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May 12, 2023

Information Quality Coordinator
U.S. Nuclear Regulatory Commission
TWFN-6B29
Washington, DC 20555

*Delivered via email to infoquality@nrc.gov*

To Whom it May Concern:

**Information Correction Request Appeal regarding Information Correction Request dated February 15, 2023**

I am appealing the U.S. Nuclear Regulatory Commission (NRC) decision on April 11, 2023[1] to "not accept the [February 15, 2023 information correction] request to correct SECY-22-0043 into the NRC's administrative information correction process." The NRC provided this decision to me on April 13, 2023 and I am appealing within 30 days of receipt.

The February 15, 2023 Information Correction Request (ICR, see Appendix A) was based on my role as an affected person and petitioner, asking the NRC to correct influential information and other information that formed the basis for its resolution of Petition for Rulemaking PRM-35-22[2], published on December 30, 2022[3]. This appeal, like the initial request, is submitted in accordance with NRC's Information Quality Guidelines[4]. In addition, this appeal is based on NRC Management Directive 3.17[5] and NRC Internal Commission Procedures[6].

**Reasons for Appeal**

I am submitting this appeal for several reasons.

Per the NRC Information Quality Guidelines, the NRC "is committed to ensuring the quality of all information that it relies on or disseminates." SECY-22-0043 fails to meet the NRC Information Quality Guidelines.

[1] NRC Response to Ronald Lattanze, Chief Executive Officer, Lucerno Dynamics, LLC, Letter regarding Extravasation, Abnormal Occurrence reporting, and Information Correction Requests, 4/11/2023. https://www.nrc.gov/docs/ML2309/ML23094A229.pdf
[2] Petition for Rulemaking PRM-35-22, posted 6/8/2020. https://www.regulations.gov/document/NRC-2020-0141-0001
[3] Reporting Nuclear Medicine Injection Extravasations as Medical Events, A Proposed Rule by the Nuclear Regulatory Commission on 12/30/2022. https://www.federalregister.gov/documents/2022/12/30/2022-28356/reporting-nuclear-medicine-injection-extravasations-as-medical-events
[4] NRC Information Quality Guidelines, OMB Federal Register Notice – Vol. 67, Num. 190, 10/1/2002. https://www.nrc.gov/public-involve/info-quality/fr67p61695.html
[5] NRC Management Directive 3.17, 6/28/2016. https://www.nrc.gov/docs/ML1610/ML16105A321.pdf
[6] NRC Internal Commission Procedures, 3/24/2016. See Chapter II – Decision Documents. https://www.nrc.gov/docs/ML1611/ML16111B158.pdf

SECY documents are included in NRC Management Directive 3.17 Table 2, and therefore usually exempt from the NRC Information Quality Guidelines. However, according to NRC Internal Commission Procedures, SECY documents are typically made available to the public. This ensures that SECY documents can be vetted before the Commissioners see the information or reach a decision. NRC Management Directive 3.17 does provide limited circumstances where the exemption no longer applies. Since SECY-22-0043 was not made public until AFTER the Commissioners reached a decision on PRM-35-22, this is an appropriate situation to allow an ICR to ensure the Commission makes a decision based on correct information.

Finally, withholding the errant SECY-22-0043 document from the public until well after the Commission decision was announced failed to meet the NRC policy for transparency.

## Supporting Detail for the Appeal

### 1. SECY-22-0043 fails to meet NRC Information Quality Guidelines.

PRM-35-22 asked the NRC to address an important radiation protection issue that affects thousands of patients every year. In response to PRM-35-22, NRC's medical staff drafted Commission Paper SECY-22-0043[7] to inform Commissioners of PRM-35-22, request approval for rulemaking, and to provide a rulemaking plan. The original ICR dated February 15, 2023 identifies numerous information quality defects with SECY-22-0043 that remain valid and problematic. The content of SECY-22-0043 does not meet the NRC's Information Quality Guidelines for influential information and other information that impacts a regulatory decision. NRC Management Directive 3.17 states "It is the policy of the U.S. Nuclear Regulatory Commission to ensure the quality of all information it relies on for making decisions or disseminates to the public." SECY-22-0043 fails to meet NRC Information Quality Guidelines, yet the Commissioners' decisions relied upon it. The Commissioners cited SECY-22-0043 in their Notation Vote Comments as having influenced their guidance to NRC Medical Staff to draft a unique reporting criterion solely for extravasations. This unique criterion is flawed, will not improve radiation protection, and is inconsistent with NRC policies.

### 2. SECY exemption from ICR can be overruled.

In the NRC response letter dated April 11, 2023, Mr. Kevin Williams states that the NRC Information Quality Guidelines, per NRC Management Directive 3.17 Table 2, "does not provide an opportunity for a member of the public to submit an information correction request" on SECY papers. He states that because these papers are produced for internal agency use, they are listed in Table 2 as exempt information. **This reason for denying acceptance of the ICR is not appropriate.** Management Directive 3.17 states, when referring to documents listed in Table 2 that are exempt from the public filing of an ICR, "It should be understood that while the table indicates a class of information that is not covered by the guidelines, there may be limited circumstances where information within that class would be subject to these guidelines."

Such limited circumstances should apply to SECY-22-0043. As described above, SECY-22-0043 has numerous information quality defects which led to the Commissioners making a flawed

[7] Commission Paper SECY-22-0043. 5/9/2022. https://www.nrc.gov/docs/ML2126/ML21268A006.pdf

decision. Without a way for the public to assess the quality of the information in SECY-22-0043 before the Commissioners used it to reach a decision, the ICR process is the only timely option left to an affected party.

**3. NRC lack of transparency regarding a radiation protection issue affecting thousands of patients every year.**

NRC Management Directive 3.17, page 4, states "Because of the importance of openness and transparency, NRC routinely makes available to the public the majority of its regulatory documents, information about its decisionmaking processes, and the standards used to analyze information submitted by the regulated community. The OMB Information Quality Guidelines require NRC to apply information quality standards only to a subset of this information; however, NRC is committed to ensuring the quality of all of the information it disseminates, whether or not it is specifically covered by these guidelines." NRC's commitment to quality should apply to SECY-22-0043.

NRC Management Directive 3.17, page 5, also refers to the Applicability to Proposed Rulemaking and Other Public Comment Processes: "The correction and appeal process that will address data quality challenges does not apply to information disseminated by NRC through a comprehensive public comment process; for example, proposed rules, regulatory analyses, requests for comments on information collections subject to the Paperwork Reduction Act, environmental impact statements, and other documents for which NRC solicits public comment by publishing a notice in the Federal Register. Persons questioning the quality of information disseminated in those documents, or documents referenced or relied upon in those documents, must submit comments as directed in the notice requesting public comment on the given document. NRC will use its existing processes for responding to public comments to address a request for correction and will describe the actions it has taken with regard to the request in the final agency rule, regulatory analysis, or other final action. An additional complaint and appeal process for information that is already subject to a public comment process would be inappropriate and unfair to other public commenters who submit timely comments." SECY-22-0043 was never made available for public comment, so a complaint and appeal process for information is appropriate. Furthermore, delaying the correction of this information by using the rulemaking process initiated as a result of the flawed Commission decision is also unacceptable to the thousands of patients who are receiving large extravasations every year.

NRC Internal Commission Procedures, Chapter II page 3, states, "the Commission's general policy is to release papers whenever possible".

Again, there was no public comment process for SECY-22-0043. Drafts of SECY-22-0043 were never made available to the public. Per NRC Internal Commission Procedures (Chapter II Page 4), "Information papers will be made publicly available 10 business days after issuance of the paper by SECY." SECY-22-0043 was delivered to the Commissioners on May 9, 2022. Nonetheless, SECY-22-0043 was withheld from the public until approximately two months after the Commissioners had signed their Notation Votes Comments.

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Even though SECY-22-0043 did not contain classified, safeguards information, allegations, investigation, security-related, proprietary, Privacy Act information, Federal/State/Foreign Government and International Agency-controlled Information, it appears that the NRC medical staff believed that the document included sensitive internal information. The document that was finally made public two months after the Commissioners' decision was stamped with "OFFICIAL USE ONLY – SENSITIVE INTERNAL INFORMATION – LIMITED TO NRC UNLESS THE COMMISSION DETERMINES OTHERWISE". The released document did not include the required justification for withholding it from the public; this justification is assumed to be in the unreleased Enclosure 5.

This is an important decision that matters to thousands of patients every year. Large radiopharmaceutical extravasations are resulting in absorbed tissue doses far greater than current NRC medical event dose thresholds. Nearly every one of these extravasations could have been prevented if licensees took the appropriate actions to provide their technologists with the best venous access tools and training. The decision to withhold SECY-22-0043 from the public without an explanation clearly does not support an NRC policy of transparency, prevented a chance to correct obviously flawed information that incorrectly influenced the Commissioners' decisions, and therefore warrants the use of the ICR process.

**Issues with ICR Process**

Based on Management Directive 3.17, the Information Quality Coordinator was required to perform an acceptance review of the February 15, 2023 ICR within five days and that the acceptance review process should include:

- a determination if I am an affected party;
- a determination if I had included all the necessary information in the ICR;
- and a determination if the ICR would be more appropriately addressed through some other NRC administration process.

If the Information Quality Coordinator determined the ICR met acceptance criteria, then the ICR would be forwarded to the office knowledgeable about the information in question. As the affected party, I am interested in why I was not informed by the five-day deadline that my ICR had been accepted by the Information Quality Coordinator.

Since Mr. Williams leads the office knowledgeable about the information in question by the ICR, and he received the ICR, it is reasonable to conclude that the ICR met acceptance criteria. However, Mr. Williams informed me in the letter I received on April 13, 58 days after submitting my ICR, that the ICR was not accepted. As the affected party, I am interested in why the NRC did not provide the required response within 45 days of receiving the ICR.

In his letter, Mr. Williams also suggested that I had a transparency concern regarding the Commission's process for voting on SECY-22-0043. Let me be clear: I did not have concerns regarding the process for voting. My concern was, and remains, the lack of transparency—SECY-22-0043 was not made publicly available as a draft, nor after 10 days of filing with the Commission.

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**Conclusion**

SECY-22-0043 provided information that did not meet the standards defined by the NRC Information Quality Guidelines. As a result, SECY-22-0043 did not provide information that enhances sound decision-making by the Commission. Rather, SECY-22-0043 provided after-the-fact rationalization for the 1980 exemption policy, proposed minimizing future reporting of extravasations that rightfully should be shared with NRC and Congress, and delayed appropriate regulatory actions. The paper did not support the statutory mission of NRC to provide reasonable assurance of adequate protection of public health and safety during medical applications of radioactive materials in the United States.

Approving the petition and ensuring that extravasations that exceed the current NRC objective dose-based thresholds for all other medical events would:

- provide worthwhile, substantial safety improvements,
- ensure consistency with actions suggested by the International Atomic Energy Agency and existing NRC medical event reporting regulations, and
- encourage licensees to adopt industry standards already used to reduce extravasations in other radiology procedures (e.g., contrast CT and MRI administrations) and oncology chemotherapy administrations.

Through this appeal process, I am, again, respectfully requesting **fair and timely consideration of the facts and evidence through this Information Correction Request Appeal**. I believe it is important for the adequate radiation protection of patients that the Commission immediately issue Interim Staff Guidance that includes:

- initiating rulemaking to ensure extravasations are reported using the existing dose-based threshold,
- standardizing an extravasation dosimetry model for tissue using the latest published method, and
- requiring licensees begin immediate efforts to monitor for and reduce extravasations.

Thank you for your consideration.

Sincerely,

Ronald K. Lattanze

Digitally signed by Ronald K. Lattanze
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Appendix A: February 15, 2023 Information Correction Request

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February 15, 2023

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To Whom it May Concern:

**Information Correction Request**

As the petitioner and on behalf the patients, patient advocates, radiation safety experts, and others who have contacted you in support of Petition for Rulemaking PRM-35-22[1], I am respectfully requesting that the U.S. Nuclear Regulatory Commission (NRC) correct influential information and other information that formed the basis for its resolution of PRM-35-22, published on December 30, 2022. This request is submitted in accordance with NRC's Information Quality Guidelines, published in OMB Federal Register Notice Vol. 67, Num. 190[2].

In response to the petition for rulemaking, NRC's medical staff drafted a Commission Paper (SECY-22-0043)[3] to inform Commissioners of PRM-35-22, request approval for rulemaking, and to provide a rulemaking plan. The content of SECY-22-0043 does not meet the NRC's Information Quality Requirements for influential information and other information that impacts a regulatory decision.

**Background**

An extravasation occurs when some or all of a radiopharmaceutical is inadvertently administered into the tissue, rather than into the venous system as intended (wrong route of administration). Large extravasations can result in high radiation doses to patient tissue. PRM-35-22 asked NRC to remove the 1980 policy that exempts extravasations that meet medical event reporting criteria from reporting. The petition cites clinical evidence demonstrating that the premise upon which the exemption was formed (extravasations are "virtually impossible to avoid") is incorrect.

