MIRD Committee Report, August 1st, 2025[1]
Society of Nuclear Medicine and Molecular Imaging

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Introduction

Radiation dosimetry provides the fundamental quantities used for radiation protection, radiation risk assessment, and radiopharmaceutical therapy planning. The Medical Internal Radiation Dose (MIRD) Committee, created in 1965, develops the notation, terminology, models, mathematical formulas, and reference data for assessing internal radiation doses from administered radiopharmaceuticals. The fundamental value of the MIRD approach is that it systematically reduces complex dosimetric analyses to methods that are relatively simple to use in practice, including software tools for experimental and clinical use. Since its inception, the MIRD schema has been recognized world-wide as *the* standard in radiopharmaceutical dosimetry. With the on-going development of new radiopharmaceuticals and the increasing therapeutic application of such agents, internal dosimetry in nuclear medicine and the MIRD schema continue to evolve - from population-average and organ-level to patient-specific and sub-organ to voxel-level to cell-level dose estimation.

Committee Charges

The MIRD Committee charges are as follows.

- Develop and provide a standardized framework and methodology for calculation of internal dose quantities in nuclear medicine.
- Compile, evaluate and disseminate data needed to implement standardized internal dosimetry methods, including radionuclide decay properties and emissions, absorbed fractions/S values, and anatomic models.
- Collect and assess experimental and peer-reviewed data to publish dose estimate reports for selected new radiopharmaceuticals which significantly impact the current practice of nuclear medicine.
- Provide peer-reviewed evaluations of proposed new dosimetry models and methods including correlating dose with biological response for cellular, animal and clinical trials data.
- Address other critical and timely dosimetry issues that may impact the current practice of nuclear medicine.

[1] This Report includes extensive material adapted from the MIRD Committee page on the SNMMI web site.

- Develop, test and publish software and internet tools that implement MIRD calculation models and techniques including dose-response data and biological effective or equivalent dose quantities.
- Actively work with other national and international committees through joint meetings and symposia to establish uniformity in dosimetry models, techniques, named special quantities and units of dose and biological response

MIRD Publications

Historically, the MIRD Committee has fulfilled its charges in very tangible ways - through its widely cited publications, including its peer-reviewed Pamphlets and its books and other long-form publications.

The MIRD Pamphlets, in *reverse* chronological order of publication, currently total 37 and are as follows.

- **MIRD Pamphlet No. 33, Part 2**: Benchmarking of MIRDct Software for CT Organ Dose Estimation. *In preparation*.
- **MIRD Pamphlet No. 33, Part 1**: MIRDct - A Customizable Software Tool for Computed Tomography Dosimetry. *Under review, J Nucl Med.*
- **MIRD Pamphlet No. 32:** A MIRD Recovery Coefficient Model for Resolution Characterization and Shape-Specific Partial-Volume Correction (2025)
- **MIRD Pamphlet No. 31:** MIRDcell V4 - Artificial Intelligence Tools to Formulate Optimized Radiopharmaceutical Cocktails for Therapy (2024)
- **MIRD Pamphlet No. 30:** MIRDfit - A Tool for Fitting of Biodistribution Time–Activity Data for Internal Dosimetry (2024)
- **MIRD Pamphlet No. 29:** MIRDy90 - A ^{90}Y Research Microsphere Dosimetry Tool (2024)
- **MIRD Pamphlet No. 28, Part 2:** Comparative Evaluation of MIRDcalc Dosimetry Software Across a Compendium of Diagnostic Radiopharmaceuticals (2023)
- **MIRD Pamphlet No. 28, Part 1:** MIRDcalc - A Software Tool for Medical Internal Radiation Dosimetry (2023)
- **MIRD Pamphlet No. 27:** MIRDcell V3, a Revised Software Tool for Multicellular Dosimetry and Bioeffect Modeling (2022)
- **MIRD Pamphlet No. 26:** Joint EANM/MIRD Guidelines for Quantitative ^{177}Lu SPECT applied for dosimetry of radiopharmaceutical therapy (2016)
- **MIRD Pamphlet No. 25:** MIRDcell V2.0 software tool for dosimetric analysis of biological response of multicellular populations (2014)
- **MIRD Pamphlet No. 24:** Guidelines for quantitative ^{131}I SPECT in dosimetry applications (2013)
- **MIRD Pamphlet No. 23:** Quantitative SPECT for patient-specific 3-dimensional dosimetry in internal radionuclide therapy (2012)

