

Evaluation of a Radiation Imaging Survey Meter for Lu-177 and I-131 Treatment Room Cleanup

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INTRODUCTION

Typically survey meters such as Geiger-Muller (GM) counters or pressurized ion chambers are used to ensure proper handling of radioactive materials and to verify that no contamination is present to ensure both patients and healthcare workers are safe from unnecessary radiation exposure¹.

Radiation contamination and safety surveys in hospitals are essential for maintaining a safe environment for patients, staff, and visitors, ensuring compliance with regulations.

However, with current instrumentation, these surveys can be time consuming, with limited ability to measure type and distance of radioactivity and are susceptible to false negatives and incomplete localization of contamination¹⁻³.



Figure 1: (a) The RAVIN RISM, (b) pancake GM counter, and (c) pressurized ion chamber.

RESULTS

The location and isotope (^{99m}Tc, ¹⁷⁷Lu, ¹³⁷Cs) of all contamination sources in the patient waiting room (fig. 2) were identified by the NMT with a GM in an average (St. Dev) of 134 (43) seconds, while with the RISM the NMTs identified the isotope and location of all sources with an average of 48 (14) seconds (table 1).

The RAVIN (Figure 1) RISM was able to identify areas of deliberate contamination within a patient waiting room (Figure 2) and the time needed to identify the location of the contamination with the RISM was found to be almost 3x less than needed using a standard pancake GM counter (Table 1).

Additionally, following RPT patient treatment use of the RISM greatly reduced the time needed to identify and clean up areas of contamination within the patient treatment rooms (Figure 3) and bathrooms (Figure 4), and was able to identify areas of residual contamination left after standard cleaning using a GM counter. We believe incorporating RISMs with the ability to image and identify the isotope(s) contained within the contamination in patient treatment areas in the hospital can greatly reduce time burden on staff needed to ensure proper clean up and verification of all radioactive sources within a nuclear imaging and RPT treatment facilities.



Figure 2. RISM image of location of three deliberate contamination sources (labeled) in a hot lab.

Table 1: Time to measure and locate all three sources with GM and RAVIN RISM.

Technician	GM	RISM	
	Time to find all 3 sources (s)	Time to image 3 sources (s)	Distance to closest source (m)
1	134	39	2.4
2	129	39	2.4
3	157	43	2.5
4	182	40	2.5
5	157	70	2.5
6	144	70	2.6
7	36	35	2.4
8	n/a	35	2.4
avg.	134.1	48.0	2.5
st dev	43.2	14.1	0.1

AIM

To test the ability of a radiation imaging survey meter (RISM), Fig. 1a, to image, identify, localize and measure the intensity of radioisotope contamination in Lu-177 and I-131 MIBG treatment rooms following therapy procedures.

METHOD

We compared the ability of several nuclear medicine technologists (NMT) (with experience ranging from 1 – 20 years) to identify sources of radiation contamination using the RAVIN (M3D inc., Ann Arbor MI) RISM, to the time needed using a pancake (GM) counter (fig. 1).

The NMTs were asked to find three hidden locations of deliberate (^{99m}Tc, ¹⁷⁷Lu, ¹³⁷Cs) contamination in a nuclear medicine hot lab using the RAVIN and GM. We recorded the time needed for eight NMT (blinded to the locations) to identify each contamination location with the GM and for the RISM to form an image localizing the contamination (Table 1).

Additionally, we tested the sensitivity of RISM to locate contamination, identify isotope and verify cleaning of treatment rooms/bathrooms after Lu-177 and I-131 (MIBG) treatment. This was compared to the time required to locate/clean with a GM as well as swipe survey verification.

Finally, we compared the relative dose rate (R/hr/mCi) measured by the RAVIN RISM and a pressurized Ion chamber for common diagnostic and therapeutic radioisotopes with energies ranging from 140 keV to 662 keV.

CONCLUSION

The RISM reduced the time needed by NMT to identify the presence of contamination compared to using a standard pancake GM counter, as well as allowed for faster clean up of patient treatment rooms following therapy.



Figure 3: RISM images acquire in (a) patient treatment bay and (b) patient bathroom showing areas of contamination after Lu-177 treatment.

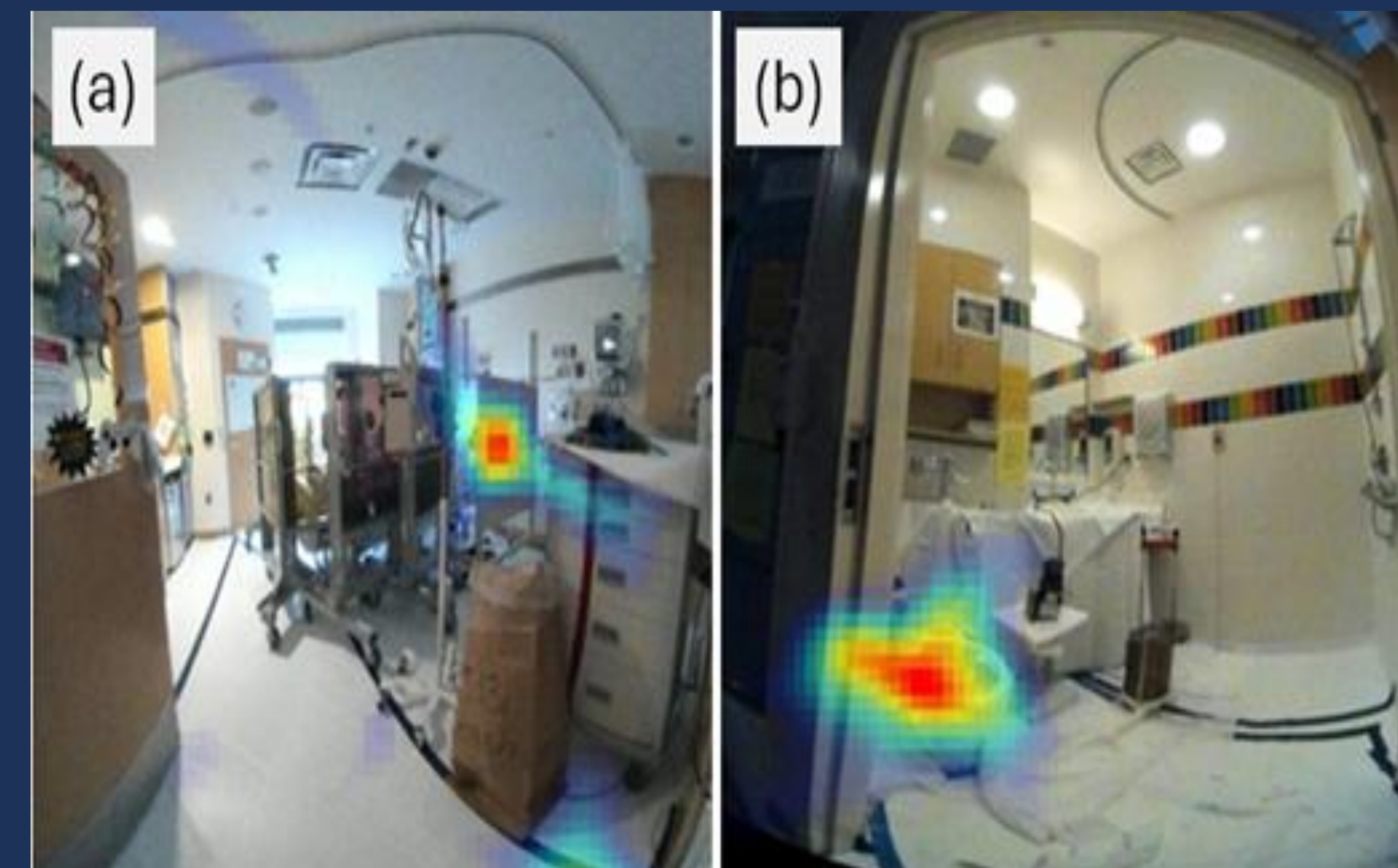


Figure 4: RISM images of I-131 MIBG patient (a) treatment room and (b) bathroom where the GM counter was overwhelmed following completion and patient release.

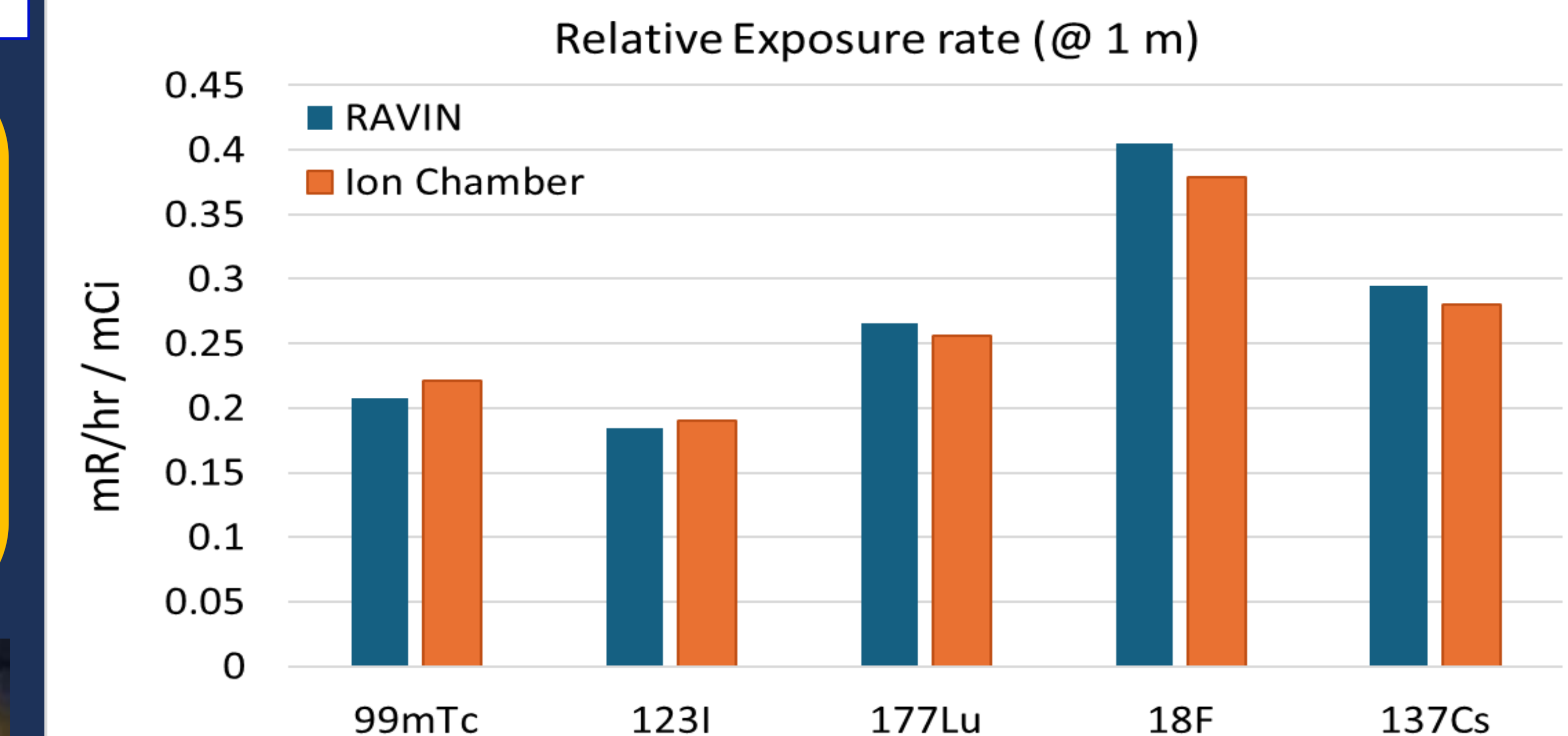


Figure 5. Relative dose rate (mR/hr/mCi) for the RISM compared to that measured with a pressurized ion chamber for a range of common radioisotopes used for diagnostics and therapeutic applications.

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