The petition demonstrated that patients experiencing large extravasations can receive radiation doses which exceed the risk-informed tissue dose threshold of 0.5 Sv. For the past 20 years, this threshold has been a cornerstone of NRC radiation protection rules. Cases exceeding the threshold are considered to be indicative of potential problems in the handling of medical isotopes. NRC defines risk-informed regulation as an approach to regulation which incorporates an assessment of safety significance or relative risk. This approach ensures that the regulatory burden imposed by an individual regulation or process is appropriate to its importance in protecting the health and safety of the public and the environment.

[1] Petition for Rulemaking PRM-35-22, posted June 8, 2020. https://www.regulations.gov/document/NRC-2020-0141-0001
[2] OMB Federal Register Notice – Vol. 67, Num. 190, October 1, 2002. https://www.nrc.gov/public-involve/info-quality/fr67p61695.html
[3] Commission Paper, SECY-22-0043. May 9, 2022. https://www.nrc.gov/docs/ML2126/ML21268A006.pdf

The petition and subsequent submissions shared cases in which patients received radiation doses that exceed the Abnormal Occurrence (AO) threshold of 10.0 Gy. The Commission Paper notes that "The NRC is required by law to report abnormal occurrences to Congress and make certain information about abnormal occurrences publicly available." However, SECY-22-0043 does not inform the Commissioners with a formal analysis of the likelihood of such events. Nor does it suggest any procedures to ensure that they are identified.

The petition and follow-on communications have provided 57 peer-reviewed articles showing how large extravasations can also compromise patients' procedures and care.

PRM-35-22 was docketed by the Commission and went through a public comment period.

SECY-22-0043 considered three possible regulatory options. It recommended that the Commission approve Option 3: accept the petition but define a new and unique reporting criterion. The criterion would require that patients themselves demonstrate that they were harmed, and that they get an authorized user's confirmation of injury for an event to be reportable. A criterion placing such a burden on the patient is unprecedented. It would be a departure from the risk-informed, dose-based limit for reporting events which the Commission had only recently reaffirmed.

Guided by information in SECY-22-0043, NRC Commissioners voted [4] 5-0 to accept the staff recommendation, as reported in the Federal Register on December 30th, 2022. The Commissioners' decision affects a broad class of licensees. However, SECY-22-0043 did not meet the utility and objectivity standards of the NRC's Information Quality Guidelines.

*Deficiencies with information utility, transparency and openness*

Regarding information utility, the Quality Guidelines state:

> "Utility is the usefulness of the information to its intended users. To ensure information utility, the NRC will:
>
> - Make information associated with the agency regulatory processes and decisions public unless release is restricted because, for example, a given regulatory process or decision contains classified national security information, safeguards information, proprietary information, sensitive homeland security information, or other information that is protected from disclosure under the Freedom of Information Act."

The requirements of the Regulatory Analysis Guidelines of the NRC[5] govern analyses that support actions associated with a petition to the NRC. These analyses must adhere to the Commissions "Principles of Good Regulation"–independence, openness, efficiency, clarity, and reliability. Regarding openness, the Analysis Guidelines state:

> "In preparing regulatory analyses, the NRC intends to ensure that its decisions that impose regulatory burdens on licensees are based on adequate information regarding the values and impacts associated with a reasonable set of alternatives, and to follow a systematic and disciplined process that is also **open and transparent in arriving at these decisions**." [emphasis added]

NRC has not met its obligations for information utility. The process has not been open and transparent.

[4] Commission Voting Records for SECY-22-0043, released December 30, 2022. https://www.nrc.gov/docs/ML2232/ML22321A137.html

[5] Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission, NUREG/IBR-0058 Revision 4, published September 2004. https://www.nrc.gov/docs/ML0428/ML042820192.pdf

- On April 1, 2021, NRC shared their Draft Findings on radiopharmaceuticals extravasations with the ACMUI. NRC did not share the Draft Findings with the public initially, but did notify the public of their existence in July 2021. Requests for access to these findings were made by the petitioner in three separate emails with NRC medical staff in July. Finally, on July 16, the medical staff responded that the findings would be withheld until the week of August 9 "to allow for subcommittee deliberations." The Draft Findings were released on August 11, 2021. The subcommittee had access to the findings for 133 days. NRC provided the public with just 20 days to analyze both the NRC Draft Findings and the ACMUI subcommittee report and then provide comments prior to an NRC and ACMUI public meeting on September 2, 2021.
- In September 2021 NRC finalized a draft Commission Paper and shared it with the ACMUI and the Agreement States in October and November. This draft was also not provided to the public. Instead, the public had to infer the content based on an Agreement States letter to NRC, which was posted on the NRC ADAMS site in January 2022.
- On May 9, 2022, NRC medical staff provided the Commission SECY-22-0043. Despite, countless requests from the petitioner, patients, patient advocates, and members of Congress over seven months, the Commission Paper was not made public until it was released on the NRC ADAMS system in January of 2023—after the Commission had made a decision.

Since finalizing the proposed regulatory analysis in September of 2021, NRC did not share information with the public for 16 months. NRC has not been open or transparent; they have not ensured information utility to the petitioner or the public regarding the Commission Paper, nor its draft recommendations. Rather, NRC withheld important influential information and other information in their regulatory analysis from the public prior to the Commissioners' vote. Had the public been able to review the medical staff's analysis, the public would have been able to comment on its numerous shortcomings before it was used to inform the Commission.

*Deficiencies with information objectivity*

SECY-22-0043 also failed to meet the objectivity standards articulated in the NRC Information Quality Guidelines. The information presented to the Commission was inaccurate, incomplete, unreliable, and biased. There is little evidence that the recommendations underwent a formal review for concurrence with long-standing—and recently affirmed—NRC principles of radiation protection. The Commission Paper also omits critical information, repeats clear falsehoods promulgated by the industry which NRC is charged with regulating, and inaccurately summarizes published literature (despite prior feedback to the staff identifying the errors in their analyses).

SECY-22-0043 also failed to meet the intent of Regulatory Analysis Guidelines. They state:

> The regulatory analysis process is intended to be an integral part of the NRC's decisionmaking that systematically provides complete disclosure of the relevant information supporting a regulatory decision. The process is to be used **neither to produce after-the-fact rationalizations to justify decisions already made, nor to unnecessarily delay regulatory actions.** The conclusions and recommendations included in a regulatory analysis document are neither final nor binding, but **are intended to enhance the soundness of decisionmaking** by NRC managers and the Commission. [emphasis added]

Much of the rest of this document analyzes 35 separate information quality failures in SECY-22-0043. Nearly all of these failures are embodied in the following two incorrect staff conclusions:

- Extravasations are not a real patient or radiation protection concern.
- But if reporting must be required, then a new criterion should be created to minimize reporting.

The Commission relied on flawed information, and therefore could not make a sound regulatory decision.

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**Information in Error that Requires Correction**

**Excerpt 1**

*Excerpt that requires correction:*

Extravasation is not limited to the administration of radiopharmaceuticals, and published studies indicate extravasation rates for all drugs, including radiopharmaceuticals, range from 0.10 to 16 percent for all injections.

*Source:* SECY-22-0043, page 2

*Why the information should be corrected:*

**NRC did not ensure accuracy, completeness, and reliability of the information. The information is also biased.** This information should be corrected because it leads the Commission to the wrong conclusions about nuclear medicine extravasation rates.

For nuclear medicine centers, the most accurate information that is available documents extravasation rates of 15.2%, on average **152 of every 1,000** nuclear medicine patients are extravasated. Some centers have extravasation rates in the low single digits, while others easily exceed 20%. The wide variation suggests potential issues in the handling of medical isotopes.

This rate is dramatically different from other areas of medicine in which peripheral IVs are used in similar patient populations. Numerous, multicenter studies from the past decade involving millions of patients demonstrate that extravasations can be extremely rare (~ 0.1% to 0.24%). Only **1 or 2 out of 1,000** contrast CT, MRI, or chemotherapy patients are extravasated.

The Commission should be informed that these low extravasations rates are realized in similar patient populations, using similar IV administrations procedures, and in similar radiology departments. There is no reason why similar results could not be achieved quickly in centers that administer radiopharmaceuticals.

*Recommended correction to SECY-22-0043:*

The published extravasation rate in nuclear medicine radiopharmaceutical administration is demonstrably higher than the rates in other radiology procedures, in similar IV administrations, and in similar patient populations (~152 extravasations/1,000 patients vs. ~1-2 extravasation/1,000 patients). This dramatic difference indicates that the training, tools, and techniques used by nuclear medicine technologists could be improved and the frequency of inadvertent misadministrations of radiopharmaceuticals that irradiate patients unnecessarily should and could be significantly lower.

*Supporting evidence:*

- Osman, M.M., et al., FDG dose extravasations in PET/CT: frequency and impact on SUV measurements. Front Oncol, 2011. 1: p. 41.
- Hall, N., et al., Impact of FDG extravasation on SUV measurements in clinical PET/CT. Should we routinely scan the injection site? J Nucl Med, 2006. 47(suppl 1): p. 115P.
- Bains, A., et al., Contamination in 18F-FDG PET/CT: an initial experience. J Nucl Med, 2009. 50 (supplement 2): p. 2222
- Krumrey, S., et al., FDG manual injection verses infusion system: a comparison of dose precision and extravasation. J Nucl Med, 2009. 50(supplement 2): p. 2031.

- Silva-Rodriguez, J., et al., Correction for FDG PET dose extravasations: Monte Carlo validation and quantitative evaluation of patient studies. Med Phys, 2014. 41(5): p. 052502.
- Muzaffar, R., et al., Novel method to detect and characterize (18)F-FDG infiltration at the injection site: a single-institution experience. J Nucl Med Technol, 2017. 45(4): p. 267-271.
- Wang CL, Cohan RH, Ellis JH, Adusumilli S, Dunnick NR. Frequency, management, and outcome of extravasation of nonionic iodinated contrast medium in 69,657 intravenous injections. Radiology. 2007;243(1):80-7.
- Dykes TM, Bhargavan-Chatfield M, Dyer RB. Intravenous contrast extravasation during CT: a national data registry and practice quality improvement initiative. J Am Coll Radiol. 2015;12(2):183-91.
- Shaqdan K, Aran S, Thrall J, Abujudeh H. Incidence of contrast medium extravasation for CT and MRI in a large academic medical centre: a report on 502,391 injections. Clin Radiol. 2014;69(12):1264-72.
- Jackson-Rose J, Del Monte J, Groman A, Dial LS, Atwell L, Graham J, et al. Chemotherapy Extravasation: Establishing a National Benchmark for Incidence Among Cancer Centers. Clin J Oncol Nurs. 2017;21(4):438-45.


## Excerpt 2

*Excerpt that requires correction:*

In 2008 and 2009, the NRC staff requested that the ACMUI evaluate whether extravasations should continue to be excluded from medical event reporting after a licensee reported (and later retracted) an extravasation involving a common diagnostic radiopharmaceutical.

*Source:* SECY-22-0043, page 2

*Why the information should be corrected:*

**NRC did not ensure completeness and reliability of the information.** This information should be corrected because the Commission needs to understand that there is written documentation that the medical staff were informed as early as 2008 that routinely used diagnostic radiopharmaceuticals, if extravasated, could result in tissue doses that exceed the risk-informed reporting dose threshold. The staff also had reached the conclusion that energy emissions of routinely used radiopharmaceuticals in 2008 and 2009 were more dangerous than emissions from routinely used radiopharmaceuticals in 1980.

In accordance with the medical event criteria implemented by NRC in 2002, The Boston Veterans Hospital recognized that they had extravasated a patient and may have exposed the patient's tissue to up to nearly 1.0 Sv. They reported this medical event to the NRC because it met the reporting criteria. The Boston VA retracted the medical event report at the request of NRC and only after NRC informed the Boston VA that NRC did not consider an extravasation to be a reportable event. As a result, no root cause was identified and then shared across licensees. The Commission should also be aware that this event made the NRC medical staff realize that it was likely that other patients were also experiencing extravasations that exceeded the 0.5 Sv dose threshold.

*Recommended correction to SECY-22-0043:*

In 2008 and 2009, NRC staff requested that the ACMUI reevaluate whether extravasations should continue to be excluded from medical event reporting. They made this request because the nature of radiopharmaceuticals being administered in 2008 and 2009 contained higher energy isotopes than the isotopes from 1980 (positron-emitting F18 was rapidly growing in volume due to the approval of PET/CT imaging) and because the radiopharmaceutical industry was developing beta- and alpha-emitting

radiopharmaceuticals for therapeutic use. NRC staff also realized this was a patient safety issue that was not being monitored by medical event reporting.

This trend in use of higher energy isotopes is even more common today. New therapies have arrived, and the market adoption will continue to be swift. Furthermore, we have learned that even the lower energy radiopharmaceuticals often used in nuclear medicine procedures can result in very high doses to tissue if extravasated.