- **MIRD Publication Pamphlet No. 22 (Abridged)**: Radiobiology and Dosimetry of α-Particle Emitters for Targeted Radionuclide Therapy (2010)
- **MIRD Pamphlet No. 22**: Radiobiology and Dosimetry of Alpha-Particle Emitters for Targeted Radionuclide Therapy (2010)
- **MIRD Pamphlet No. 21**: A Generalized Schema for Radiopharmaceutical Dosimetry - Standardization of Nomenclature (2009)
- **MIRD Pamphlet No. 20**: The Effect of Model Assumptions on Kidney Dosimetry and Response - Implications for Radionuclide Therapy (2008)
- **MIRD Pamphlet No. 19**: Absorbed Fractions and Radionuclide S Values for Six Age-Dependent Multiregion Models of the Kidney (2003)
- **MIRD Pamphlet No. 18**: Administered Cumulated Activity for Ventilation Studies (2001)
- **MIRD Pamphlet No. 17**: The Dosimetry of Nonuniform Activity Distributions - Radionuclide S Values at the Voxel Level. *J Nucl Med* 1999; 40:11S-36S; MIRD Supplement (1999)
- **MIRD Pamphlet No. 16**: Techniques for Quantitative Radiopharmaceutical Biodistribution Data Acquisition and Analysis for Use in Human Radiation Dose Estimates (1999)
- **MIRD Pamphlet No. 15**: Radionuclide S Values in a Revised Dosimetric Model of the Adult Head and Brain (1999)
- **MIRD Pamphlet No. 14 *Revised***: A Dynamic Urinary Bladder Model for Radiation Dose Calculations (1999)
- **MIRD Pamphlet No. 13**: Specific Absorbed Fractions for Photon Sources Uniformly Distributed in the Heart Chambers and Heart Wall (1981)
- **MIRD Pamphlet No. 12**: Kinetic Models for Absorbed Dose Calculations (1977).
- **MIRD Pamphlet No. 11**: S, Absorbed Dose per Unit Cumulated Activity for Selected Radionuclides and Organs **(**1975).
- **MIRD Pamphlet No. 10**: Radionuclide Decay Schemes and Nuclear Parameters for Use in Radiation-Dose Estimation (1975). *Superseded by MIRD Decay Schemes 2nd Edition*.
- **MIRD Pamphlet No. 9:** Radiation Dose to Humans from ^{75}Se-L-Selenomethionine (1972). J. Nucl. Med. 13, Supplement Number No. 6.
- **MIRD Pamphlet No. 8:** Absorbed Fractions for Small Volumes Containing Photon Emitting Radioactivity (1971). J. Nucl. Med. 12, Supplement No. 5.
- **MIRD Pamphlet No. 7:** Distribution of Absorbed Dose Around Point Sources of Electrons and Beta Particles in Water and Other Media (1971). J. Nucl. Med. 12, Supplement No. 5.
- **MIRD Pamphlet No. 6:** Radionuclide Decay Schemes and Nuclear Parameters for Use in Radiation-Dose Estimation, Part 2. *Superseded by MIRD Decay Schemes 2nd Edition*.
- **MIRD Pamphlet No. 5, *Revised*:** Estimates of Absorbed Fractions for Photon Sources Uniformly Distributed in Various Organs of a Heterogeneous Phantom (1978).
- **MIRD Pamphlet No. 4:** Radionuclide Decay Schemes and Nuclear Parameters for Use in Radiation-Dose Estimation. *Superseded by MIRD Decay Schemes 2nd Edition*.

