised.

4. Reporting

In accordance with 10 CFR 35.3045(c), licensees must notify the NRC Operations Center by telephone, at 301-816-5100, no later than the next calendar day after discovery of a medical event. Discovery occurs when a licensee identifies an administration that appears not to have gone in accordance with the written procedure or the AU's intent. As many medical events are complex, the NRC recognizes that the licensee may not have all of the necessary information the day an event is discovered. However, if the licensee suspects that a medical event has occurred, to ensure compliance and to allow the NRC and the licensee to respond appropriately, the licensee should report the event no later than the next calendar day. To allow the NRC to respond quickly to any generic issues, the report should contain as much information as the licensee knows at the time of reporting.

An extravasation that results or has the potential to result in, a radiation injury, as determined by a physician, must be reported as a medical event under 10 CFR 35.3045(a)(3), and therefore the licensee must meet all reporting requirements outlined in 10 CFR 35.3045. In accordance with 10 CFR 35.3045(c), the licensee must report medical events resulting from an extravasation no later than the calendar day following discovery of the event. In the context of medical events arising from an extravasation, an event is discovered when the licensee makes or is notified of a final determination made by a physician that the event satisfies the criteria in 10 CFR 35.3045(a)(3). This may be the day the administration occurred or sometime afterwards. Examples include the following:

- Immediately after the administration, a licensee physician determines that the extravasation is severe enough to have already resulted in deterministic effects, or that it has the potential to result in a radiation injury.

- A patient's physician notifies the licensee, or a licensee physician determines, that the criteria for a medical event have been met.

- A patient's physician notifies the licensee that the criteria for a medical event may have been met, and further evaluation by the licensee has confirmed that the criteria have been met.

In all of the above cases, the licensee must notify the NRC Operations Center no later than the next calendar day after discovery. The report should contain as much information as the licensee knows at the time of reporting; however, the NRC recognizes that not all information may be available to the licensee at this point.

In accordance with 10 CFR 35.3045(d), the licensee must submit a written report to the appropriate NRC regional office within 15 days after discovery of the medical event by a method listed in 10 CFR 30.6(a). The licensee's report must include the information listed in 10 CFR 35.3045(d)(1). The regulation at 10 CFR 35.3045(d)(1)(v) requires the report to include the effect, if any, on the individual(s) who received the administration. In the case of a medical event resulting from an extravasation, the effect on the individual who received the administration may not present until weeks or months after the event. If the report is based on a determination that the extravasation has the potential to result in a radiation injury, the report should describe the potential deterministic effects anticipated (e.g., erythema, necrosis).

The NRC uses the reported information to assess trends or patterns, identify generic issues or generic concerns, and recognize any inadequacies or unreliability in specific equipment or procedures. The reported information is critical, because it helps the NRC gain a timely and effective understanding of why the event occurred and identify any actions necessary to minimize the risk that similar events will occur. While the regulations identify specific information that must be included, medical event reports submitted by licensees range from minimally to highly detailed. Reports that provide only the minimum required information often lack useful narratives that would allow the NRC staff to fully assess medical

events and identify trends or patterns. Therefore, to help prevent future medical events, the NRC recommends that licensees consider the following best practices elements for reporting:

- Include relevant information provided by the manufacturer (when applicable).
- Include effective dose, or isotope and activity, and tissue volume information.
- Include medical and technical information about the event, including any adverse effects that are expected as a result of the event or a statement that no adverse effects are expected.
- Include as much relevant details as possible for the written report. The licensee should also complete the final reporting as soon as possible.

For examples of helpful reports and more information, see appendix E to the Nuclear Material Events Database Annual Report for 2021, issued January 2022 (ML22049B538) (Ref. 13).

5. Recordkeeping

In accordance with 10 CFR 35.2041, "Records for procedures for administrations requiring a written directive," and 10 CFR 35.2042, "Records for procedures for evaluating and reporting extravasations,", a licensee must retain a copy of the procedures required by 10 CFR 35.41(a) and 10 CFR 35.42(a) for the duration of its license. If the licensee changes the procedures for any reason, it must also keep all previous versions of the procedures for the duration of the license. The licensee should annotate each version of each procedure with the dates during which that version was used.