*Supporting evidence:*

- Official Transcript of Proceedings, Advisory Committee on the Medical Uses of Isotopes. US Nuclear Regulatory Commission; 2008. Page 17-20.
- Official Transcript of Proceedings, Advisory Committee on the Medical Use of Isotopes. US Nuclear Regulatory Commission; 2009.

## Excerpt 3

*Excerpt that requires correction:*
During ACMUI public meetings in December 2008 and May 2009, the NRC Advisory Committee on the Medical Uses of Isotopes (ACMUI) recommended that extravasations should continue to be excluded from reporting.

*Source:* SECY-22-0043, page 2

*Why the information should be corrected:*
**NRC did not ensure accuracy, completeness, and reliability of the information. NRC also omits critical information the Commission needs to know.** This information needs to be corrected so the Commissioners fully understand the reason why the ACMUI recommended retaining the exemption. They should understand that as early as 2008-2009, NRC medical staff knew the exemption was incorrect and accepted ACMUI input uncritically.

The ACMUI recommendation was not based on science, but instead, driven by their members' desire to avoid the administrative burden of addressing extravasations. Near the end of the meeting, after much discussion about how patients were being extravasated resulting in high radiation doses, members were informed that the only reason these medical events were not being reported was because of the 1980 exemption. At this point, ACMUI member Nag made the following statement.

> "However, the first thing before us is, should NRC consider it as a medical event. Now if we consider this as a medical event, if we go through all the procedures and identify whatever- 3 or 4 or 5 - the patient will have to be informed; the physician have to be informed, blah blah blah [sic], and then - you have to go into all the reporting mechanisms. And therefore, I am thoroughly against this being reported as a medical event."

As soon as he finished, there was a motion to retain the exemption. The ACMUI members immediately voted to retain the exemption.

*Recommended correction to SECY-22-0043:*
During ACMUI meetings in December 2008 and May 2009, the NRC Advisory Committee on the Medical Uses of Isotopes (ACMUI) agreed that extravasations were almost completely preventable, that diagnostic and certainly therapeutic radiopharmaceuticals could result in very high tissue doses if extravasated, and could be considered medical events because they were administered through the wrong route of administration. Despite all the evidence that extravasations should be reported, the ACMUI members voted to retain the exemption so they would not have to spend the time and effort to improve this process and would not have to spend the time and effort to tell patients and their doctors when they had been extravasated, and not have to do all the "blah, blah, blah" associated with reporting to the NRC.

*Supporting evidence:*
- Official Transcript of Proceedings, Advisory Committee on the Medical Uses of Isotopes. US Nuclear Regulatory Commission; 2008. Page 19.
- Official Transcript of Proceedings, Advisory Committee on the Medical Use of Isotopes. US Nuclear Regulatory Commission; 2009. Page 162.

## Excerpt 4

*Excerpt that requires correction:*
During the December 2008 meeting (ADAMS Accession No. ML090340745), ACMUI members observed that diagnostic extravasations are relatively common but rarely result in adverse clinical outcomes or the need for a repeat diagnostic procedure. During the May 2009 meeting (ADAMS Accession No. ML092090025), ACMUI members discussed reporting therapeutic extravasations based on obvious tissue damage instead of using a dose threshold criterion because extravasation dose calculations are not standardized. Ultimately, the ACMUI supported continuing to exclude therapeutic extravasations from medical event reporting because (1) patients would be well aware of tissue damage from a therapeutic extravasation and (2) the U.S. Food and Drug Administration Adverse Event Reporting System was an existing mechanism to track adverse reactions from radiopharmaceuticals.

*Source:* SECY-22-0043, page 2 footnote 4

*Why the information should be corrected:*
**NRC did not ensure accuracy, completeness, and reliability of this information. NRC also omits critical information important to the Commissioners' decisions.** The information should be corrected because the information misled the Commission regarding the potential danger of extravasations. Because of the reporting exemption, extravasations are not characterized and patients are not monitored for long-term effects. Because there are no records of extravasations and which images are repeated, there is no evidence to support the Commission Paper statements. Furthermore, the real reason the exemption was retained was explained in Excerpt 3.

*Recommended correction to SECY-22-0043:*
During the December 2008 meeting (ADAMS Accession No. ML090340745), ACMUI members observed that diagnostic extravasations are relatively common. They made the statements that these events rarely result in adverse clinical outcomes or the need for a repeat diagnostic procedure. But we could not find evidence to support these statements. ACMUI members admitted that they do not monitor for extravasations, they do not see patients, and they do not follow patients. No ACMUI member described how an appropriate decision is made regarding whether to repeat imaging or not.

During the May 2009 meeting (ADAMS Accession No. ML092090025), ACMUI members discussed reporting therapeutic extravasations based on obvious tissue damage instead of using a dose threshold criterion because extravasation dose calculations are not standardized. This approach discounted the latent nature of symptoms caused by ionizing radiation. It ignored NRC precedent when the Commission abandoned clinically detectable adverse events as reporting criterion in 1980. It ignored the fact that dosimetry methods did exist -- licensees were required to perform dosimetry for other medical events, and in the case of the Boston VA, for extravasation. NRC agreed with the dose calculation provided by the Boston VA.

Ultimately, the ACMUI supported continuing to exclude therapeutic extravasations from medical event reporting because (1) patients would be well aware of tissue damage from a therapeutic extravasation, (2) the U.S. Food and Drug Administration Adverse Event Reporting System was an existing mechanism to track adverse reactions from radiopharmaceuticals, (3) and members did not want to spend the time reporting. The AMCUI members did not consider that medical event reporting is intended to capture events to prevent patient injury.

*Supporting evidence:*

- Official Transcript of Proceedings, Advisory Committee on the Medical Uses of Isotopes. US Nuclear Regulatory Commission; 2008. Page 26.
- Official Transcript of Proceedings, Advisory Committee on the Medical Use of Isotopes. US Nuclear Regulatory Commission; 2009. Page 163.

## Excerpt 5

*Excerpt that requires correction:*

In September 2019, the ACMUI endorsed the extravasation subcommittee's recommendation that extravasations should be considered a type of "passive" patient intervention, and extravasations that lead to unintended permanent functional damage should be reported as medical events.

*Source:* SECY-22-0043, page 3

*Why the information should be corrected:*

**NRC did not ensure completeness of the information and omitted critical information.** The statement fails to capture all the inaccuracies that the ACMUI subcommittee stated in their evaluation. As a result, the Commission remains unaware of what the ACMUI continues to say and do to avoid fixing the extravasation problem. The Commission Paper also does not report that the subcommittee actually recommended retaining the exemption. Nor does it report that one ACMUI subcommittee member, the patient advocate, dissented in writing and stated that there was no reason why extravasations should be treated any differently than other medical events.

*Recommended correction to SECY-22-0043:*

In September 2019, the ACMUI endorsed the extravasation subcommittee's recommendation. The recommendation suggested that extravasations should be considered a type of "passive" patient intervention, and extravasations that lead to unintended permanent functional damage should be reported as medical events. Since that time, there has been clear evidence presented by the leading vascular access association that extravasations are not the patient's fault. Additional information has been received which

shows extravasations can be almost entirely eliminated, indicating that extravasations are the result of training, technique, and tools.

Additionally, the patient advocate on the subcommittee officially dissented in writing. She stated that extravasations should be handled just like any other medical event.

*Supporting evidence:*


- Official Transcript of Proceedings Nuclear Regulatory Commission, Meeting of the Advisory Committee on the Medical Uses of Isotopes: Open Session, July 24, 2019. https://www.nrc.gov/docs/ML1925/ML19255G942.pdf
- Comment (367) from Laura Weil on PRM-35-22. https://www.nrc.gov/docs/ML2033/ML20335A484.pdf
- Comment (463) from the Association for Vascular Access on FR Doc # 2020-19903. https://www.regulations.gov/comment/NRC-2020-0141-0466
- Osman, M.M., et al., FDG dose extravasations in PET/CT: frequency and impact on SUV measurements. Front Oncol, 2011. 1: p. 41.
- Hall, N., et al., Impact of FDG extravasation on SUV measurements in clinical PET/CT. Should we routinely scan the injection site? J Nucl Med, 2006. 47(suppl 1): p. 115P.
- Bains, A., et al., Contamination in 18F-FDG PET/CT: an initial experience. J Nucl Med, 2009. 50 (supplement 2): p. 2222
- Krumrey, S., et al., FDG manual injection verses infusion system: a comparison of dose precision and extravasation. J Nucl Med, 2009. 50(supplement 2): p. 2031.
- Silva-Rodriguez, J., et al., Correction for FDG PET dose extravasations: Monte Carlo validation and quantitative evaluation of patient studies. Med Phys, 2014. 41(5): p. 052502.
- Muzaffar, R., et al., Novel method to detect and characterize (18)F-FDG infiltration at the injection site: a single-institution experience. J Nucl Med Technol, 2017. 45(4): p. 267-271.
- Wang CL, Cohan RH, Ellis JH, Adusumilli S, Dunnick NR. Frequency, management, and outcome of extravasation of nonionic iodinated contrast medium in 69,657 intravenous injections. Radiology. 2007;243(1):80-7.
- Dykes TM, Bhargavan-Chatfield M, Dyer RB. Intravenous contrast extravasation during CT: a national data registry and practice quality improvement initiative. J Am Coll Radiol. 2015;12(2):183-91.
- Shaqdan K, Aran S, Thrall J, Abujudeh H. Incidence of contrast medium extravasation for CT and MRI in a large academic medical centre: a report on 502,391 injections. Clin Radiol. 2014;69(12):1264-72.
- Jackson-Rose J, Del Monte J, Groman A, Dial LS, Atwell L, Graham J, et al. Chemotherapy Extravasation: Establishing a National Benchmark for Incidence Among Cancer Centers. Clin J Oncol Nurs. 2017;21(4):438-45.

**Excerpt 6**

*Excerpt that requires correction:*

The staff considered the radiation safety risks associated with extravasations—the radiological consequences and the likelihood of those consequences—to determine whether certain extravasations may merit medical event reporting.

*Source:* SECY-22-0043, page 4

*Why the information should be corrected:*

**NRC did not ensure accuracy, completeness, and reliability of the information. It omits critical information.** This information should be corrected because the criterion to determine whether an event merits reporting has already been defined. NRC determined in 2002 with the agreement of ACMUI that 0.5 Sv to tissue is the risk-informed dose threshold for medical event reporting. As a result, the Commission Paper's comment should not have passed concurrence. The regulations that govern medical event reporting are clear. A regulatory analysis of the petition should not be questioning or revaluating the risk-informed threshold currently used across NRC. In fact, in the recent denial of three petitions, NRC confirmed support for the existing threshold.

*Recommended correction to SECY-22-0043:*

The staff considered whether extravasations could exceed the current medical event dose-based threshold. Through consultation with experts in dosimetry, with radio pharmacists, with physicists, and from a thorough review of the literature and over 50 cases submitted with and after the petition. We determined that diagnostic and therapeutic extravasations can in fact lead to very high doses of radiation to significant volumes of tissue (5-10 cc). Several cases have exceeded Abnormal Occurrence reporting threshold, indicating increased safety risk for the patient. These extravasations certainly merit medical event reporting. Furthermore, these patients should be followed clinically for several years to ensure that any adverse tissue effects are captured.

*Supporting evidence:*

- Misadministration Reporting Requirements, 45 Fed. Reg. (May 14, 1980): 31701-31705
- Federal Register. Volume 67, No. 79. April 24, 2002. Page 20250.

**Excerpt 7**

*Excerpt that requires correction:*

(a study cited by the petitioner found a 15.2-percent average extravasation rate for positron emission tomography/computed tomography [PET/CT] radiotracers)

*Source:* SECY-22-0043, page 4

*Why the information should be corrected:*

**NRC did not ensure accuracy, completeness, and reliability of the information. NRC omitted critical information.** This information leads the Commissioner to believe that just one study supports a nuclear medicine extravasation rate of 15.2% (0%-44%). In fact, several centers have made the effort to review images in order to estimate their extravasation rate. In nine separate studies from thirteen nuclear medicine centers, the average extravasation rate was 15.2%. The findings from a separate quality improvement study across seven other centers supported the previously published rate of 15.2%.

*Recommended correction to SECY-22-0043:*
Multiple studies cited by the petitioner found a 15.2 percent average extravasation rate for 18F and 99mTc radiotracers. Extravasation rates ranged from 0%-44% indicating wide variability in the handling of medical isotopes. The petitioner also cited the largest ever quality improvement study of seven other centers that supported the previously mentioned 15.2% and demonstrated that quality improvement efforts could statistically significantly reduce the extravasation rates quickly. This quality improvement study was highlighted as one of the most significant findings at the 2018 SNMMI annual meeting.