- **MIRD Pamphlet No. 3:** Absorbed Fractions for Photon Dosimetry (1968). J. Nucl. Med. 9, Supplement No. 1, 27-39.
- **MIRD Pamphlet No. 2:** Energy Deposition in Water by Photons from Point Isotropic Sources (1968). J. Nucl. Med. 9, Supplement No. 1, 15-25.
- **MIRD Pamphlet No. 1, *Revised*:** A Revised Schema for Calculating the Absorbed Dose from Biologically Distributed Radionuclides (1975). *Superseded by MIRD Primer for Absorbed Dose Calculations, revised (1991).*
- **MIRD Pamphlet No. 1:** A Schema for Absorbed-dose Calculations for Biologically Distributed Radionuclides (1968). J. Nucl. Med. 9, Supplement No. 1, 7-14. *Superseded by MIRD Primer for Absorbed Dose Calculations, revised (1991).*

The MIRD books and other long-form publications, again in *reverse* chronological order of publication, are as follows.

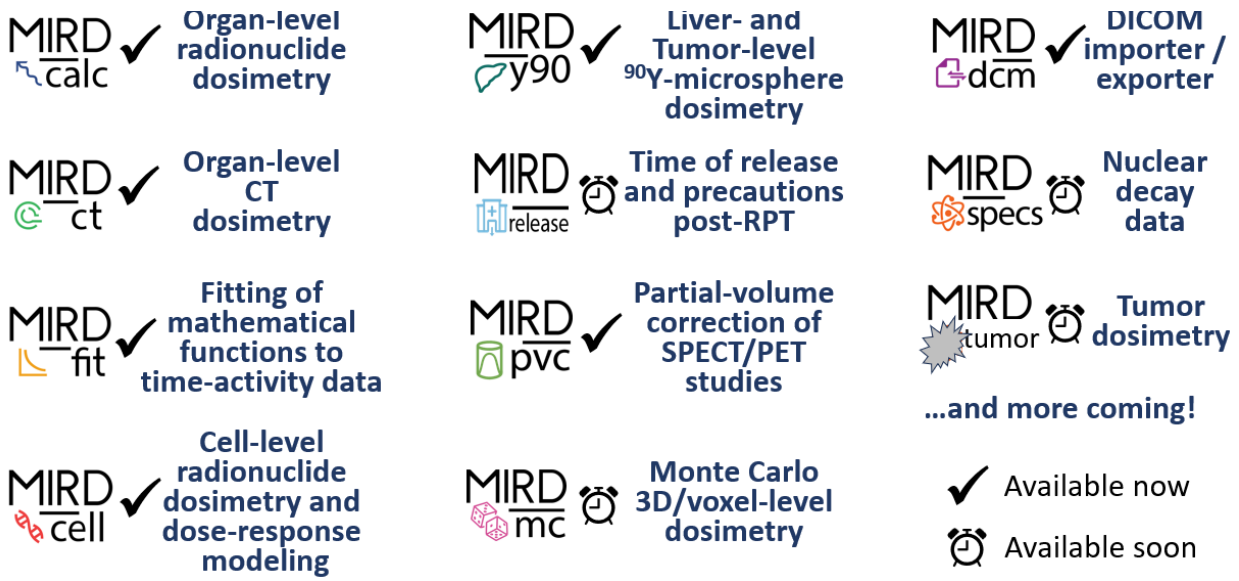
- **MIRD Primer 2022: A Complete Guide to Radiopharmaceutical Dosimetry (2022).** The MIRD Primer 2022 is a completely dated and expanded version of the original MIRD Primer, including extensive material on quantitative radionuclide imaging, radiobiology, and bioeffect modeling. It also includes an extensive compilation of worked examples.
- **MIRD Radiobiology and Dosimetry for Radiopharmaceutical Therapy with Alpha-Particle Emitters (2016).** This monograph reviews pioneering and current studies related to targeted alpha-particle-emitter therapy and provides guidance and recommendations for human dosimetry.
- **MIRD Decay Schemes 2nd edition (2016).** This updated and expanded edition of *MIRD: Radionuclide Data and Decay Schemes* remains an essential reference for radiation dosimetry and again includes the detailed decay properties of several hundred radionuclides in a graphical, easy-to-understand format.
- **MIRD Head and Brain Dosimetry (1999).** Addresses available neuroimaging applications in nuclear medicine internal dosimetry for both children and adults. Contains comprehensive tables of absorbed fractions and S values for all models and radiopharmaceuticals, along with steps for verifying calculations and tabulations.
- **MIRD Cellular S Values (1997).** Provides tools necessary to estimate the absorbed dose at the cellular level from intracellularly localized radionuclides using cellular S values for emitters of monoenergetic electrons and alpha particles and almost all radionuclides.
- **MIRD Primer for Absorbed Dose Calculations (1991).** The MIRD Primer is the "teaching" standard reference on radiation dosimetry of radiopharmaceuticals in humans, offering a thorough review of absorbed dose calculations used in the application of radiopharmaceuticals to medical studies. *Superseded by the MIRD Primer 2022: A Complete Guide to Radiopharmaceutical Dosimetry.*