D. IMPLEMENTATION

The NRC staff may use this regulatory guide as a reference in its regulatory processes, such as licensing, inspection, or enforcement. Backfitting and issue finality considerations do not apply to 10 CFR Part 35 licensees and applicants, because 10 CFR Part 35 does not include backfitting or issue finality provisions. The forward fitting policy in Management Directive 8.4, "Management of Backfitting, Forward Fitting, Issue Finality, and Information Requests" (Ref. 14), also does not apply to these licensees and applicants.

REFERENCES[4]

1. U.S. *Code of Federal Regulations*, "Medical Use of Byproduct Material," Part 35, Chapter I, Title 10, "Energy."

2. U.S. Nuclear Regulatory Commission (NRC), NUREG-1556, "Consolidated Guidance about Materials Licenses," Volume 9, "Program Specific Guidance about Medical Use Licenses," Washington, DC.

3. NRC, "Staff Requirements—SECY-22-0043—Petition for Rulemaking and Rulemaking Plan on Reporting Nuclear Medicine Injection Extravasations as Medical Events, Washington, DC, December 12, 20222.

4. NRC, "Medical Use of Byproduct Material; Policy Statement, Revision," *Federal Register*, Vol. 65, No. 150, pp. 47654–47660 (65 FR 47654), Washington, DC, August 3, 2000.

5. NRC, "Nuclear Regulatory Commission International Policy Statement," *Federal Register*, Vol. 79, No. 132, pp. 39415–39418 (79 FR 39415), Washington, DC, July 10, 2014.

6. NRC, Management Directive 6.6, "Regulatory Guides," Washington, DC.

7. International Atomic Energy Agency (IAEA), Specific Safety Guide No. 46, "Radiation Protection and Safety in Medical Uses of Ionizing Radiation," Vienna, Austria, 2018.

8. IAEA, Human Health Series No. 46, "QUANUM 3.0: An Updated Tool for Nuclear Medicine," 3rd Edition, Vienna, Austria, August 2021.

9. International Council of Radiation Protection, Publication 140, "Radiological Protection in Therapy with Radiopharmaceuticals," September 2019.

10. Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), Radiation Protection Series No. 14.2, "Safety Guide for Radiation Protection in Nuclear Medicine," Chief Executive Officer of ARPANSA, Yallambie, Victoria, August 2008.

11. NRC, Information Notice 2006-11, "Applicability of Patient Intervention in Determining Medical Events for Gamma Stereotactic Radiosurgery and Other Therapy Procedures", Washington, DC, June 12, 2006.

12. NRC, Regulatory Guide 8.36, "Radiation Dose to the Embryo/Fetus," Washington, DC, July 1992.

13. NRC, "Nuclear Material Events Database, Annual Report, Fiscal Year 2021," Washington, DC, January 2022.

[4] Publicly available NRC published documents are available electronically through the NRC Library on the NRC's public website at http://www.nrc.gov/reading-rm/doc-collections/ and through the NRC's Agencywide Documents Access and Management System (ADAMS) at http://www.nrc.gov/reading-rm/adams.html. For problems with ADAMS, contact the Public Document Room staff at 301-415-4737 or (800) 397-4209, or email pdr.resource@nrc.gov. The NRC Public Document Room (PDR), where you may also examine and order copies of publicly available documents, is open by appointment. To make an appointment to visit the PDR, please send an email to PDR.Resource@nrc.gov or call 1-800-397-4209 or 301-415-4737, between 8 a.m. and 4 p.m. eastern time (ET), Monday through Friday, except Federal holidays.

14. NRC, Management Directive 8.4, "Management of Backfitting, Forward Fitting, Issue Finality, and Information Requests," Washington, DC.

APPENDIX A

LIST OF GENERIC COMMUNICATIONS ON MEDICAL EVENTS

Below is a list of generic communications on medical events issued between 2002 and the time of publication of this document. More recent generic communications are available at the U.S. Nuclear Regulatory Commission medical use licensee toolkit webpage at https://www.nrc.gov/materials/miau/med-use-toolkit.html.

- Information Notice (IN) 2019-12, "Recent Reported Medical Events Involving the Administration of Yttrium-90 Microspheres for Therapeutic Medical Procedures," dated December 31, 2019, includes information on yttrium-90 microsphere medical events so that licensees can evaluate the possibility of such events at their facilities and consider actions, as appropriate, to avoid similar events.