*Supporting evidence:*
- Osman, M.M., et al., FDG dose extravasations in PET/CT: frequency and impact on SUV measurements. Front Oncol, 2011. 1: p. 41.
- Hall, N., et al., Impact of FDG extravasation on SUV measurements in clinical PET/CT. Should we routinely scan the injection site? J Nucl Med, 2006. 47(suppl 1): p. 115P.
- Bains, A., et al., Contamination in 18F-FDG PET/CT: an initial experience. J Nucl Med, 2009. 50 (supplement 2): p. 2222
- Krumrey, S., et al., FDG manual injection verses infusion system: a comparison of dose precision and extravasation. J Nucl Med, 2009. 50(supplement 2): p. 2031.
- Silva-Rodriguez, J., et al., Correction for FDG PET dose extravasations: Monte Carlo validation and quantitative evaluation of patient studies. Med Phys, 2014. 41(5): p. 052502.
- Muzaffar, R., et al., Novel method to detect and characterize (18)F-FDG infiltration at the injection site: a single-institution experience. J Nucl Med Technol, 2017. 45(4): p. 267-271.
- McIntosh, C. and J. Abele, Frequency of Interstitial Radiotracer Injection for Patients Undergoing Bone Scan, in The Canadian Association of Radiologists. 2016: Montreal, Quebec.
- Ashley M, Zachary Higgins, et.al. Importance of Injection Site Image in DaTscans. Mayo Clinic Department of Radiology, Rochester, Minnesota
- Wong TZ, Benefield T, Masters S, Kiser JW, Crowley J, Osborne D, et al. Quality Improvement Initiatives to Assess and Improve PET/CT Injection Infiltration Rates at Multiple Centers. J Nucl Med Technol. 2019;47(4):326-31.
- SNMMI Value Initiative Newsletter, September 2019. https://valueinitiative.snmmi.org/imis/VIRC/SNMMIVIRC/Value_Initiative_Newsletter.aspx

**Excerpt 8**
*Excerpt that requires correction:*
However, as indicated by published studies and information gathered by the staff, most diagnostic extravasations are of low radiation-safety significance and would rarely be expected to result in adverse tissue effects.

*Source:* SECY-22-0043, page 4

*Why the information should be corrected:*
**NRC did not ensure accuracy, completeness, and reliability of the information. NRC omitted critical information and is also biased.** This information would lead the Commissioners to reach the wrong conclusion about the risk to patients when they are extravasated with diagnostic radiopharmaceuticals.

The statement is repeating, uncritically, the unsubstantiated claims of the nuclear medicine community. Since extravasations are rarely measured and patients even more rarely followed post-event, the medical

staff has NO scientific/clinical evidence to support this statement. However, when diagnostic extravasations have actually been measured, they have often been found to result in very high doses. When these patients are followed for the appropriate amount of time, they have suffered adverse tissue effects. References provided to NRC medical staff and Commissioners clearly show this. Despite the lack of NRC reporting, occasionally reports have been submitted by manufacturers or others to the FDA adverse event database and the European Vigilance reporting system. These cases mention diagnostic extravasation patients with adverse tissue effects. Furthermore, medical staff is ignoring the information regarding state-of-the-art dosimetry of over 50 cases provided to NRC, which all exceed the existing NRC risk-informed threshold. The threshold is regarded as the current radiation protection model, rather than the presence of adverse tissue effects.

The information also neglects what is known about adverse tissue effects. Because of health issues and associated treatments, most nuclear medicine patients are more radiosensitive than healthy members of the public. As a result, this population may experience adverse effects from lower doses. We also know that doses as low as 1.0 Sv can result in adverse tissue effects from a publication written by leaders of SNMMI and posted on the NRC website. Furthermore, we know that many extravasated patients are receiving doses that greatly exceed 1.0 Sv.

This information also shows a lack of peer-review within NRC. NRC knows how to perform dosimetry on extravasated tissue. They could calculate the absorbed dose and realize that patients who have been extravasated with diagnostic radiopharmaceuticals have received tissues doses that can and likely have led to adverse tissue effects.

*Recommended correction to SECY-22-0043:*
Published studies and information gathered by the staff suggest that large diagnostic extravasations are of high radiation-safety significance and would be expected to result in adverse tissue effects. Staff have forwarded over 50 cases to our in-house dosimetry experts who have confirmed that diagnostic extravasations can lead to high tissue doses. Doses that greatly exceed thresholds which can lead to adverse tissue effects. These experts reminded staff that 11% of the energy emitted by the most commonly used radiotracer, 99mTc, are conversion electrons, Auger electrons, and low-level x-rays, that deposit their energies within 1-2 mm of the decay. Depending on the amount of activity extravasated, the absorbed dose can certainly lead to adverse tissue effects. In an often mis-quoted reference, van der Pol et al., suggest that very few diagnostic extravasations are reported and fewer have been characterized and led to clinical follow-up of patients. But in the three patients who were actually followed, all three experienced adverse tissue effects.

*Supporting evidence:*

- Food and Drug Administration. Adverse Event Reporting System (FAERS) Public Dashboard. https://fis.fda.gov/sense/app/95239e26-e0be-42d9-a960-9a5f7f1c25ee/sheet/7a47a261-d58b-4203-a8aa-6d3021737452/state/analysis
- Public Dashboard for U.S. adverse events and the European Vigilance (EV) reporting system. https://www.adrreports.eu/en/search.html
- Siegel, J.A. Guide for Diagnostic Nuclear Medicine. Society of Nuclear Medicine. 2002. https://www.nrc.gov/docs/ML0222/ML022250828.pdf
- Eckerman K, Endo A. ICRP publication 107. Nuclear decay data for dosimetric calculations. Ann ICRP 38: 7-96; 2008.

- van der Pol J, Voo S, Bucerius J, Mottaghy FM. Consequences of radiopharmaceutical extravasation and therapeutic interventions: a systematic review. Eur J Nucl Med Mol Imaging. 2017;44(7):1234-43.

## Excerpt 9

*Excerpt that requires correction:*
The staff does not support medical event reporting of low radiation-safety-significant extravasations.

*Source:* SECY-22-0043, page 4

*Why the information should be corrected:*
**NRC did not ensure accuracy and reliability of the information. This information is misleading.** This information should not have passed concurrence. First and foremost, NRC has said that events with tissue-dose greater than 0.5 Sv could indicate problems with handling of isotopes. If the staff does not support medical event reporting of what they are calling low radiation safety-significant (~0.5 Sv to tissue) extravasations, then NRC should revisit the entire medical event reporting structure. Why would NRC still support the reporting of other medical events that barely exceed 0.5 Sv?

Risk-informed regulation is an approach to regulation taken by the NRC, which incorporates an assessment of safety significance or relative risk. This approach ensures that the regulatory burden imposed by an individual regulation or process is appropriate to its importance in protecting the health and safety of the public and the environment. In 2002, NRC began using risk-informed regulation for reporting medical events. Therefore, that approach already incorporated a burden that was appropriate to the importance of protecting health and safety. The 0.5 Sv dose is the criterion that NRC has chosen to show potential for affecting safety.

But even if NRC decided to invent a new reporting criterion JUST for extravasations, the medical staff has provided misleading and unreliable information. In NUREG-2122 Glossary of Risk-Related Terms in Support of Risk-Informed Decisionmaking, NRC has also defined safety significant as “a qualifying term that indicates if something does not meet some predetermined criterion, it has the potential to affect safety.” NRC’s Website Glossary defines Safety Significant as “When used to qualify an object, such as a system, structure, component, or accident sequence, this term identifies that object as having an impact on safety, whether determined through risk analysis or other means, which exceeds a predetermined significance criterion.”

If the predetermined criterion or predetermined significance criterion is being defined as “patient injury as reported by an authorized user,” the SECY-22-0043 also states: “However, while rare, an extravasation **could result** in adverse tissue effects and would be considered a safety-significant medical event.” [**emphasis added**]

If extravasations are not characterized and patients are not followed, licensees, patients, and the NRC cannot accurately state that these extravasations are not safety significant. Extravasations would need to be identified and patients would need to be followed for adverse tissue effects. Without doing so, NRC cannot assure Congress that extravasations that exceed 10.0 Gy to tissue are being reported as required.

Excerpt 9 is an example of how the NRC medical staff has tried to justify past actions. NRC and ACMUI agreed in 2002 that 0.5 Sv was a risk-informed dose threshold. Now, in 2023, faced with the possibility of extravasation being reported, medical staff has proposed a new (and previously abandoned) reporting criterion. Rather than fixing the problem, medical staff are inventing new criterion.

*Recommended correction to SECY-22-0043:*
The staff supports medical event reporting of medical events, including extravasations, that meet reporting criteria.

*Supporting evidence:*
- U.S. NRC Subpart M – Reports § 35.3045 Report and notification of a medical event. https://www.nrc.gov/reading-rm/doc-collections/cfr/part035/part035-3045.html
- Glossary of Risk-Related Terms in Support of Risk-Informed Decisionmaking, NUREG-2122. November 2013. https://www.nrc.gov/docs/ML1331/ML13311A353.pdf
- NRC Library, Basic References, Glossary. Definition of safety-significant. Last updated March 9, 2021. https://www.nrc.gov/reading-rm/basic-ref/glossary/safety-significant.html

**Excerpt 10**
*Excerpt that requires correction:*
With regard to tissue damage from extravasation, the ACMUI stated, "[w]hile exceedingly rare, there have been reports of patients who developed severe tissue damage following extravasation of radiopharmaceuticals (almost exclusively from therapeutic radiopharmaceuticals). When this occurs, the effort involved in assessing the event and determining a potential dose to affected tissue is warranted."

*Source:* SECY-22-0043, page 4

*Why the information should be corrected:*
**NRC did not ensure accuracy, completeness, and reliability of the information. NRC omitted critical information and is also biased.** This information might lead the Commissioners to believe that extravasations can be characterized well after the event. That is not true. If a center waits until a patient reports injury, they are not going to be able to determine potential dose to affected tissue because the radiation will no longer be present. If centers are not monitoring for extravasations and imaging the injection site when they suspect an extravasation, they will not be able to perform dosimetry appropriately.

*Recommended correction to SECY-22-0043:*
With regard to tissue damage from extravasation, the ACMUI stated, "[w]hile exceedingly rare, there have been reports of patients who developed severe tissue damage following extravasation of radiopharmaceuticals (almost exclusively from therapeutic radiopharmaceuticals). When this occurs, the effort involved in assessing the event and determining a potential dose to affected tissue is warranted." Unfortunately, the ACMUI statement is misleading. A licensee will not be able to effectively determine a potential dose to affected tissue if they find out about the injury days, weeks, or months later.

*Supporting evidence:*
- The 2007 recommendations of the international commission on radiological protection. ICRP Publication 103. Ann ICRP 37: 1-332; 2007.

**Excerpt 11**

*Excerpt that requires correction:*

Because certain extravasations may result in tissue damage around the administration site, the staff believes that a risk-informed medical event reporting requirement may be warranted to capture these radiation-safety-significant extravasation events.

*Source:* SECY-22-0043, page 4

*Why the information should be corrected:*

**NRC did not ensure accuracy and reliability of the information. This information is misleading.** This information should not have passed concurrence; NRC determined in 2002 that the objective dose threshold of 0.5 Sv is a risk-informed threshold. As a result, NRC should be indifferent to whether the medical event is the result of a spill **on** the patient that exposes a patient to >0.5 Sv to tissue (which is currently reportable) or if the exposure is from an extravasation directly **into** the tissue.

*Recommended correction to SECY-22-0043:*

Certain extravasations may result in tissue dose >0.5 Sv. The staff believes that an extravasation that exceeds this risk-informed medical event reporting requirement should be reported.

*Supporting evidence:*

- Federal Register. Volume 67, No. 79. April 24, 2002. Page 20250.

**Excerpt 12**

*Excerpt that requires correction:*

A comprehensive study published in the European Journal of Nuclear Medicine and Molecular Imaging in 2017 reviewed 3,016 radiopharmaceutical extravasations: 3,006 involved diagnostic radiopharmaceuticals and 10 involved therapeutic radiopharmaceuticals. Just three diagnostic extravasations required follow up because of skin irritation and tissue swelling around the injection site, whereas 5 of the 10 therapeutic extravasations resulted in ulceration around the injection site (see Ref. 7 in Enclosure 3).

*Source:* SECY-22-0043, page 4

*Why the information should be corrected:*

**NRC did not ensure accuracy, completeness, and reliability of the information. NRC omitted critical information and is also biased.** This information should be corrected because it is influencing the Commission to believe that diagnostic radiopharmaceuticals are low risk. NRC medical staff has been made aware several times through official communication that they are misquoting the van der Pol et al. reference. The paper states that of all the 3,000+ reports of diagnostic extravasations they found in the literature, **only 3 patients** had dosimetry reported for their extravasation and all three patients experienced adverse tissue effects, from weeks to two years later. For the remaining patients, the authors cited the lack of reporting requirement as one of the reasons why dosimetry and clinical follow-up do not occur.

