Committee on Medical Internal Radiation Dose (MIRD)
Committee Report
To the SNMMI Board of Directors
December 2019

The MIRD Committee advances nuclear medicine and radionuclide therapy by developing standard methods, models, reference data, and mathematical schema for assessing internal radiation doses from administered radiopharmaceuticals.

Committee Charges for 2019-2020:

1. Develop and improve a standardized framework and methodology for calculating internal radiation dose quantities in nuclear medicine.
2. Compile, evaluate and disseminate data needed to implement standardized internal dosimetry methods, including radionuclide decay properties and emissions, energy absorbed fractions, and anatomic models.
3. Collect and critically assess experimental and peer-reviewed data to prepare and publish dose estimate reports for selected new radiopharmaceuticals that significantly impact the current practice of nuclear medicine.
4. Provide peer-reviewed evaluations of proposed new dosimetry models and methods, including correlations of radiation dose with biological response for cellular, animal, and human clinical trials data.
5. Address other critical and timely dosimetry issues that may impact the current practice of nuclear medicine.
6. Develop, test, and publish computational software and web-based tools that implement MIRD models and techniques for calculating internal radiation dose, including dose-response data, the biological effective dose, and equivalent dose quantities.
7. Work actively with other national and international scientific organizations and scientific committees through joint meetings and symposia to establish consistency and harmony among dosimetry models, techniques, named special quantities, and units of dose, and biological response.

Committee Membership for 2019-2020

Pat Zanonico, Ph.D., Chair (Memorial Sloan-Kettering Cancer Center)
Rachael M. Bartlett, Ph.D. (NYU School of Medicine)
Wesley E. Bolch, Ph.D. (University of Florida)
A. Bertrand (Randy) Brill, M.D., Ph.D. (Vanderbilt University School of Medicine)
Yuni K. Dewaraja, Ph.D. (University of Michigan)
Frederic H. Fahey, D.Sc. (Children’s Hospital Boston and Harvard Medical School)
Darrell R. Fisher, Ph.D. (Versant Medical Physics and Radiation Safety)
Robert F. Hobbs, Ph.D. (Johns Hopkins Medical Institutions)
Roger W. Howell, Ph.D. (Rutgers New Jersey Medical School)
Ruby Meredith M.D., Ph.D. (University of Alabama Medical Center)
Joseph Rajendran, M.D. (Veterans Administration, retired)
George Sgouros, Ph.D. (Johns Hopkins Medical Institutions)
Committee members represent diverse demographics and a balanced set of experience and skills needed to effectively accomplish assigned Committee charges, working goals, and objectives

**Current Working Goals and Objectives (Referencing the SNMMI Strategic Plan):**

- Continue to develop and publish, for the nuclear medicine community, appropriate scientific methods for calculating internal radiation doses from diagnostic and therapeutic radiopharmaceuticals (Core Purpose; Core Values; Goal A to Advance Development and Approval of Nuclear Medicine; Goal C to Increase Use of Radionuclide Therapy; Goal D to Advance Quality, Value, and Safety of Nuclear Medicine; Goal E to Support the Professional Workforce).
- Compile and disseminate supporting data needed to implement such methods, such as radionuclide decay properties and emissions, energy absorbed fractions, and anatomic models (Goal A to Advance Development and Approval of Nuclear Medicine).
- Develop and publish software tools that implement MIRD calculations and models (Goal D to Advance Quality, Value, Safety of Nuclear Medicine; disseminate information on dose optimization; launch web-based dose calculators).
- Assess and publish dosimetry for new radiopharmaceuticals (Goal A to Advance Development and approval of Nuclear Medicine; Goal C to Increase Use of Radionuclide Therapy).
- Develop methods for correlating dose with response to evaluate the relevance of factors, in addition to absorbed dose, that influence biological response from internal emitters (Vision to Unify, Advance, and Optimize Nuclear Medicine and Radionuclide Therapy; Goal A to Advance Development and Approval of Nuclear Medicine; risk to benefit ratio of new radiotracers; disseminate positions and papers; publish pamphlets related to alpha emitters; standardized monographs).
- Address other critical and timely dosimetry issues that may impact the practice of nuclear medicine (Goal E to Support and Enhance the Professional Workforce; Training, Continuing Education, and Best Practices).
- Solicit nominations for the annual Society of Nuclear Medicine and Molecular Imaging Loevinger-Berman Award, named in honor of two founding members of the Medical Internal Radiation Dose Committee; review nominations and elect awardees (Core Values).
- Promote and advance the education of SNMMI members in dosimetry and related areas by organizing Continuing Educations sessions at the annual SNMMI meetings (Goal E to Support and Enhance the Professional Workforce).

**Additional Goals/Objectives Added for 2019-2020:**

1. Continue the work to update and publish the popular *MIRD Primer on Absorbed Dose Calculations* as a substantially revised and updated new edition.
2. Continue the series on SPECT Quantitative Imaging for Dosimetry.
3. In conjunction with SNMMI Dose Optimization Task Force, provide information and guidance on radiation dose optimization in nuclear medicine to imaging professionals, referring physicians, and the public.
4. Provide timely support to the Society on federal regulatory issues, including licensing guidance, training and education requirements for authorized users, critical organ and tissue dose limits, patient release criteria, regulatory compliance, and related scientific matters such as linearity of radiation dose-response relationships.
Progress of Charge/Objectives/Goal to Date:

1. 2019 Annual Meeting (Anaheim): The MIRD Committee selected Lars Johan Sören Mattsson, Ph.D., to receive the 2019 SNMMI Loevinger-Berman Award, recognizing a lifetime of achievements in internal radiation dosimetry for nuclear medicine. Dr. Mattsson is senior professor of Medical Radiation Physics at Lund University, Skåne University Hospital, in Malmö, Sweden. The Loevinger-Berman award was presented during a special continuing education session organized by the MIRD Committee and the Therapy Center of Excellence at the Annual Meeting. In addition, three members of the MIRD Committee (Darrell Fisher, Robert Hobbs, and Pat Zanzonico) participated in a special debate session at the Annual Meeting organized by Alan Packard on validity of the linear no-threshold dose-response hypothesis, and its relevance to radiation protection standards applicable to nuclear medicine.

2. The primary focus of the MIRD Committee during 2018 through 2019 has been rewriting and updating the \textit{MIRD Primer on Absorbed Dose Calculations}. The currently available \textit{Primer} has been a well-received and popular volume among nuclear medicine practitioners, students, and medical physicists. Since the \textit{Primer} is more than 20 years old, the new \textit{Primer} will provide updated content covering recent developments and newest approaches for medical internal radiation dosimetry. It will contain updated equations, mathematical notation, definition of terms, methods for data acquisition, analyzing imaging data, fitting imaging data to mathematical functions, radiation effects and radiobiological implications, and reviews of current software for performing Monte Carlo simulations and implementing the MIRD schema. The Committee worked on the \textit{Primer} during one face-to-face meeting (Baltimore, March 2019) and during weekly telephone conferences throughout much of 2018 and 2019.

3. A special subcommittee has been developing a spreadsheet-based \textit{MIRDcalc} tool for internal dosimetry. Lead authors include Adam Kesner and Pat Zanzonico of Memorial Sloan-Kettering Cancer Center, and Wes Bolch at the University of Florida. Features of \textit{MIRDcalc} were presented at the 2018 SNMMI annual meeting in Philadelphia and were reviewed at the MIRD Committee’s meeting in Baltimore during March 2019.

4. An ongoing effort of the Committee is the refinement of the \textit{MIRDcell} cell-level dosimetry and bioeffect modeling software. This effort is led by its creator, Roger Howell.

5. An additional ongoing effort of the Committee is the updating of the kidney dosimetry and bioeffect modeling software originally developed by Barry Wessels, a former MIRD Committee member.

6. Robert Hobbs presented the MIRD Schema on behalf of the MIRD Committee at the MRTDosimetry Workshop at the National Physical Laboratory

7. Several MIRD committee members have been active in international standards and scientific committees to transfer MIRD knowledge, recommendations, and work product to national and international standards:
   a. ICRP Committees and Task Groups - Wes Bolch and Darrell Fisher
   b. NCRP - Pat Zanzonico, Darrell Fisher, Wes Bolch, George Sgouros, Roger Howell
   c. ICRU Commission and Report Committees - Roger Howell, George Sgouros, Wes Bolch, Yuni Dewaraja, Robert Hobbs
   d. IAEA Report Committees – Yuni Dewaraja, George Sgouros
   e. Quantitative Imaging Biomarker Alliance (RSNA) - Yuni Dewaraja
   f. AAPM working group on radionuclide therapy – Robert Hobbs, Wesley Bolch, Yuni Dewaraja
   g. NCI TRT working group – George Sgouros, Robert Hobbs, Yuni Dewaraja
   h. ASTRO Task Force on Theranostics – Robert Hobbs
## APPENDIX – MIRD COMMITTEE TASK GROUPS

<table>
<thead>
<tr>
<th>Task Group</th>
<th>Title</th>
<th>Chair</th>
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<tbody>
<tr>
<td>TG1</td>
<td>Quantitative tools for benefit/risk optimization in medical imaging</td>
<td>Bolch</td>
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<td></td>
<td>Draft pamphlet to be discussed at November meetings</td>
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<tr>
<td>TG2</td>
<td>Hybrid phantoms and skeletal models</td>
<td>Bolch</td>
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<tr>
<td>TG3</td>
<td>Quantitative imaging for dosimetry calculations; Pamphlet 23 is published; Pamphlet 24 on I-131 has been published; Lu-177 with the dosimetry task force of EANM has been published by JNM.</td>
<td>Dewaraja</td>
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<tr>
<td>TG5</td>
<td>Cellular and multicellular radiobiology and dose modeling</td>
<td>Howell</td>
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<td>Recent expansion to two and 3-D cellular arrays since the Miami meeting. Pamphlet 25 has been published; Roger Howell applied for an NIH/R01 to support the further development of MIRDcell V3</td>
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<tr>
<td>TG7</td>
<td>Radiobiological reference human</td>
<td>Sgouros</td>
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<td>Received supplementary funding from NIH to hire an information specialist with additional support from a Sgouros grant</td>
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<td>TG9</td>
<td>Clinical dosimetry for bone pain palliation agents</td>
<td>Zanzonico</td>
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<td>Waiting on funding from IAEA; animal protocols in place</td>
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<tr>
<td>TG10</td>
<td>Patient-to-family member and member of general public dosimetry as the basis for patient-release criteria</td>
<td>Zanzonico</td>
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<td>TG11</td>
<td>Regional and interstitial therapies</td>
<td>Zanzonico</td>
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<td>TG12</td>
<td>Voxel S values and Web-Based Generator Tool</td>
<td>Bolch</td>
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<td>Software completed, pamphlet being circulated</td>
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<td>TG13</td>
<td>Revision of the MIRD Primer and other education materials</td>
<td>Sgouros</td>
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<td>Launching effort to create Self-Assessment Module (SAM) for dosimetry and update to MIRD primer</td>
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