The University of Michigan
EHS-Radiation Safety Service
1239 Kipke Dr., Ann Arbor, MI 48109-1010
July 3, 2025

Report of Potential Medical Event on June 12, 2025

In accordance with 10 CFR 35.3045(d), the University of Michigan (U-M) is submitting this written report to summarize a potential medical event occurring on June 12, 2025. The potential medical event was reported to the NRC Operations Center on June 20, 2025, by Karl Fischer, Radiation Safety Officer and Director, EHS-Radiation Safety Service (RSS). This report summarizes the events prompting notification, assessed causes, and proposed corrective actions.

Licensee:	The Regents of the University of Michigan
License Number:	21-00215-04
Facility:	University of Michigan Health
NRC Operations Center Event Report No.:	57771
Prescribing Physician:	Ben Viglianti, MD, PhD, Nuclear Medicine Service Chief
Referring Physicians:	Tasha Hughes, MD; Michael Sabel, MD; Chaz Stucken, MD

Description of Event

On June 12, 2025, four patients were scheduled to receive intradermal injections of 3 mCi of filtered Tc-99m sulfur colloid (administered as three to four separate injections of 0.75 to 1 mCi) for lymphoscintigraphy; three patients at 0800 and one at 0900. Lymphoscintigraphy involves injecting filtered Tc-99m sulfur colloid intradermally at sites surrounding a cancerous skin lesion, ensuring the filtered Tc-99m sulfur colloid enters all intradermal lymph vessels draining from the site of the lesion. The filtered Tc-99m sulfur colloid migrates from the injection sites to the lymph nodes most likely to be metastatically affected, allowing a surgeon to identify sentinel lymph nodes using a scintillation detector (and dye) and remove them surgically.

Instead of receiving 3 mCi of filtered Tc-99m sulfur colloid, all four patients received 3 mCi of filtered Tc-99m mebrofenin (in three or four separate injections of 0.75 to 1 mCi). Tc-99m mebrofenin is typically administered intravenously for diagnostic imaging of the liver and gallbladder, and it distributes quickly into the body to permit timely and effective imaging; the typical administered activity for Tc-99m mebrofenin is 5 mCi. All syringes were labeled as filtered Tc-99m sulfur colloid (with the correct prescribed dosage of 3 mCi), so the required verification of radiopharmaceutical and dosage by the administering nuclear medicine technologists (NMT) could not detect the dispensing error. The error was discovered around 1000 by Nuclear Medicine physicians evaluating imaging of the morning's patients, when the Tc-99m was observed to be migrating to the liver and gallbladder, along with the lymph nodes in the vicinity of the injection site.

Imaging for these lymphoscintigraphy patients showed the injected Tc-99m mebrofenin activity had traveled well into the systemic circulatory system and distributed into the liver and gallbladder within 20 minutes after administration. This behavior is characteristic of Tc-99m mebrofenin, which has a shorter effective half-life than sulfur colloid and distributes more widely throughout the body in a short period of time. Discovery of the error was made in time to administer the correct radiopharmaceutical (3 mCi filtered Tc-99m sulfur colloid) to the fourth patient before the patient went to surgery for lymphoscintigraphy; the other three patients had already gone to surgery when the dosing error was detected.

The day's schedule of diagnostic administrations also included three patients receiving Tc-99m mebrofenin for acute vs. chronic cholecystography imaging. All three patients received the correct radiopharmaceutical (Tc-99m mebrofenin) and correct prescribed activity (5 mCi).

Notifications

Following detection of the dosing error, the following personnel were notified on June 12, 2025: the Chief NMT, the lead Nuclear Pharmacist, the Nuclear Medicine Authorized Medical Physicist (AMP), the Nuclear Medicine Service Chief (Authorized User and prescribing physician), and the Nuclear Medicine Division Chief; the patients and their referring physicians were also notified on the same day. Following investigation of the event and root causes by Nuclear Medicine, the Radiation Safety Officer (RSO) was notified on June 17, 2025. After consulting with Nuclear Medicine, the RSO determined on June 19, 2025, that the NRC Operations Center should be notified of a potential medical event under 35.3045(a)(1)(ii)(A), pending further evaluation of the skin dose to the injection site. The RSO notified the Operations Center by phone on June 20, 2025, followed by an e-mail to the Operations Center and Region III program manager.