These inaccurate statements by the NRC medical staff reflect bias since the medical community makes the same claims. NRC fails to follow the specific instructions of the NRC Information Quality Guidelines that state:

> "Where information has been subjected to formal, independent, external peer review, the information may generally be presumed to be of acceptable objectivity. However, this presumption is rebuttable based on a persuasive showing in a particular instance."

Certainly, an unbiased reading of this article would lead NRC to realize that diagnostic extravasations, if characterized and followed would likely show significantly more cases of adverse tissue effects. NRC staff also failed to include comments by the lead author, Dr. van der Pol, during the Spring 2021 ACMUI meeting that supported the petition.

*Recommended correction to SECY-22-0043:*
A comprehensive study published in the European Journal of Nuclear Medicine and Molecular Imaging in 2017 reviewed 3,016 radiopharmaceutical extravasations: 3,006 involved diagnostic radiopharmaceuticals and 10 involved therapeutic radiopharmaceuticals. Only three of the diagnostic extravasations were characterized and all three resulted in adverse tissue effects weeks, months and years later. These findings suggest that had more diagnostic extravasations been characterized, and these patients followed for the appropriate amount of time, more adverse tissue effects would have been revealed. (see Ref. 7 in Enclosure 3). Furthermore, Dr. van Der Pol participated in the Spring 2021 ACMUI meeting. During that meeting Dr. van der Pol reiterated that extravasations did not have to happen. He also emphasized that certain vascular access tools can lead to more extravasations, and shared a graph with NRC and ACMUI showing how diagnostic radiopharmaceutical extravasations can exceed the NRC regulatory reporting threshold.

*Supporting evidence:*
- van der Pol J, Voo S, Bucerius J, Mottaghy FM. Consequences of radiopharmaceutical extravasation and therapeutic interventions: a systematic review. Eur J Nucl Med Mol Imaging. 2017;44(7):1234-43.
- Transcript of the Advisory Committee on the Medical Uses of Isotopes, March 16, 2021. https://www.nrc.gov/docs/ML2110/ML21102A264.pdf

## Excerpt 13

*Excerpt that requires correction:*
Input from the medical community and the ACMUI indicates that extravasations are not entirely preventable. Even the most skilled clinician may extravasate an injection. Patient anatomy, age, body habitus, hydration, and prior medical treatment are all factors outside the control of the clinician that may impact a successful IV administration.

*Source:* SECY-22-0043, page 5

*Why the information should be corrected:*
**NRC did not ensure accuracy, completeness, and reliability of the information. NRC omitted critical information and is also biased.** This information should be corrected because it is leading the Commission to reach the conclusion that extravasations really are not preventable. The Commissioners stated as much in their Notation Votes comments. Opinions of the regulated should be considered through a skeptical lens, especially after they have routinely misled the NRC on this issue. Continued reliance on the medical community and ACMUI comments without critical review suggests bias by the NRC. What the nuclear medicine community and ACMUI are telling NRC medical staff and the Commissioners differs from what vascular access experts told NRC. A 2013 publication from Harvard of 502,391 contrast CT and MRI

patients suggests that an extravasation rate for peripheral IV injections of 0.00108 is possible. These patients are the same patients being injected by nuclear medicine. But the clinicians administering contrast CT and MRI contrast are certified for vascular access and credentialed. Their techniques and tools used on the same patients that nuclear medicine sees have led to very low extravasation rates. However, most nuclear medicine practitioners are not using the latest tools, not employing the best practices, and not providing their technologists with the best training. The conclusion is that virtually every extravasation is preventable. While some may not be preventable, this is likely to be the 0.1% of patients that are still extravasated despite CT and MRI improvement efforts. The vast majority of extravasations are preventable – as evidenced by the results from CT, MRI, and chemotherapy administrations data.

*Recommended correction to SECY-22-0043:*
Input from the medical community and the ACMUI indicates that extravasations are not entirely preventable. Even the most skilled clinician may extravasate an injection. Patient anatomy, age, body habitus, hydration, and prior medical treatment are all factors outside the control of the clinician that may impact a successful IV administration. While this may be true, the evidence indicates that radiopharmaceuticals are extravasated much more frequently than other pharmaceuticals. The premise of the 1980 exemption policy is incorrect.

*Supporting evidence:*

- Wang CL, Cohan RH, Ellis JH, Adusumilli S, Dunnick NR. Frequency, management, and outcome of extravasation of nonionic iodinated contrast medium in 69,657 intravenous injections. Radiology. 2007;243(1):80-7.
- Dykes TM, Bhargavan-Chatfield M, Dyer RB. Intravenous contrast extravasation during CT: a national data registry and practice quality improvement initiative. J Am Coll Radiol. 2015;12(2):183-91.
- Shaqdan K, Aran S, Thrall J, Abujudeh H. Incidence of contrast medium extravasation for CT and MRI in a large academic medical centre: a report on 502,391 injections. Clin Radiol. 2014;69(12):1264-72.
- Jackson-Rose J, Del Monte J, Groman A, Dial LS, Atwell L, Graham J, et al. Chemotherapy Extravasation: Establishing a National Benchmark for Incidence Among Cancer Centers. Clin J Oncol Nurs. 2017;21(4):438-45.

## Excerpt 14

*Excerpt that requires correction:*
By including radiation-safety-significant extravasations in medical event reporting, the staff could obtain operating experience and track and trend these events.

*Source:* SECY-22-0043, page 5

*Why the information should be corrected:*
**NRC did not ensure accuracy, completeness, and reliability of the information.** There is no evidence to support the expectation that self-reporting by patients will result in meaningful data collection or improvement. This is especially true because patients will not know they have been extravasated. They will not be familiar with symptoms of exposure nor the length of time for these symptoms to manifest. They may associate the symptoms with their underlying condition. If they do connect the symptoms with an extravasation they must schedule a follow-up exam with a physician, likely a physician who they have never met and who does not routinely see patients. The patient will be required to pay for this visit. If it is delayed, the symptoms may dissipate before the patient is seen.

*Recommended correction to SECY-22-0043:*
Attempting to include radiation-safety-significant extravasations in medical event reporting through the process of requiring patients to self-report will not provide NRC with enough information to track and trend these events. Therefore, it cannot reasonably be expected to reduce extravasations.

*Supporting evidence:*
- LTR-23-0009 Mary Ajango, Spokesperson, Young Survival Coalition, Patients for Safer Nuclear Medicine Coalition Spokesperson, Letter re: NRC's decision about extravasations. https://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML23011A041

## Excerpt 15

*Excerpt that requires correction:*
When the Commission excluded extravasations from medical event reporting in 1980, the use of injectable radiopharmaceuticals was limited to diagnostic dosages of lower energy gamma-emitting radionuclides.

*Source:* SECY-22-0043, page 6

*Why the information should be corrected:*
**NRC did not ensure accuracy, completeness, and reliability of the information. NRC omitted critical information and is also biased.** This statement should be corrected because it leads the Commission to believe that in the early years of the exemption that there was little risk from extravasations. Low energy diagnostic radiopharmaceuticals are not pure gamma emitters. They are not harmless if extravasated. This statement reflects the medical staff's lack of understanding of the energy emissions of radiopharmaceuticals used in the 1980s and 1990s, many of which are still used today. These radiopharmaceuticals typically used 99mTc as the radiotracer. This isotope can cause high tissue doses if extravasated, due to 11% of the emissions which are not gamma. Furthermore, this is not the reason why NRC originally excluded extravasations. The action was taken because NRC was incorrectly informed that extravasations were virtually impossible to avoid. NRC incorrectly concluded at the time that there would be nothing that could be learned and shared from the reporting of extravasations.

NRC medical staff continue to show that they have not performed even the most basic dosimetry calculations. When a routine diagnostic radiopharmaceutical is properly injected into a patient, the radiation dose to the patient and their tissue is minimal; when that same amount of radiation is injected into the tissue (e.g., 5 – 10 cc), the absorbed dose can easily exceed 10.0 Gy. A paper published in the radiation protection journal ***Health Physics*** in January 2023 provides independent data to confirm that routinely used diagnostic and new therapeutic radiopharmaceuticals can result in very high absorbed tissue doses, if extravasated.

*Recommended correction to SECY-22-0043:*
When the Commission excluded extravasations from medical event reporting in 1980, patients were still at risk from extravasations. Even though the use of injectable radiopharmaceuticals was primarily limited to diagnostic dosages of lower energy gamma-emitting radionuclides, other energy emissions from the radiotracer could easily result in high tissue doses. 99mTc is the perfect example. 11% of energy emitted is in the form of conversion electrons, Auger electrons, and low-level x-rays which can damage tissue if extravasated.

*Supporting evidence:*

- Tsorxe IY, Hayes RB. Dose Estimation for Extravasation of 177Lu, 99mTc, and 18F. Health Phys. 2023 Mar 1;124(3):217-220. doi: 10.1097/HP.0000000000001653. PMID: 36719937.
- Eckerman K, Endo A. Icrp publication 107. Nuclear decay data for dosimetric calculations. Ann ICRP 38: 7-96; 2008.

## Excerpt 16

*Excerpt that requires correction:*

However, the staff has also sought to develop a standard for reporting extravasations that would not intrude into medical judgements or place undue burden on licensees.

*Source:* SECY-22-0043, page 6

*Why the information should be corrected:*

**NRC did not ensure accuracy, completeness, and reliability of the information. NRC omitted critical information and is also biased.** This is a statement made by the medical community that should be analyzed critically. It suggests to the Commission that the extravasation issue borders on medical practice/judgment. This is not true. NRC omitted critical information. The judgment or medical practice argument suggests that protecting patients from extravasation or ensuring extravasations are reported intrudes into medical judgment. It does not, since physicians would never order that a patient be extravasated. The medical judgment argument is correctly used to ensure that NRC will not interfere in the practice of medicine. For example, NRC will not interfere in radiation dose or imaging practices that the medical field believes have benefits to patients. An extravasation, however, is not a medical practice issue, it is a radiation protection issue. It does not benefit a patient. If anything, it is medical malpractice of the type that should be of concern to NRC.

Furthermore, standards are not putting undue burden on licensees, who are already expected to monitor for and perform dosimetry of extravasations according to their own medical guidelines. The ACR requirements for management of contrast medium extravasations and venous access are very prescriptive and exceed the work that would be necessary for monitoring and characterizing nuclear medicine extravasations.

*Recommended correction to SECY-22-0043:*

The staff is not concerned that the dose-threshold criterion would intrude into medical judgment or place undue burden on licensees. Physicians would not instruct technologists to inject a radiopharmaceutical into the patient's tissue. Extravasations, therefore, are not a practice of medicine issue. And monitoring and characterizing is not overly burdensome. A review of other radiology departments' requirements for monitoring administrations are enlightening. Every year in the US, radiology departments perform over 100 million Contrast CT and MRI administrations. ACR guidelines require monitoring for and characterizing of extravasations. They also include reporting requirements. These required activities in a sister department to nuclear medicine dwarf the expected effort that would be needed to effectively monitor radiopharmaceutical administrations and to characterize extravasations.

*Supporting evidence:*

- Shaqdan K, Aran S, Thrall J, Abujudeh H. Incidence of contrast medium extravasation for CT and MRI in a large academic medical centre: a report on 502,391 injections. Clin Radiol. 2014;69(12):1264-72.

- Boellaard R, et al. European Association of Nuclear M. FDG PET/CT: EANM procedure guidelines for tumour imaging: Version 2.0. Eur J Nucl Med Mol Imaging 42: 328-54; 2015. (Note: this is the guideline used by US physicians for PET/CT imaging procedures)

**Excerpt 17**

*Excerpt that requires correction:*

The staff's development of a regulatory approach for extravasations considered input from the medical community and the ACMUI on the risk of extravasation inherent to all IV administrations and issues related to dosimetry for extravasations. In consideration of this input, the staff is recommending a reporting requirement that would screen out extravasation events of low radiation-safety significance because the proposed reporting requirement is based on suspected radiation injury instead of a dose threshold.

*Source:* SECY-22-0043, page 7

*Why the information should be corrected:*

**This information is biased. The medical staff over-relied on input from ACMUI, who previously have made clear that extravasations happen, can be serious, can be prevented, but that they do not want to report any extravasations as medical events.** This information should be corrected because it specifically states that the medical staff **used this information to form its recommendation** that the Commission adopted. NRC is required to ensure that information is reliable and unbiased. NRC did not critically assess the information that they used to reach their recommendation. They did not reflect any public statements from experts in vascular access or dosimetry (including the SNMMI Committee on Medical Internal Radiation Dose (MIRD)), and as a result reached an improper recommendation.

This specific excerpt is damning. Had the staff presented unbiased information in SECY-22-0043, they could not have reached the recommendation they provided the Commission. The regulated medical society members serve on the ACMUI. They are not independent. Their input over the past 43 years has consistently been disingenuous regarding extravasations with a goal of preventing reporting. Their recent comments regarding dosimetry have also proven to be incorrect. Yet despite clear misinformation, the medical staff has used these arguments to reach their recommendation. It is inexcusable and negligent.