- IN 2019-07, "Methods to Prevent Medical Events," dated August 26, 2019, provides the results of an evaluation of medical events, as well as strategies to reduce or prevent medical events.

- IN 2019-06, "Patient Skin Contamination Events Associated with I-131 Metaiodobenzylguanidine [MIBG] during Neuroblastoma Treatments," dated August 26, 2019, gives an overview of patient contamination risks associated with therapeutic treatments using iodine (I)-131 MIBG.

- IN 2012-08, "High Dose-Rate Remote Afterloader (HDR) Physical Presence Requirements," dated April 10, 2012, informs licensees about several high-dose-rate remote afterloader administration medical events, to demonstrate the importance of verifying treatment parameters before treatment.

- IN 2009-17, "Reportable Medical Events Involving Treatment Delivery Errors Caused by Confusion of Units for the Specification of Brachytherapy Sources," dated August 28, 2009, informs licensees of treatment delivery errors and associated medical events caused by confusion of units for the specification of low-energy photon-emitting brachytherapy sources implanted into patients.

- IN 2009-15, "Varian Medical Systems Varisource High Dose-Rate Remote Afterloader Events: Source Retraction Problems," dated August 28, 2009, alerts licensees about events reported at three locations where service engineers experienced problems with the VariSource HDR during source retractions.

- IN 2007-35, "Varian Medical Systems Varisource HDR Events: Iridium-192 Source Pulled from Shielded Position," dated October 17, 2007, alerts licensees about events when the use of the emergency manual retract hand wheel on the VariSource HDR had caused the active iridium-192 source to be pulled out of the shielded position.

- IN 2007-03, "Reportable Medical Events Involving Patients Receiving Dosages of Sodium Iodide Iodine-131 Less than the Prescribed Dosage Because of Capsules Remaining in Vials after Administration," dated February 2, 2007, describes events in which I-131 capsules remained in vials after administration. Similar events have continued to occur in more recent years.

- IN 2006-11, "Applicability of Patient Intervention in Determining Medical Events for Gamma Stereotactic Radiosurgery and Other Therapy Procedures," dated June 6, 2006, describes the applicability of patient intervention in two events related to gamma stereotactic radiosurgery use.

- IN 2005-27, "Low-Dose-Rate Manual Brachytherapy—Equipment-Related Medical Events," dated October 7, 2005, informs licensees of recently reported medical events that occurred during a licensee's implementation of low-dose-rate manual brachytherapy procedures.

- IN 2005-17, "Manual Brachytherapy Source Jamming," dated June 23, 2005, informs licensees of medical events involving ruptured seeds that had occurred at different facilities during manual brachytherapy as a result of seed jamming.

APPENDIX B

EXAMPLES OF MEDICAL EVENTS

This appendix provides examples that do and do not meet the medical event criteria. An overview of recent medical events appears on the U.S. Nuclear Regulatory Commission (NRC) medical use licensee toolkit webpage at https://www.nrc.gov/materials/miau/med-use-toolkit.html.

Wrong Dosage Event

A patient was prescribed 3.7 gigabecquerels (GBq) (100 millicuries (mCi)) of lutetium (Lu)-177 radiopharmaceutical on a written directive but received 7.62 GBq (206 mCi). Although this occurred at the patient's third treatment of a four-treatment protocol, the licensee used separate written directives for each administration; therefore, only this administration needs to be considered for the medical event evaluation. The percent difference between the total dosage delivered and the total prescribed dosage was

$$\%\ difference = \frac{7.62 - 3.7}{3.7} \times 100\% = 107\%.$$

The licensee calculated that the difference between the administered dosage and the prescribed dosage resulted in an additional organ dose of 256 centigrays (cGy) (rad) to the kidney. As the percent difference in dosage and the dose threshold are greater than the limits listed in Title 10 of the *Code of Federal Regulations* (10 CFR) 35.3045(a)(1)(i), this event is reportable as a medical event.