Dose Evaluation

Because Tc-99m mebrofenin is intended to be administered intravenously for liver and gallbladder studies, the package insert does not include a skin dose (SDE) to the injection site and there is no published data on SDE from intradermal administration. The Nuclear Medicine AMP does not believe the SDE from 3 mCi intradermal Tc-99m mebrofenin would exceed the documented SDE from 3 mCi intradermal Tc-99m sulfur colloid (105 rad) due to the biokinetics of Tc-99m mebrofenin (imaging confirms that it quickly migrated away from the injection site), but the licensee is not confident that the SDE is less than 50 rad (the SDE threshold for a medical event). Due to the uncertainty in the dose estimation and the complex nature of estimating a dose for which there is no published dosimetry, the RSO elected to treat this as a potential medical event (pending further evaluation of the SDE). A medical event notification can be retracted after final assessment of the injection site dose, if necessary.

Subsequent to NRC notification, the RSO contacted the Department of Energy's Radiation Emergency Assistance Center/Training Site (REAC/TS) for assistance with estimating the SDE from intradermal administration of Tc-99m mebrofenin. However, REAC/TS was not able to provide assistance due to the lack of published dosimetry data. The RSO has also contacted the manufacturer (about the potential availability of dosimetry data for intradermal administration) as well as third-party dose reconstruction services (about their ability to provide fee-based estimation of the SDE). The RSO is also working with health physics faculty at the U-M Department of Nuclear Engineering and Radiological Sciences about the potential use of Monte Carlo modeling to estimate the SDE.

Cause of the Event

Immediate investigation by Nuclear Medicine (initiated after detection during review of patient imaging) concluded that a Nuclear Medicine hot lab technician prepared the wrong radiopharmaceutical (filtered Tc-99m mebrofenin instead of filtered Tc-99m sulfur colloid) while preparing multiple radiopharmaceuticals in the same laminar flow hood; it is unclear how the Tc-99m mebrofenin kit was introduced into the hood. The Tc-99m mebrofenin kit was prepared overnight by the on-call technologist.

The dispensing pharmacist drew the correct dosage (3 mCi) of the wrong radiopharmaceutical (Tc-99m mebrofenin) into a syringe; the syringe, syringe shield, and dose carrier were all labeled (as filtered Tc-99m sulfur colloid) and identified per 10 CFR 35.69. Prepared doses are placed on a stainless steel cart in the Nuclear Medicine hot lab, which is a secured room. NMTs gain access to the secured hot lab to retrieve the prepared dose for each patient. Written procedures require NMTs to confirm the identity of each patient by two independent means and to verify the labels on the dose carrier and syringe shield prior to administering the dose to the patient. These procedures were followed appropriately but could not have prevented the dosing error.

Nuclear Medicine and the RSO have identified three root causes:

- The hot lab technician did not read or scan the barcode label on top of what was erroneously assumed to be the Tc-99m sulfur colloid kit (but was actually a Tc-99m mebrofenin kit) when beginning preparation of filtered Tc-99m sulfur colloid.
- The hot lab technician did not properly interpret the lower than usual activity contained in the filtered Tc-99m sulfur colloid vial as indicating a potential preparation error. The filtered Tc-99m sulfur colloid vial typically contains 100-115 mCi of filtered Tc-99m sulfur colloid, but the vial assayed at approximately 50 mCi.
- The hot lab technician correctly prepared another filtered Tc-99m sulfur colloid kit, but without informing others on the hot lab team. This allowed for multiple quality control (QC) samples that were labeled as filtered Tc-99m sulfur colloid. The initial QC sample contained filtered Tc-99m mebrofenin labeled as filtered Tc-99m sulfur colloid. The second QC sample contained filtered Tc-99m sulfur colloid correctly labeled as filtered Tc-99m sulfur colloid. This caused others on the hot lab team to erroneously conclude that the filtered Tc-99m sulfur collide kit had passed QC testing.

Determination of No Significant Medical Effect

The Nuclear Medicine Service Chief determined that administration of the wrong radiopharmaceutical did not (and will not) result in any adverse effect to the patients. According to the package insert, the total body dose for Tc-99m mebrofenin (10 mCi administered intravenously) is 0.2 rad, and the highest organ dose is 4.7 rad to the wall of the upper large intestine. It follows, the doses resulting from administration of 3 mCi would be approximately 30% of those values, with

some uncertainty for the atypical route of administration. Notably, the skin tissue at the injection sites is excised by the surgeon following the lymphoscintigraphy procedure.