ACMUI members and society leaders have willfully misled the NRC. Dr. Schleipman publicly misled the NRC about the dangers of extravasations during the Dec 8, 2020 public meeting. Dr. Jean Luc Urbain, in his role as a member of SNMMI leadership, wrote to NRC that monitoring would not lead to improving administration quality, even though he was an author on a poster that reached the exact opposite conclusion. NRC has not critically assessed the information from third parties to ensure they are using unbiased information.

*Recommended correction to SECY-22-0043:*

The staff's development of a regulatory approach for extravasations considered input from the medical community and the ACMUI on the risk of extravasation inherent to all IV administrations and issues related to dosimetry for extravasations. However, when this input was compared to input from independent organizations like the Association for Vascular Access, to peer-reviewed publications, and when we consulted with experts on dosimetry (including within the SNMMI MIRD Committee), staff learned that extravasations are almost entirely preventable, and dosimetry can be easily and quickly estimated using patient-specific biological clearance at no cost to the licensee. In consideration of this input, the staff is

recommending that extravasations be assessed against the dose threshold like all other reportable medical events.

*Supporting evidence:*

- Official Transcript of Proceedings - Public Comment Meeting on Radiopharmaceutical Extravasations. December 8, 2020. https://www.nrc.gov/docs/ML2101/ML21012A446.pdf
- Letter from R. Lattanze to K. Williams, NMSS/MSST, expressing concerns about statements made by ACMUI members during December 8, 2020 public meeting on extravasations. https://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML21021A32
- Comment (425) of Christina Arenas, et al. from the Society of Nuclear Medicine Molecular Imaging and the American College of Nuclear Medicine on PRM-35-22 - Reporting Nuclear Medicine Intravasations as Medical Events. https://www.regulations.gov/comment/NRC-2020-0141-0428
- Fulp A, Masters S, Thomas A, Urbain JL, Richardson J, Bennett B. Improving the quality of PET radiopharmaceutical injections: Our lessons learned. Poster, SNMMI Mid-Winter Meeting 2019. https://lucerno.com/wp-content/uploads/2023/02/WFU_Poster.pdf
- Osborne D, Kiser JW, Knowland J, Townsend D, Fisher DR. Patient-specific Extravasation Dosimetry Using Uptake Probe Measurements. Health Phys. 2021;120(3):339-43.
- Comment (463) from the Association for Vascular Access on FR Doc # 2020-19903. https://www.regulations.gov/comment/NRC-2020-0141-0466

**Excerpt 18**

*Excerpt that requires correction:*

Additionally, multiple mechanisms exist to evaluate and promote the safe medical use of radioactive materials, including regulation and monitoring by the U.S. Food and Drug Administration, the U.S. Centers for Medicare and Medicaid Services, and Joint Commission on Accreditation of Healthcare Organizations.

*Source:* SECY-22-0043, page 7

*Why the information should be corrected:*

**NRC did not ensure accuracy, completeness, and reliability of the information. NRC omitted critical information and is also biased.** This information should be corrected because it suggests to the Commission that other government agencies are monitoring for and acting on extravasations. That is not true. This information should not have passed concurrence. NRC's statutory responsibilities include ensuring the proper use of medical isotopes. None of these cited organizations has a program that evaluates and promotes the safe medical use of radioactive materials. FDA has no mechanism to evaluate the safe ongoing use of radiopharmaceuticals and the FDA database is not designed to capture medical events. The Joint Commission does not audit radiopharmaceutical administrations. CMS has no quality measures for radiopharmaceutical administrations.

*Recommended correction to SECY-22-0043:*

Additionally, staff looked at other possible organizations to assess whether they exist to evaluate and promote the safe medical use of radioactive materials, including regulation and monitoring by the U.S. Food and Drug Administration, the U.S. Centers for Medicare and Medicaid Services, and Joint Commission on Accreditation of Healthcare Organizations. No other organization plays a role in the safe administration of radioactive materials to patients.

*Supporting evidence:*

- None required.

**Excerpt 19**

*Excerpt that requires correction:*

The International Atomic Energy Agency classifies extravasation as a type of misadministration that involves the wrong route of administration, and recommends that nuclear medicine services have procedures to prevent, monitor for, manage, and document all misadministrations.

*Source:* SECY-22-0043, page 9

*Why the information should be corrected:*

**NRC did not ensure completeness and reliability of the information. NRC omitted critical information.** This statement should be corrected because it leads the Commission to believe that the medical staff recommendation would be aligned with IAEA guidance. In fact, the staff's Option 2 is most clearly aligned. Here is the complete IAEA position that the medical staff referenced in the footnotes:

> "Another type of misadministration is to use the wrong route of administration, which includes complete extravascular injections that **can result in very high absorbed exposure** at the injection site especially if the volume is small, the activity is high, and the radiopharmaceutical has a long retention time."
>
> When an extravasation occurs, the staff should do the following:
> "**Immediately use all available means to minimize any adverse effects**; Inform responsible nuclear medicine physician; **Inform patient and referring physician; Calculate dose; Indicate corrective measures; Implement measures**; **Submit report** to the head of the department, to the radiation protection committee and, **if required, to the regulatory authority**; Inform all staff of the accident/incident and the corrective measures implemented."

By implementing a dose-based threshold for extravasations like every other medical event, NRC would be encouraging licensees to address extravasations in the manner that medical event reporting is intended to cause. Such an action would also align U.S. policy with that of the IAEA, an authoritative body that NRC states they use for guidance.

*Recommended correction to SECY-22-0043:*

The International Atomic Energy Agency classifies extravasation as a type of misadministration that involves the wrong route of administration. IAEA recognizes that large extravasations can result in high absorbed tissue dose. IAEA recommends that in case of an extravasation, nuclear medicine clinicians should do the following:

> "Immediately use all available means to minimize any adverse effects; Inform responsible nuclear medicine physician; Inform patient and referring physician; Calculate dose; Indicate corrective measures; Implement measures; Submit report to the head of the department, to the radiation protection committee and, if required, to the regulatory authority; Inform all staff of the accident/incident and the corrective measures implemented."

These recommendations are aligned with current NRC medical event reporting regulations if extravasations were reportable using a dose-threshold criterion.

*Supporting evidence:*

- International Atomic Energy Agency's FAQs on misadministrations in diagnostic nuclear medicine. https://www.iaea.org/resources/rpop/health-professionals/nuclear-medicine/diagnostic-nuclearmedicine/misadministrations

## Excerpt 20

*Excerpt that requires correction:*

[The patient injury criterion option]…would allow reporting of extravasation events that meet the public health and safety significance criteria for abnormal occurrences.

*Source:* SECY-22-0043, page 10

*Why the information should be corrected:*

**NRC did not ensure reliability of the information.** This information should be corrected because it provides the Commission with the incorrect belief that NRC will be meeting its statutory responsibility to Congress. There is no evidence that that requiring patients to self-report will result in AOs being reported to Congress as required. If a patient experiences an absorbed dose to their tissue that exceeds 10.0 Gy, but does not self-report, then NRC will not fulfill its Congressional obligation. As previously described in Excerpt 14 it is unlikely that patients will self-report extravasations.

*Recommended correction to SECY-22-0043:*

[The patient injury criterion option]…would **NOT** ensure reporting of extravasation events that meet the public health and safety significance criteria for abnormal occurrences. Because of previously cited deficiencies in having patients self-report, staff is not confident that absorbed doses >10.0 Gy will be reported as required to Congress.

*Supporting evidence:*

- None required.

## Excerpt 21

*Excerpt that requires correction:*

Extravasations are rarely significant from a radiation safety risk perspective.

*Source:* SECY-22-0043, page 11

*Why the information should be corrected:*

**NRC did not ensure accuracy, completeness, and reliability of the information. NRC omitted critical information and is also biased.** This information should be corrected because it misled the Commission regarding the danger of extravasations and the risk to patients when they are extravasated. The medical staff has not provided the Commission with evidence that shows the absorbed doses to tissue from large extravasations and literature that described the adverse tissue effects and stochastic effects from these doses. This information should not have passed concurrence, since it disregards the LNT model and the

ALARA principle that NRC has recently reconfirmed. The information is also a common theme from the community that needs to be assessed critically. Large extravasations that result in high absorbed doses can result in high radiation risk. They can also compromise the nuclear medicine procedure used as part of patient care, which has a cost. A basic radiation protection tenet espoused by NRC and the radiation protection community is that high absorbed doses of radiation to healthy tissue is not beneficial for patients and increases their risk for adverse tissue effects and cancer; the staff has not provided any evidence to the contrary that these high doses do not result in high radiation safety risk. Staff cannot provide evidence, since extravasations are not identified, not measured, and patients are not followed. NRC has stated in the past that just because one does not see an outcome, does not mean that the outcome did not occur. The Guide for Diagnostic Nuclear Medicine, authored by leading members of SNMMI, is posted on the NRC website. It states:

> "Deterministic effects occur only after relatively high dose levels that exceed the threshold for those effects, **usually a dose on the order of 100 rem (1Sv)."**

As noted above, the recent Health Physics publication demonstrated how routinely-used diagnostic and therapeutic radiopharmaceutical extravasations can result in extremely high tissue doses in large volumes of tissue. These examples are significant from a radiation safety risk perspective and as demonstrated to NRC, **they happen frequently**.

*Recommended correction to SECY-22-0043:*
Large extravasations can result in high absorbed tissue doses, which are associated with adverse tissue effects and increasing stochastic effects. SNMMI has also stated that extravasations can negatively affect the quality and quantification of diagnostic procedures and the delivery of therapeutics. This comment has been confirmed through staff review of numerous peer-reviewed articles which either show how a large extravasation has affected patient care or described how the extravasation may have affected care. Large extravasations can also exceed the medical event reporting threshold, which may not necessarily result in patient harm, but may indicate a potential issue in how a licensee handles medical isotopes.

*Supporting evidence:*
- Petition for rulemaking; denial of dockets PRM-20-28, PRM-20-29, and PRM-20-30. 86 FR 45923, August 17, 2021. https://www.govinfo.gov/app/details/FR-2021-08-17/2021-17475/summary
- Siegel, J.A. Guide for Diagnostic Nuclear Medicine. Society of Nuclear Medicine. 2002. https://www.nrc.gov/docs/ML0222/ML022250828.pdf
- Petition for Rulemaking PRM-35-22, posted June 8, 2020. https://www.regulations.gov/document/NRC-2020-0141-0001
- NRC Requests Comments on Additional Rulemaking for Extravasations. SNMMI Press Release, September 29, 2020. https://www.snmmi.org/NewsPublications/NewsDetail.aspx?ItemNumber=34704

**Excerpt 22**

*Excerpt that requires correction:*

…extravasations are not fully preventable so licensees should not have to report them as medical events…

*Source:* SECY-22-0043, page 11

*Why the information should be corrected:*

**NRC did not ensure accuracy, completeness, and reliability of the information. NRC omitted critical information and is also biased.** This information should be corrected because it reinforces the misinformation the Commission has read about extravasations being virtually impossible to avoid. The information is unreliable. It fails to acknowledge that more than 99% of radiopharmaceutical extravasations could be prevented in the future by adopting improved training, new tools and techniques. Just because extravasations are not 100 percent preventable is NO REASON to avoid reporting. Medical event reporting exists because no medical event is fully preventable.

*Recommended correction to SECY-22-0043:*

If extravasations exceed the reporting dose threshold, they should be considered medical events because they are delivered through the wrong route of administration. They are caused by human error, lack of quality procedures, and lack of training.

*Supporting evidence:*

- Wang CL, Cohan RH, Ellis JH, Adusumilli S, Dunnick NR. Frequency, management, and outcome of extravasation of nonionic iodinated contrast medium in 69,657 intravenous injections. Radiology. 2007;243(1):80-7.
- Dykes TM, Bhargavan-Chatfield M, Dyer RB. Intravenous contrast extravasation during CT: a national data registry and practice quality improvement initiative. J Am Coll Radiol. 2015;12(2):183-91.
- Comment (463) from the Association for Vascular Access on FR Doc # 2020-19903. https://www.regulations.gov/comment/NRC-2020-0141-0466

**Excerpt 23**

*Excerpt that requires correction:*

…unlike other medical events, the occurrence of an extravasation does not necessarily indicate a potential problem in a medical facility's use of radioactive materials nor does it mean the administration deviated from the written directive or the authorized user physician's intent.

*Source:* SECY-22-0043, page 11

*Why the information should be corrected:*

**NRC did not ensure accuracy, completeness, and reliability of the information. NRC omitted critical information and is also biased.** This information should be corrected because it provides the Commission with incorrect information that falsely describes an extravasation and inappropriately suggests extravasations should not be considered a medical event. An extravasation clearly indicates that an administration deviated from a written directive. An extravasation is an **inadvertent** injection of the radiopharmaceutical into the tissue. No written directive would call for an extravasation. In diagnostic procedures that do not require a written directive, an extravasation also deviated from the authorized user physicians' intent. Diagnostic procedures using peripheral IV administration require an injection as a bolus

into the venous system. Centers who routinely inject radiation into patient tissue that result in radiation doses that exceed the reporting criteria are clearly demonstrating a potential problem in their use of radioactive materials. The information provided to the Commission is not supported by any scientific evidence and is in direct conflict with statements from the international authoritative body IAEA.