Wrong Treatment Site

A licensee discovered that a tandem and ovoid applicator had shifted inside a patient's pelvis during administration, causing several dwell positions to shift slightly from the treatment plan. As a result, the licensee evaluated the administered dose to nontreatment sites to determine whether it met the criteria in 10 CFR 35.3045(a)(1)(iii). As the criteria in 10 CFR 35.3045(a)(1)(iii) are based on the difference between the expected and the administered dose to the wrong treatment site, the licensee compared the original treatment plan to a treatment plan created to model the administered dose. In this example, the licensee model found that the administered dose to 5 cubic centimeters of nontarget bowel tissue was 550 cGy (rad), instead of the 220 cGy (rad) planned. Thus, this tissue received 330 cGy (rad) more than expected - a difference of 150 percent. As these doses are greater than the thresholds in the criteria in 10 CFR 35.3045(a)(1)(iii), this event is reportable as a medical event.

Wrong Treatment Site for Microspheres

A patient was prescribed 3 GBq (81.08 mCi) of Y-90 microspheres to the right hepatic lobe. Upon post-treatment imaging, the AU determined that the activity had instead been delivered to the left hepatic lobe, with no indication of microspheres administered to the intended treatment site. The licensee determined that the left hepatic lobe received 73 Gy (7300 rad). Because the dose to the unintended tissue exceeds 0.5 Sv (50 rem) and more than 50% of the expected dose in accordance with the written directive, the incident is likely a reportable medical event as per recommended medical event criteria described in the Y-90 microsphere licensing guidance, "Yttrium-90 Microsphere Brachytherapy Sources and Devices TheraSphere® and SIR-Spheres® Licensing Guidance."

Wrong Treatment Site for Permanent Implant Brachytherapy

A patient's prescribed treatment plan was to have 54 iodine (I)-125 seeds with a total activity of 1.01 GBq (27.4 mCi) implanted into the prostate. As the licensee believed that the administration had gone as planned, the post-implantation portion of the written directive matched the pretreatment written directive containing the prescribed treatment plan. However, the patient's follow-up CT scan revealed that 28 seeds with a total activity of 0.52 GBq (14.2 mCi) had been implanted into the patient's penile bulb. This meant that more than 20 percent of the total source strength documented in the post-implantation portion of the written directive had been administered outside the treatment site. Therefore, this event is reportable as a medical event under the criteria in 10 CFR 35.3045(a)(2)(ii).

Wrong Treatment Configuration within the Treatment Site for Permanent Implant Brachytherapy

A patient's prescribed treatment plan was to have 61 I-125 seeds permanently implanted into the prostate. The Authorized User (AU) intended to place the seeds in a uniform distribution to achieve the intended dose distribution within the treatment site. However, during administration, the seeds were inadvertently placed with higher distribution in the center of the treatment site, so that the absorbed dose in the center was higher than intended. In accordance with 10 CFR 35.3045, the NRC does not consider this a medical event, because the NRC's regulations on medical event reporting do not consider the details of source placement within the treatment site or dose for permanent implant brachytherapy. Therefore, the licensee is not required to report this event to the NRC. However, since the treatment did not conform to the AU's intentions, the NRC would recommend that the licensee evaluate the cause of the error and take corrective actions as necessary.

Radiopharmaceutical Extravasation Determined to Have the Potential for Radiation Injury

A patient was prescribed 3.7 GBq (100 mCi) of a Lu-177 radiopharmaceutical, administered by infusion. During the administration, the patient complained of pain in the arm, and examination of the injection site showed clear swelling. The administration was halted, and the patient was given a warm compress to hold to the site and told to elevate the arm above their head. Post-treatment imaging of the site showed a significant amount of activity remaining in the arm, and the physician determined that this extravasation had the potential to result in a radiation injury. Based on the physician's determination, this event is reportable as a medical event under the criteria in 10 CFR 35.3045(a)(3) and must be reported no later than the next calendar day after the physician made the determination.

Radiopharmaceutical Extravasation Discovered after the Fact

A patient was prescribed a therapeutic administration of a radiopharmaceutical at licensee X. The treatment was initially thought to have been completed without incident, and the patient was given leave to return home. Two days after the administration, the patient returned to their primary care physician and reported a rash and blistering at the injection site. Using the information card given to the patient by licensee X, the patient's primary care physician contacted the licensee and shared their suspicions of radiation induced injury. In collaboration, the two physicians ultimately concluded that the injury was not likely due to radiation from a suspected extravasation of the original radiopharmaceutical. Their medical opinion was that the symptoms were from an allergic reaction. This is not a reportable event, since the physicians determined that the injury was not due to radiation from the radiopharmaceutical administration.