NIST NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY
U.S. DEPARTMENT OF COMMERCE

NIH National Institute of Biomedical Imaging and Bioengineering

NIST/NIBIB Symposium on Medical Metrology and Standards for American Healthcare and Commerce

Medical Imaging, Devices, & Diagnostics

Sept. 24, 2026

Joint NIST/UMD Institute for Bioscience and Biotechnology Research (IBBR)
9600 Gudelsky Dr, Rockville, MD 20850

Agenda, Speakers and Abstracts

To submit written comments on Future Needs for Medical Metrology and Standards for Medical Imaging Devices Diagnostics and Therapy: Go to www.regulations.gov **and enter NIST-2026-0133** in the search field.
Docket Number: 260909-0004
Or email: medicalmetrologyandstandards@nist.gov
Responses must be submitted by the November 30 deadline to be guaranteed consideration.

IEEE EMBS IEEE Engineering Medicine & Biology Society
CALIBER MRI
QMIC QUANTITATIVE MEDICAL IMAGING COALITION
QUEL IMAGING
Calimetrix
SUN NUCLEAR A MIRION MEDICAL COMPANY
AAPM
RSD Radiology Support Devices, Inc.
DataSpectrum
GOLD STANDARD PHANTOMS
phantomlab imageOwl
DOSEOPTICS

Agenda

WELCOME & KICKOFF | Chair: Katy Keenan, Quantitative MRI Leader, NIST

8:45 AM **Shyam Sunder,** NIST Associate Director for Laboratory Programs**, Welcome**

9:00 AM **Bruce Tromberg**, NIBIB Director: *Healthcare needs and challenges*

PANEL 1: CLINICAL PERSPECTIVE | Chair: Afrouz Anderson, Program Director, NIBIB

9:20 AM **Dan Sullivan**, Professor Emeritus, Department of Radiology, Duke University Medical Center*: Impact of medical metrology and standards in the clinic*

9:38 AM **Maryellen Giger**, Pritzker Distinguished Service Professor of Radiology, University of Chicago*: MIDRC: Contributions in Metrology and Standards*

9:56 AM **John Boone**, Distinguished Professor of Radiology, University of California at Davis: *Metrology for Computed Tomography: Lessons from the Past, Needs for the Future*

10:14 AM **Panel Discussion**

10:40 AM **Coffee Break & Posters** — 20 minutes

PANEL 2: INDUSTRY PERSPECTIVE | Chair: Martin Tornai, Program Director, NIBIB

11:00 AM **Joshua Welsh**, Senior Staff Scientist, Becton Dickinson*: The transition from arbitrary to quantitative flow cytometry assays*

11:18 AM **Kyoko Fujimoto**, Medical Device/Safety Consultant*: Analysis of US Leadership in Medical Imaging: Research & Development to Marketing Pathway*

11:36 AM **Joseph Naegele**, Principal Software Engineer, Microsoft Research, Health Futures: *The Future of Diagnostic Imaging: AI, Cloud Computing, and Intelligent Systems*

11:54 AM **Panel Discussion**

12:20 PM **Lunch** — 60 minutes

PANEL 3: GOVERNMENT ROLE | Chair: Stephen Russek, Project Leader, Magnetic Imaging, NIST

1:20 PM **Joshua Pfefer**, Biomedical Research Engineer, FDA/CDRH*: Performance Standardization of Emerging Biophotonic Imaging and Sensing Technologies*

Agenda

1:38 PM **Passley Hargrove-Grimes**, Program Officer, Office of Special Initiatives, NIH Tissue Chip Program: *Metrology & Standards for New Approach Methodologies: Building an Infrastructure for Tissue Chips and Human-Relevant Drug Testing*

1:56 PM **NIST Talks** *(6 minutes each)*

- **Ron Tosh**, Radiation Physicist: *Evolving Dosimetry Standards at NIST*
- **Katy Keenan**, Project Leader, Quantitative MRI: *What is Needed to Enable the Coming Impact of Quantitative MRI?*
- **Toni Litorja**, Senior Scientist, Sensor Science Division: *Optical Imaging Measurements and Traceability to the SI*
- **Matt DiSalvo**, Biomedical Engineer, Biophysical and Biomedical Measurement Group: *Microsystems for Medical Metrology*

2:20 PM **Panel Discussion**

2:50 PM **Coffee Break & Posters** — 20 minutes

PANEL 4: RESEARCH FRONTIERS & FUTURE NEEDS | Chair: Matt DiSalvo, Biomedical Engineer, Microsystems for Medical Metrology, NIST

3:10 PM **Paul Kinahan**, Professor of Radiology, Radiation Oncology, and Bioengineering; Vice-Chair of Radiology Research, University of Washington*: QUIC Implementation Roadmaps for translation of quantitative imaging biomarkers to clinical practice*