A center that routinely extravasates patients does have a problem in the way it uses radioactive materials. The fact that some licensees do not routinely extravasate and other centers extravasate every other patient is evidence that indicates that the problem can be corrected.

*Recommended correction to SECY-22-0043:*
…like other medical events, the occurrence of an extravasation can indicate a potential problem in a medical facility's use of radioactive materials. An extravasation is an inadvertent injection into the tissue. By definition, it means the administration deviated from the written directive or the authorized user physician's intent.

*Supporting evidence:*
- International Atomic Energy Agency's FAQs on misadministrations in diagnostic nuclear medicine. https://www.iaea.org/resources/rpop/health-professionals/nuclear-medicine/diagnostic-nuclearmedicine/misadministrations

**Excerpt 24**
*Excerpt that requires correction:*
The NRC's existing medical use regulations are protective of public health and safety, and even without a regulation for reporting extravasations, significant extravasations would still be clinically addressed by physicians.

*Source:* SECY-22-0043, page 11

*Why the information should be corrected:*
**NRC did not ensure accuracy, completeness, and reliability of the information. This information is also biased.** This information should be corrected because it misleads the Commission into thinking patients are currently protected. **They are not.** NRC estimates that were it not for their current exemption, an estimated 28,000 patients are receiving doses that exceed medical event reporting limits. These 28,000 extravasated patients would likely disagree strongly that NRC's existing medical use regulations are protective of public health. Furthermore, since these patients are not being reported to the NRC at this time, they are also not aware that they have been extravasated, that their tissue has been irradiated with potentially high doses of radiation, and their procedure and possibly their treatments have also been compromised. These patients have not and will not be clinically addressed by physicians.

*Recommended correction to SECY-22-0043:*
Due to the existing reporting exemption, the NRC's existing medical use regulations are not protective of public health and safety for extravasated patients. Based on medical staff estimates, it is likely that over 28,000 patients are receiving large extravasations annually. These patients are not routinely being informed since centers are not adequately monitoring for or characterizing extravasations. NRC is not protecting these patients and future patients.

*Supporting evidence:*

- Commission Paper, SECY-22-0043. May 9, 2022. https://www.nrc.gov/docs/ML2126/ML21268A006.pdf

**Excerpt 25**

*Excerpt that requires correction:*

Monitoring for extravasation would require taking an image over the injection site soon after administration or using some type of radiation detector device to monitor the administration. If an extravasation were detected, the licensee would then need to calculate radiation dose to determine if the extravasation exceeded the 50-rem dose threshold for reporting.

*Source:* SECY-22-0043, page 11

*Why the information should be corrected:*

**NRC did not ensure completeness, and reliability of the information. NRC omitted critical information and is also biased.** This information should be corrected because leads the Commission to believe that licensees would need to do something dramatically different than what they should be doing now. This information requires critical review. Current medical guidelines state that clinicians should monitor for and characterize extravasations to assess the effects of the extravasation on the patient's procedure. This effort currently takes just a few minutes. Any incremental cost/time to the center is not material – after all, the centers should already be doing these activities. The medical staff failed to make the natural comparison to the work expended to ensure MRI and CT contrast delivery quality or the comparison to the work and investment that is made by radiology to detect, characterize, and mitigate CT and MRI contrast medium extravasations and then clinically follow patients. Nor did they mention that the medical community monitors over 100 million contrast CT and MRI injections annually. Monitoring and characterizing nuclear medicine administration pales in comparison. ACR guidance is prescriptive and thorough and warrants review. Similar to the approach in reporting contrast CT and MRI extravasations, clinically insignificant (<10ml for contrast, <.5 Sv for nuclear medicine), would not require reporting or characterization.

Unfortunately, monitoring in nuclear medicine is generally not happening at this time because centers are not required to report when an extravasation occurs. NRC's exemption is detrimental to radiation protection and patient care.

*Recommended correction to SECY-22-0043:*

Licensees should be monitoring for extravasations today and many say that they do monitor. However, due to the difficulties in technologist and patient awareness of a radiopharmaceutical extravasations, current monitoring processes would require improvement through imaging at time of injection or use of commercially available Geiger counters, ion chambers, or other measurement sensors. If an extravasation were detected, the licensee would then need to follow a quick characterization process to determine if the dose to tissue might exceed the reporting threshold. If necessary, the licensee would calculate radiation dose to determine reporting and in accordance with medical guidelines further assess the impact of the extravasation on the procedures. The incremental time required for more advanced monitoring is ~ 1-2 minutes. All other activities are not incremental to what licensees should be doing clinically at this time, and typically less than what is required for contrast CT and MRI administrations.

*Supporting evidence:*

- Shaqdan K, Aran S, Thrall J, Abujudeh H. Incidence of contrast medium extravasation for CT and MRI in a large academic medical centre: a report on 502,391 injections. Clin Radiol. 2014;69(12):1264-72.
- Boellaard R, et al. European Association of Nuclear M. FDG PET/CT: EANM procedure guidelines for tumour imaging: Version 2.0. Eur J Nucl Med Mol Imaging 42: 328-54; 2015. (Note: this is the guideline used by US physicians for PET/CT imaging procedures)

## Excerpt 26

*Excerpt that requires correction:*

However, the NRC's medical event reporting criteria are set at conservative levels that would rarely cause patient harm, and this low-dose threshold for reporting could result in tens of thousands of extravasation events of low radiation-safety significance reported annually with no corresponding benefit to patient safety.

*Source:* SECY-22-0043, page 12

*Why the information should be corrected:*

**NRC did not ensure accuracy, completeness, and reliability of the information.** This information should be corrected because it leads the Commission to believe that there is no benefit to patient safety by eliminating tens of thousands of large radiopharmaceutical extravasations. Additionally, the statement suggests that NRC medical staff does not understand their own radiation protection approach of using the risk-informed thresholds to look for potential issues **before patients are exposed to higher doses that could result in injury.** Without monitoring, licensees are unable to mitigate extravasations when they occur to reduce the dose to tissue. This has a direct impact on patient safety.

If the 0.5 Sv threshold is not providing a benefit to patient safety, why has NRC been using it for the past 21 years? The medical staff should reexamine the reasons the NRC provided for denying three petitions on August 17, 2021.

*Recommended correction to SECY-22-0043:*

The NRC's medical event reporting criteria are set at conservative levels that would rarely cause patient harm and are intended to reveal which centers are potentially having issues in handling medical isotopes with the hope that these can be corrected before patients are injured. If licensees are informed that rulemaking will be initiated to ensure that extravasations that exceed 0.5 Sv are reportable, this will drive licensees to act to reduce the occurrence of the tens of thousands of extravasation events that might be reportable annually. Since monitoring will also provide licensees the opportunity to mitigate dose to tissue, a decision to make extravasations that exceed the objective dose-based threshold reportable will drive significant benefits to patient safety.

*Supporting evidence:*

- Petition for rulemaking; denial of dockets PRM-20-28, PRM-20-29, and PRM-20-30. 86 FR 45923, August 17, 2021. https://www.govinfo.gov/app/details/FR-2021-08-17/2021-17475/summary

## Excerpt 27

*Excerpt that requires correction:*
Requiring the reporting of events of low radiation-safety significance would not align with the objectives of medical event reporting nor the NRC's Medical Use Policy Statement.

*Source:* SECY-22-0043, page 12

*Why the information should be corrected:*
**NRC did not ensure accuracy, completeness, and reliability of the information.** This information should be corrected because it implies that the existing 0.5 Sv threshold does not support the medical event reporting process and does not support the Medical Use Policy Statement. If centers were required to report extravasations and perform root cause analysis, then they would find the contributing factors that lead to extravasations. By addressing these factors, extravasation rates would be significantly reduced and radiation safety for patients would be increased as technologists learned how to ensure they were administering radiopharmaceuticals in accordance with physician direction.

*Recommended correction to SECY-22-0043:*
Requiring the reporting of extravasation events that exceed the existing objective dose-based threshold provides clarity and consistency for licensees and aligns with the objectives of medical event reporting to reduce the number of misadministrations that result from human error, lack of training or lack of quality procedures. It would also support the NRC's Medical Use Policy Statement by providing for the radiation safety of the general public (including patients) and by regulating the radiation safety of patients to ensure the use of radionuclides is in accordance with the physician's directions.

*Supporting evidence:*
- US Nuclear Regulatory Commission Rules and Regulations, Title 10, Chapter 1, Code of Federal Regulations – Energy. Commission Notices. Policy Statements: Medical Uses. https://www.nrc.gov/reading-rm/doc-collections/commission/policy/65fr47654.pdf

## Excerpt 28

*Excerpt that requires correction:*
The staff estimates that costs for licensees to comply with Option 2 could approach $140 million per year (see the "Description of Rulemaking: Estimate of Resources" section of this paper for details of this cost estimate); the staff considers this to be a low estimate.

*Source:* SECY-22-0043, page 12

*Why the information should be corrected:*
**NRC did not ensure accuracy, completeness, and reliability of the information. NRC omitted critical information and is also biased.** This information should be corrected because it misrepresents the cost and benefits of protecting patients from large extravasations. The analysis does not account for the benefits patients gain by avoiding unnecessary doses of radiation to healthy tissue. It also ignores the associated costs to society of unnecessary procedures, repeat imaging and additional purchases of diagnostic doses or the extremely expensive radiotherapeutic doses, incorrect treatments, and follow-up visits for patients and payers. It completely ignores the holistic cost to the patient. It neglects recent studies from Fox Chase Cancer Center and an Italian hospital that discuss how equipment commonly available in licensees' facilities

can be used to monitor for extravasations. This information should not have passed concurrence. NRC policies suggest that the cost of providing reasonable radiation protection for the public cannot be used as an excuse. The steps required by licensees are reasonable as previously demonstrated by the effort in place to monitor Contrast CT and MRI administrations and the effort to characterize extravasations in these procedures.

*Recommended correction to SECY-22-0043:*
The staff estimates that benefits to the public far outweigh the costs for licensees to comply with Option 2 (see the "Description of Rulemaking: Estimate of Resources" section of this paper for details of this cost estimate).

*Supporting evidence:*

- Berry K, Kendrick J. Lutetium-177 radiopharmaceutical therapy extravasation lessons learned. Health Phys [Internet]. 2022 Mar 22. https://www.ncbi.nlm.nih.gov/pubmed/35318982
- Mauro L, et. al. Safety Injections of Nuclear Medicine radiotracers: towards a new modality for a real-time detection of extravasation events and 18F-FDG SUV data correction. September 8, 2022. https://assets.researchsquare.com/files/rs-2009242/v1/a89fec81-860b-4ca2-bfab-9f73f2be19d4.pdf?c=1662656880

**Excerpt 29**

*Excerpt that requires correction:*
To implement Option 2, the NRC and Agreement States would require significant resources to review tens of thousands of extravasation events of low radiation-safety significance annually to screen for significant events.

*Source:* SECY-22-0043, page 12

*Why the information should be corrected:*
**NRC did not ensure accuracy, completeness, and reliability of the information. NRC omitted critical information and is also biased.** This information should be corrected because it is inaccurate and does not consider how reporting requirements would drive reductions in extravasation rates. If NRC were to announce that extravasations that exceed the existing dose threshold will be reportable, then hospitals would apply the same processes that they have used to drive down extravasation rates in contrast CT and MRI injections prior to that rule taking effect. **Based on 18,500,000 administrations and a 0.00108 extravasation rate, fewer than 20,000 extravasations would occur every year and only 200 would be reportable, according to the NRC's own estimates.**

*Recommended correction to SECY-22-0043:*
By implementing Option 2, the NRC and Agreement States expect that licensees would work to reduce their extravasations. Evidence suggests that these improvements could come quickly, in less than a year for licensees that focus on this issue. Our estimates suggest that at the time of rulemaking implementation, NRC and Agreement States should expect approximately 200 reportable events and this number should progressively decrease over time as lessons learned are applied.

*Supporting evidence:*

- Wong TZ, Benefield T, Masters S, Kiser JW, Crowley J, Osborne D, et al. Quality Improvement Initiatives to Assess and Improve PET/CT Injection Infiltration Rates at Multiple Centers. J Nucl Med Technol. 2019;47(4):326-31.

## Excerpt 30

*Excerpt that requires correction:*

**Option 3, "Extravasation events that require medical attention for suspected radiation injury,"** would be a non-dose-based option for reporting extravasations. If a patient requires medical attention for suspected radiation injury from an extravasation, then this extravasation would require medical event reporting.