- **MIRD Decay Schemes (1989).** This is an essential reference for radiation dosimetry. It includes the detailed decay properties of several hundred radionuclides in a graphical, easy-to-understand format.

MIRD Software

The MIRD schema continues to evolve, as technology and the field of nuclear medicine have advanced. Importantly, in addition to its traditional hard-copy resources - the MIRD Pamphlets and associated publications - our Committee, led by Adam Kesner, Wes Bolch, and Roger Howell, has created and is expanding the MIRDsoft website (nowhosted by the SNMMI) that provides a suite of *freely downloadable, peer-reviewed* software tools for radiopharmaceutical dosimetry. MIRDsoft currently includes MIRDcalc (for organ-level and tumor dosimetry, including such novel features as error propagation) and MIRDcell (for not only cellular and sub-cellular dosimetry but also bioeffect modeling). Recent additions to MIRDsoft include MIRDfit (for curve fitting, with error propagation, of radiopharmaceutical time-activity data), MIRDy90 (for yttrium-90 (^{90}Y)-microsphere dosimetry for radioembolic therapy of liver tumors), and MIRDpvc (for correction of the partial-volume effect in SPECT and PET). Forthcoming additions to MIRDsoft will include MIRDct (for individualized CT dosimetry), MIRDrelease (for assessment of the releasability of radiopharmaceutical therapy patients and of the duration of post-release precautions), and MIRDtumor (for tumor dosimetry, including tumors of various shapes and compositions).

A graphical summary of the current and planned MIRDsoft software is follows.



The Loevinger-Berman Award

The Loevinger-Berman Award was established in 1999 by the MIRD Committee and the Society to recognize and promote excellence in the field of internal dosimetry, in terms of research and development, significant publication contributions, advancement of the understanding of internal dosimetry in relationship to risk and therapeutic efficacy. The Loevinger-Berman Award is presented each year at the Annual Meeting of the SNMMI, as part of the MIRD Committee's CE session, with a presentation by the Awardee. The Awardee is selected by the MIRD Committee membership from among investigators throughout the world by a rigorous, multi-step process. The Loevinger-Berman Award has come to be recognized as the most prestigious award in the world in the field of radiopharmaceutical dosimetry.

The roster of Loevinger-Berman Awardees includes not only luminaries from the field of nuclear medicine but also from the broader field of biomedical science:

Roger J Cloutier, 1999
Dadmudi V Rao, 2000
Keith F Eckerman, 2001
Sven Erik-Strand, 2002
John W Poston, Sr, 2003
Roger W Howell, 2004
James S Robertson, 2005
Gordon L Brownell, 2006
Evelyn E Watson, 2007
Harold L Atkins, 2008
Stephen R Thomas, 2009
Anib I Kassis, 2010
Kenneth F Koral, 2011
John L Humm, 2012
Michael Ljungberg, 2013
John Boice, 2014
Roger Dale, 2015
Joseph O'Donoghue, 2016
Michael Lassman, 2017
Barry Wessels, 2018
Sören Mattsson, 2019
Marta Cermonesi, 2020
Glenn Flux, 2023
Katarina Sjögreen Gleisner, 2024
Robert Hobbs, 2025.
(*Note:* The Award suspended in 2021 and 2022 due to COVID-19 pandemic.)