3:28 PM **Dan Sullivan**, Professor Emeritus, Department of Radiology, Duke University Medical Center*: Quantitative Medical Imaging Coalition (QMIC)*

3:46 PM **Florence Hudson**, Executive Director, Northeast Big Data Innovation Hub at Columbia University; Vice Chair, IEEE Engineering in Medicine and Biology Society: *US Leadership in healthcare and medical technology: TIPPSS, AI and Beyond*

4:04 PM **Rock Mackie**, Emeritus Professor, Medical Physics and Human Oncology, University of Wisconsin*: Novel Dosimetry Systems for Radiation Oncology*

4:22 PM **Kishore Rajendran**, Associate Professor of Radiological Sciences, UCLA: *Medical Imaging Metrology—Perspectives from the AAPM Working Group on the Physics of Quantitative Imaging*

4:40 PM **Panel Discussion**

5:00 PM **White Paper Outline** — Chairs: Stephen Russek and Martin Tornai

5:30 PM **Adjourn**

Invited Speaker Abstract & Bio

Bruce Tromberg, Director, National Institute of Biomedical Imaging and Bioengineering

Healthcare needs and challenges

Bio: Dr. Tromberg is the Director of the National Institute of Biomedical Imaging and Bioengineering (NIBIB) at NIH where he oversees research programs focused on developing, translating, and commercializing engineering, physical science, and computational technologies in biology and medicine. He leads NIBIB's Rapid Acceleration of Diagnostics technology initiative (RADx Tech), established in 2020 to meet an urgent need for increasing SARS-COV-2 testing capacity & performance, and broadened in 2023 to include a wide range of over the counter (OTC) and point of care (POC) medical devices. His laboratory, the Section on Biomedical Optics (SBO) in the Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD), develops portable, bedside, non-contact, and wearable technologies for quantitative sensing and imaging of tissue composition and metabolism.

Dr. Tromberg specializes in the development of optics and photonics technologies for biomedical imaging and therapy. He has co-authored more than 450 publications and holds 29 patents in new technology development as well as bench-to-bedside clinical translation, validation, and commercialization of devices. Dr. Tromberg has trained more than 100 students and fellows, is co-founder of the biophotonics company, Modulim, Inc, and has served on numerous advisory boards in academia, government, and the private sector.

Dr. Tromberg received his undergraduate training in chemistry from Vanderbilt University and MS and PhD degrees in chemistry from the University of Tennessee. He joined the University of California, Irvine (UCI) faculty in 1990, and became a professor of biomedical engineering and surgery during his 30-year academic career there, serving in multiple leadership roles, including, director of UCI's Beckman Laser Institute and Medical Clinic (BLIMC), PI of the Laser Microbeam and Medical Program (LAMMP), an NIH National Biomedical Technology Center, and co-founder of UC Irvine's Department of Biomedical Engineering. He joined the NIBIB as Director in Jan 2019.

Invited Speaker Abstract & Bio

Dan Sullivan, Professor Emeritus, Dept. of Radiology, Duke University Medical Center

Impact of medical metrology and standards in the clinic

Abstract: During the past two decades, the molecular characterization of disease has revealed that each patient is likely to have a unique combination of genotypic, epigenetic, and phenotypic profiles for their disease. In other words, no two patients with lung cancer or diabetes will have exactly the same molecular profile for their diseases, despite the fact that we currently give them the same clinical diagnosis. Biomarkers--both specimen and imaging--play an increasingly significant role in healthcare as physicians try to determine the most appropriate therapy for any patient's molecularly-unique version of disease.

For clinical imaging there are three important implications of Precision Medicine. These are (1) the importance of imaging information (biological, functional or anatomic) that reflects the individual's molecular basis of disease, (2) objective, quantitative information that is reproducible and can be incorporated into decision support algorithms, and (3) a focus on therapeutic implications or options as opposed to primarily focusing on diagnosis.

Quantitative imaging biomarkers (QIBs) from CT, MR, NM or US play an essential role in clinical management. However, differences in technical performance (e.g., scanner hardware, image analysis software, image acquisition logistics) lead to considerable variability in QIB outputs. Rigorous attention to standardizing the technical performance parameters for QIB measurements can mitigate this variability.

Our healthcare system tends to be slow to change practice until either consumers, regulatory agencies, payers, etc., pressure it to do so, or until compelling data appear. Unfortunately, it takes time to develop vetted clinical data and for referring physicians to become aware of it. But, in general, treating physicians want quantitative results. They prefer numerical probabilities to ambiguous qualitative descriptors.

This presentation will review some of the clinical areas that need objective, quantitative information from clinical imaging, including oncology, brain disorders, cardiovascular disorders, infections, metabolic disorders, and other inflammatory disorders. The challenges that must be addressed will be outlined.

Invited Speaker Abstract & Bio

Bio: Dr. