

Precision in dosimetric analysis and generation of a benchmark dosimetry dataset - An IAEA study

Gunjan Kayal, Nathaly Barbosa, Carlos Marín, Ludovic Ferrer, José Alejandro FRAGOSO NEGRIN, Darko Grosev, Santosh Gupta, Nur Hidayati, Robert Hobbs, Tumelo Moalosi, Gian Luca Poli, Parul Thakral, Virginia Tsapaki, Sebastien Vauclin, Alex Vergara-Gil, Peter Knoll and Manuel Bardiès

Journal of Nuclear Medicine June 2022, 63 (supplement 2) 2812;

Article

Info & Metrics

Abstract

2812

Introduction: Nuclear medicine dosimetry implementation varies depending on the clinical application, dosimetry protocol, software, and ultimately the operator. Assessing clinical dosimetry accuracy & precision in MRT is therefore a challenging task. This work illustrates some pitfalls encountered even during a very structured analysis, performed on a single patient dataset by various participants using one standard protocol and clinically approved (CE) software. The study required the development of specific dosimetry checkpoints and led to a comprehensive benchmark dataset that can be used by individuals to assess their expertise in MRT clinical dosimetry.

Methods: The clinical dataset was derived from the dosimetric study of a patient administered with Lutathera® at Tygerberg Hospital, South Africa, as a part of an IAEA-CRP E23005. SPECT/CT images were acquired at five time points post injection on a GE Infinia Hawkeye 4 (3/8" NaI crystal thickness and medium energy collimator). A calibration phantom was imaged using the same acquisition settings. Patient and calibration images were reconstructed on a Hermes™ workstation, and a calibration factor of 122.6 Bq/cts was derived.

A standard dosimetric protocol was defined and PLANET® Dose (v3.1.1) from DOSIsoft SA was installed in nine participating centers to perform the dosimetric analysis of 3 (out of 4) treatment cycles on the reconstructed patient image dataset. The protocol included rigid image registration, segmentation (semi-manual for organs, activity threshold for tumors), dose point kernel convolution of activity followed by absorbed dose rates (ADR) integration to obtain the absorbed doses (AD). Iterations of the protocol were conducted with training and brainstorming sessions, to analyze dosimetric result variability. Intermediary checkpoints were developed to understand the sources of variation and to differentiate user error from legitimate user variability. Eventually, a 'real-time' clinical dosimetry session was conducted for one cycle at IAEA headquarters with 8 participants in order to reduce the sources of identifiable error.

Results: Initial dosimetric results (AD, ADR) for organs (liver & kidneys) and liver lesions showed considerable inter-operator variability (as high as 161%). This necessitated the generation of intermediate checkpoints like total counts, volumes, activity, but also activity-to-counts ratio, activity concentration (AC), and ADR/AC ratio to analyze most variable steps. For the 'real-time' analysis, absorbed doses for normal organs were within 5%, while for lesions, up to 25% variation was observed, mostly due to the choice of the fitting model. Volume differences across organs were reduced to 9.4% (except for right kidney with 14%) and among

lesions to 5%. Activity in organs and lesions varied by 10% (excluding 11.5% in right kidneys) and 4.2% respectively, whereas AC and ADR variations dropped below 5%.

Conclusions: Even in a simplified situation where the same patient dataset was analyzed using the same dosimetry procedure and software, significant disparities were observed in the results obtained. The results of the 'real-time' multi-centric dosimetry analysis were striking, with most variation sources identified as either error or permissible. Variations owing to human error may be minimized or avoided by performing intensive training sessions, establishing intermediate checkpoints, conducting sanity checks, and cross-validating results across physicists. This promotes the development of quality assurance in clinical dosimetry. This study produced a 'benchmark dataset' that includes expected dosimetry results for the considered dosimetry procedure and software that will be made available freely. The work should be extended to various dosimetry softwares. Simulated datasets should provide ground truth for accuracy assessment. This will allow individuals to train themselves and increase their proficiency in clinical dosimetry procedures.

[← Previous](#)

[^ Back to top](#)

In this issue

Journal of Nuclear Medicine
Vol. 63, Issue supplement 2
June 1, 2022
[Table of Contents](#)
[Index by author](#)

[🔔 Article Alerts](#)

[✉ Email Article](#)

[🔗 Citation Tools](#)

[↪ Share](#)

[Tweet](#)

[🔖 Bookmark this article](#)

▼ Related Articles

No related articles found.

[Google Scholar](#)

▶ **Cited By...**

▶ **More in this TOC Section**

▶ **Similar Articles**

We recommend

Automated batch dosimetry data processing software for improved clinical applications and workflow.

Adam Kesner et al., J Nucl Med, 2018

Radiation Dosimetry for CXCR4 chemokine receptor targeting probe-68Ga-Pentixafor in patients with Lung Carcinoma: An approach to future theranostics

Ankit Watts et al., J Nucl Med, 2021

MIRDct: a computed tomography dosimetry software - initial development and overview

Juan Ocampo Ramos et al., J Nucl Med, 2022

Real-world Implementation of an eHealth System Based on Artificial Intelligence Designed to Predict and Reduce Emergency

Department Visits by Older Adults: Pragmatic Trial

Joël Belmin et al., J Med Internet Res, 2022

Dosimetric comparison of tomotherapy and volumetric-modulated arc therapy for children with neuroblastoma

Xia Liu et al., Pediatric Investigation, 2020

A standard Fricke dosimeter compared to an ionization chamber used for dosimetric characterization of 60Co photon beam

Quiza Moussous et al., Polish Journal of Medical Physics and Engineering, 2016

Investigating the impact of 3D tumor shape features on dosimetric outcomes

Lukas Carter et al., J Nucl Med, 2022

Impact of the Monte Carlo code GATE for Targeted Radionuclide Therapy (TRT): imaging and dosimetric calculations.

Daphnee VILLOING, J Nucl Med, 2016

Comparison of three film analysis softwares using EBT2 and EBT3 films in radiotherapy

Tamás Pócza et al., Radiology and Oncology, 2020

A protocol for accurate radiochromic film dosimetry using Radiochromic.com

Ignasi Méndez et al., Radiology and Oncology, 2021

Powered by **TREND MD**

I consent to the use of Google Analytics and related cookies across the TrendMD network (widget, website, blog). [Learn more](#)

S NM
M I

© 2022 Journal of Nuclear Medicine