The MIRD Committee CE Session

Each year at the Annual Meeting of the Society the MIRD Committee organizes and hosts a Continuing Education (CE) session open to all attendees of the Meeting. While emphasizing radiation dosimetry and radiation biology and related areas, the MIRD Committee selects topics that are timely, scientifically rigorous, and of broad interest to all meeting attendees. At the 2025 Annual Meeting, the topic of our CE session was "Current Status of Alpha-Particle Radiopharmaceutical Therapy: Dosimetry, Radiobiology, and Technical Considerations," and the agenda was as follows:

1. Presentation of Loevinger-Berman Award to Dr. Robert Hobbs, Pat Zanzonico, PhD

2. Overview of Alpha-Particle Radiopharmaceutical Therapy, George Sgouros, PhD

3. Bioeffect Modeling - Lecture by Loevinger-Berman Awardee, Robert Hobbs, PhD

4. Quantitative Imaging and Organ-level Dosimetry of Alpha-Particle Emitters, Kamo Ramonaheng, PhD

5. Q&A

Predictably, this CE session was very well attended!

Other MIRD Committee Activities

In addition to its publications and software and its presentation of the Loevinger-Berman Award and CE sessions at the Annual Meeting, the MIRD Committee regularly contributes in important ways to the Society and the field of nuclear medicine. The expertise among the Committee membership serves as an invaluable resource to the Society in a number of settings. For example, Committee members (including myself) attended and spoke at public meetings of the Nuclear Regulatory Commission (NRC) in opposition to (1) re-categorizing extravasation of radiopharmaceuticals as a "medical event" and (2) reversal to the "30-mCi rule" for releasability (i.e., outpatient administration) of radiopharmaceutical therapies. More recently, Committee members (again including myself) attended another public meeting of the NRC addressing an Executive Order to reconsider the use of the linear no-threshold (LNT) dose-response model for formulation of radiation protection standards. The MIRD Committee also attended and actively participated in the SNMMI Theranostic Stakeholders' Summit this past May and, on behalf of the Society, the ICRP Task Group 36 Workshop on Radiation Dose to Patients in Diagnostic Nuclear Medicine last month. Additionally, members of the MIRD Committee will represent the Society at the upcoming Symposium on Molecular Radiotherapy Dosimetry in Athens, Greece, in November being organized by the European Federation of Medical Physics Organizations (EFOMP).

MIRD Committee Meetings

For a number of years, the MIRD Committee convened two Society-funded in-person meetings annually. The number of such meetings were subsequently reduced to only one. These were working meetings, typically two full days in duration, in which the full Committee membership edited in real time Pamphlets and other publications, planned in detail near-term initiatives, and, more recently, critically reviewed MIRDsoft software, among other tasks. These meetings contributed in important ways to the remarkable sustained productivity of the Committee. For the last number of years, however, the MIRD Committee has not had any in-person meetings – in part because of the COVID pandemic and the emergence of remote-meeting alternatives via ZOOM and TEAMS. Our Committee has nonetheless managed to maintain its productivity and its prominence in the field. Without regular in-person meetings, this is *not* sustainable indefinitely!

For example, active engagement of new, younger members, who are vital to the long-term productivity of the Committee, simply has not worked and face-to-face, real-time engagement at in-person meetings is essential - especially as the most productive Committee members "age out" of the field. Lest the Society and the entire field ultimately lose the MIRD Committee as the invaluable resource it is, at least one in-person meeting of the Committee annually is absolutely essential! A reasonable estimate of the cost of such a meeting (including travel expenses, housing, meals etc), planned as economically as possible, is approximately $25,000.

Concluding Remarks

Through its widely cited Pamphlets and other publications, the Loevinger-Berman Award, and, now, its MIRDsoft software, the MIRD schema is recognized world-wide as *the* standard in radiopharmaceutical dosimetry. The tangible and varied work-product of the Committee has been and remains an invaluable resource to Society members and to the entire field of nuclear medicine. The MIRD Committee thus greatly enhances the recognition and standing of the Society throughout the world.