*Source:* SECY-22-0043, page 12

*Why the information should be corrected:*

**NRC did not ensure accuracy of and unbiased information. NRC is biased.** This information should be corrected because it should have never passed concurrence. In 1980, the Commission abandoned the option to use clinically detectable adverse events (patient injury) as a reporting criterion. Furthermore, in 2002, NRC adopted a risk-informed objective, dose-based threshold for reporting medical events after receiving input from physicians and Congress. Now that the physicians have seen evidence that extravasations can exceed the risk-informed threshold, the physicians suggested the medical staff use patient injury as confirmed by an authorized user physician as the criterion.

*Recommended correction to SECY-22-0043:*

**Option 3, "Extravasation events that require medical attention for suspected radiation injury,"** as suggested by the medical community in collaboration with the ACMUI would be a non-dose-based option for reporting extravasations. If a patient requires medical attention for suspected radiation injury from an extravasation, then this extravasation would require medical event reporting. However, this suggestion is inconsistent with previous Commission decisions and ignores the risk-informed threshold adopted in 2022 with ACMUI endorsement when the medical event reporting criteria was updated.

*Supporting evidence:*

- Misadministration Reporting Requirements, 45 Fed. Reg. (May 14, 1980): 31701-31705. Page 17.
- Federal Register. Volume 67, No. 79. April 24, 2002. Page 20250.
- Official Transcript of Proceedings Nuclear Regulatory Commission, Meeting of the Advisory Committee on the Medical Use of Isotopes, September 2, 2021. https://www.nrc.gov/docs/ML2128/ML21286A807.pdf

## Excerpt 31

*Excerpt that requires correction:*

Option 3 would improve patient safety by screening out extravasations of low radiation-safety significance and allowing the NRC to collect and analyze operating experience on radiation-safety-significant extravasations.

*Source:* SECY-22-0043, page 13

*Why the information should be corrected:*
**NRC did not ensure accuracy, completeness, and reliability of the information. NRC omitted critical information and is also biased.** This information should be corrected because it is repeating information suggesting the Commission should believe that extravasations do not put patients at risk and that the staff recommendation will result in meaningful data and improvement. These issues have been previously addressed in other excerpts.

*Recommended correction to SECY-22-0043:*
Because patients are unlikely to report injury for reasons previously cited, Option 3 would not improve patient safety or allow the NRC to collect and analyze operating experience. Option 3 will not change licensee behavior and will not allow NRC to gain insight into generic factors that could be used to improve radiopharmaceutical administrations.

*Supporting evidence:*
- LTR-23-0009 Mary Ajango, Spokesperson, Young Survival Coalition, Patients for Safer Nuclear Medicine Coalition Spokesperson, Letter re: NRC's decision about extravasations. https://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML23011A041

**Excerpt 32**
*Excerpt that requires correction:*
The staff evaluated the rulemaking's impacts as follows:
Medium contributor toward the NRC's Principles of Good Regulation by implementing two principles: (1) enhancing the agency's independence as a regulator through ethical and professional performance that has been informed by objective, unbiased assessments of all information provided by stakeholders and (2) enhancing the agency's ability to uphold its safety mission in an open and transparent way through medical event reporting of radiation-safety-significant extravasations.

*Source:* SECY-22-0043, page 15

*Why the information should be corrected:*
**NRC did not ensure accuracy, completeness, and reliability of the information. NRC omitted critical information and is also biased.** The medical staff's assessment has NOT been informed by objective, unbiased evaluation of all information provided by stakeholders. The influence of the medical societies and the ACMUI has been readily observable. Had the staff been interested in objective and unbiased assessment, they would have visited centers in the field and seen how radiopharmaceuticals are administered. They would have visited centers that claim to monitor and those that actually monitor. Additionally, NRC has NOT been transparent with the content of, nor the process of their regulatory analysis. Contributions from ACMUI and the medical societies to the original draft of the staff paper were documented in an email exchange with NRC. Furthermore, the lack of transparency in providing this staff paper to the public is evidence that NRC did not follow an open process. Had the staff presented this information prior to the Commissioners' reviews, the public would have discovered many inaccurate and misleading statements that also omit critical information. An open process would have allowed the public to correct those statements and resulted in the Commissioners making decisions using an evidence-based approach.

**There is NO appropriate recommended correction** for the misinformation provided by the staff here.

*Recommended correction to SECY-22-0043:*
None can be provided (see above).

*Supporting evidence:*
- Lucerno letter to NRC, August 31 2021. https://documents.lucerno.com/NRC_Communications/2021-08-31%20Lucerno%20Input%20for%20September%202%2C%202021%20Meeting_signed.pdf

## Excerpt 33

*Excerpt that requires correction:*
Using the estimated extravasation assumptions outlined in fn. 31, the staff assumed that (1) monitoring all 18.5 million radiopharmaceutical IV administrations for extravasation would take, on average, an additional 90 seconds per administration, (2) performing dosimetry using the standardized dosimetry model that the NRC would provide would take an average of 15 minutes for each of the 2.8 million extravasations, and (3) reporting the 28,000 reportable extravasation events and following up with regulators as needed would take an average of 1 hour per event.

*Source:* SECY-22-0043, page 16 footnote 36

*Why the information should be corrected:*
**NRC did not ensure accuracy, completeness, and reliability of the information. NRC omitted critical information and is also biased.** This information should be corrected because it grossly overestimates the work that would be involved. If NRC required dose-based threshold reporting, licensees would fix their extravasations rates rather than ignoring them as they do now. Using reasonable estimates of what is an achievable extravasation rate to drive dosimetry conversations, and the NRC estimates of 1% of these extravasations being large enough to report. The community would need to do dosimetry on a maximum of 20,000, not 2.8M extravasations, and report on 200, not 28,000.

If made reportable, licensees will have to fix the factors that contribute to extravasations. This will cause the extravasation rate to drop, as it has in MRI and CT administrations.

*Recommended correction to SECY-22-0043:*
Using the estimated extravasation assumptions outlined in fn. 31, the staff assumed that (1) monitoring all 18.5 million radiopharmaceutical IV administrations for extravasation would take, on average, an additional 90 seconds per administration, (2) performing dosimetry using the standardized dosimetry model that the NRC would provide would take an average of 5 minutes for each of the 20,000 extravasations, and (3) reporting the 200 reportable extravasation events and following up with regulators as needed would take an average of 1 hour per event.

*Supporting evidence:*
- Shaqdan K, Aran S, Thrall J, Abujudeh H. Incidence of contrast medium extravasation for CT and MRI in a large academic medical centre: a report on 502,391 injections. Clin Radiol. 2014;69(12):1264-72.

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**Excerpt 34**

*Excerpt that requires correction:*

Option 2 may result in a marginal increase in patient safety versus Option 3, but that increase would be far outweighed by the significant increase in regulatory burden and costs for licensees to comply with Option 2 and Agreement States and the NRC to implement Option 2.

*Source:* SECY-22-0043, page 17

*Why the information should be corrected:*

**NRC did not ensure accuracy, completeness, and reliability of the information. NRC omitted critical information and is also biased.** This information should be corrected because the cost benefit analysis does not account for the benefit of monitoring for extravasations. The emphasis is on minimizing reporting, rather than minimizing extravasations. The staff ignores the positive impact of Option 2. They do not account for reductions in extravasations. Notifying licensees that extravasations will be handled like any other medical event would eliminate hundreds of thousands of patient extravasation cases. Those centers would be incentivized to take incremental actions to ensure they provide safe nuclear medicine procedures and avoid potential reputational harm.

The medical staff also grossly miscalculates the regulatory burden to licensees. They estimate the cost to society of licensees having to monitor for extravasations, even though licensees should already be monitoring and have existing monitoring equipment available on site. However, they neglect to capture value for improved radiation protection and ignore the healthcare savings that result from reducing compromised nuclear medicine procedures. NRC has consistently recognized that compromised images can negatively affect treatment, reimaging, and additional unnecessary procedures (points substantiated in peer-reviewed articles submitted to NRC). Yet, the medical staff did not provide the Commission with saving estimates, even though these savings would dwarf the expected monitoring costs.

Furthermore, the medical staff overestimates the patient safety benefits of Option 3. There is no evidence that Option 3 will reduce extravasations. Instead, it places a substantial burden on the patient, which is exactly why the medical societies proposed it.

*Recommended correction to SECY-22-0043:*

Option 2 will result in a dramatic increase in patient safety versus Option 3, with a marginal increase in regulatory burden. Societal cost would be dwarfed by the benefits of reducing wrong treatment, repeat imaging, unnecessary procedures, and extra visits by patients.

*Supporting evidence:*

- Misadministration Reporting Requirements, 45 Fed. Reg. (May 14, 1980): 31701-31705. Page 17.
- Federal Register. Volume 67, No. 79. April 24, 2002. Page 20250.

**Excerpt 35**

*Excerpt that requires correction:*

Additionally, during the December 8, 2020, public meeting, the staff received comments that overregulation of extravasation could have a chilling effect on nuclear medicine, discouraging physicians from going into nuclear medicine (and especially pediatric nuclear medicine, where patient intervention is a concern and specialized pediatric venipuncture teams are needed to establish IV access in children).

*Source:* SECY-22-0043, page 17

*Why the information should be corrected:*

**NRC did not ensure accuracy, completeness, and reliability of the information. NRC omitted critical information and is also biased.** This information should be corrected because it is simply an attempt by the regulated industry and the medical staff to scare the Commissioners away from doing the right thing. Chairman Hanson even mentioned this point in his Notation Vote comments. Nuclear medicine centers already spend an enormous amount of time and money to ensure the quality of their procedures. Monitoring for extravasations and characterizing those that occur are already expected of these centers by their guidelines.

Furthermore, medical staff did not mention that during this December 8, 2020 meeting, an ACMUI member misled the NRC and the public by citing a million-patient clinical study which resulted in a very small number of adverse events. The ACMUI member failed to disclose that extravasations and their damage to tissue were excluded from being recorded as an adverse event.

NRC has not demonstrated their ability to discern fact from fear mongering in comments from those they regulate. Including such “chilling effects” comments, may have biased Commissioners without cause.

*Recommended correction to SECY-22-0043:*

Additionally, during the December 8, 2020, public meeting, the staff received comments that overregulation of extravasation could have a chilling effect on nuclear medicine, discouraging physicians from going into nuclear medicine (and especially pediatric nuclear medicine, where patient intervention is a concern and specialized pediatric venipuncture teams are needed to establish IV access in children). Staff has researched this issue and concluded that there is no basis for such claims. The investment to correct extravasations would be a minimal expense compared to the expenditures licensees already make today to ensure quality procedures. Furthermore, in pediatric nuclear medicine there is an even greater concern for extravasations and stochastic effects. Reducing extravasations in pediatric centers, if they are not already reduced, would be very beneficial to society.

*Supporting evidence:*

- Boellaard R, et al. European Association of Nuclear M. FDG PET/CT: EANM procedure guidelines for tumour imaging: Version 2.0. Eur J Nucl Med Mol Imaging 42: 328-54; 2015. (Note: this is the guideline used by US physicians for PET/CT imaging procedures)

**How Lucerno and Patients are Affected by the Information for Which We Seek Correction**

As required as part of an Information Correction Request, these information quality failures negatively affect Lucerno and nuclear medicine patients. Lucerno petitioned NRC to remove the incorrect reporting exemption so that extravasations that exceed 0.5 Sv would be reported to NRC and patients. We remain confident that removing the exemption would encourage licensees to substantially reduce nuclear medicine extravasation rates, resulting in improved radiation protection for patients. The Commission relied on flawed information in SECY-22-0043, and therefore could not make a sound regulatory decision. As described in the excerpts above, this decision will not reduce extravasations, and will increase the burden on patients.

**Conclusion**

SECY-22-0043 provided information that did not meet the quality standards of the NRC Information Quality Guidelines. As a result, the Commission Paper did not provide information that enhances sound decision-making by the Commission. Rather, the Commission Paper provided after-the-fact rationalization for the 1980 exemption policy, minimized future reporting of extravasations that should be shared with NRC and Congress, and delayed appropriate regulatory actions. The paper did not support the statutory mission of NRC to ensure that civilian uses of nuclear materials in the United States in medical applications are carried out with proper regard and provision for the protection of the public health and safety.

Approving the petition and ensuring that extravasations that exceed the current NRC objective dose-based thresholds for all other medical events would provide worthwhile, substantial safety improvements, would:

- ensure consistency with actions suggested by the International Atomic Energy Agency and existing NRC medical event reporting regulations, and
- encourage licensees to adopt industry standards already used to reduce extravasations in other radiology procedures (e.g., contrast CT and MRI administrations) and oncology chemotherapy administrations.

We respectfully request fair and timely consideration of the facts and evidence through this Information Correction Request. We suggest that the Commission immediately issue Interim Staff Guidance to ensure radiation protection of patients. Guidance could include:

- Initiating rulemaking to ensure extravasations are reported using the existing dose-based threshold,
- standardizing an extravasation dosimetry model for tissue using the latest published method, and
- requiring licensees begin immediate efforts to monitor for and reduce extravasations.

Thank you for your consideration.

Sincerely,

Ronald K. Lattanze

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