On the day of the event, Nuclear Medicine personnel (lead Nuclear Pharmacist and Chief NMT) reviewed surgery reports for the first three patients and observed that Tc-99m mebrofenin remained in the sentinel lymph nodes long enough to allow them to be located by the surgeon(s) using a detection instrument. The Nuclear Medicine Service Chief also reviewed pathology reports for the four patients who erroneously received filtered Tc-99m mebrofenin. Of the 12 total lymph nodes removed from the four patients, 11 showed uptake of both the lymphoscintigraphy dye (methylene blue) and Tc-99m mebrofenin. One lymph node contained the lymphoscintigraphy dye but not Tc-99m mebrofenin. The Nuclear Medicine Service Chief confirms that care for these patients (i.e., removal of potentially cancerous lymph nodes) was not affected by the dosing error, and none of the patients need to repeat lymphoscintigraphy or surgery.

Corrective Actions

Following Nuclear Medicine's detection of the dosing errors on June 12, 2025, and the subsequent investigation by Nuclear Medicine, corrective actions were promptly implemented the following day:

- Previously, personnel compounding (labeling) radiopharmaceuticals in the hot lab cleanroom would label the Tc-99m sulfur colloid kit and filter an aliquot of the kit to prepare the filtered Tc-99m sulfur colloid kit. As of June 13, 2025, the individual compounding the radiopharmaceutical passes the Tc-99m sulfur colloid kit to a second individual in the hot lab for preparation of the filtered Tc-99m sulfur colloid kit. The second individual opens the vial shield to confirm the presence of a Tc-99m sulfur colloid kit inside and then prepares the filtered Tc-99m sulfur colloid kit. This incorporates a second pair of eyes and verification that what is contained inside the vial shield is labeled as Tc-99m sulfur colloid.
- When preparing the filtered Tc-99m sulfur colloid kit in the hot lab software (BioRx), the second individual scans the label affixed to the vial shield containing the Tc-99m sulfur colloid kit, which was visually confirmed in the double-check above. The barcode reader confirms that the second individual is filtering the correct radiopharmaceutical.
- All hot lab personnel were reminded and instructed to "See something, say something." If something seems amiss or if there is any question, verbalize it and discuss with others in the hot lab. Trust your instincts and investigate early.

There have been no additional issues with intradermal administrations of filtered Tc-99m sulfur colloid, including the two that were performed on the afternoon of June 12, 2025. Two previously dispensed doses of filtered Tc-99m mebrofenin that were erroneously labeled as filtered Tc-99m sulfur colloid (but later QC-tested and confirmed to be Tc-99m mebrofenin) were sequestered and discarded. New filtered Tc-99m sulfur colloid doses were prepared, dispensed, and administered to the patients.

Current Status

As of July 3, 2025, RSS continues its investigation and documentation of the event, and the NRC Region III project manager has started an in-office reactive inspection to investigate the circumstances of the event.

From: Ryan Craffey
To: "Fischer, Karl"
Cc: Danielle Sheen; Scott, Peter
Subject: RE: Written report for Event 57771
Date: Monday, July 7, 2025 9:10:00 AM
Attachments: image001.png

Good morning Karl,

This acknowledges receipt of your correspondence dated July 3, 2025, providing a written report for a potential medical event that was discovered on June 19, 2025. The U.S. Nuclear Regulatory Commission (NRC) has reviewed your report and confirms that it was received timely and contained all required information. We will continue our review of this potential medical event through remote inspection activities.

In accordance with the NRC's "Rules of Practice" in Title 10 of the Code of Federal Regulations Section 2.390, a copy of this correspondence will be available electronically for public inspection in the NRC's Public Document Room or in the NRC's Agencywide Documents Access and Management System (ADAMS), accessible from the NRC's website at https://www.nrc.gov/reading-rm/adams.html

Please feel free to contact me if you have any questions or would like to provide any additional information regarding this event. Thank you!

Ryan Craffey
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From: Fischer, Karl <kfisch@med.umich.edu>
Sent: Thursday, July 3, 2025 4:31 PM
To: Ryan Craffey <Ryan.Craffey@nrc.gov>
Cc: Danielle Sheen <drsheen@umich.edu>; Scott, Peter <pjhscott@med.umich.edu>
Subject: [External_Sender] Written report for Event 57771

Mr. Craffey:

Per 35.3045(d), attached is the written report describing a potential medical event that

occurred at University of Michigan Health on June 12, 2025. The event was reported by phone to the NRC Operations Center on June 20, 2025.

Thank you,

Karl Fischer, CHP
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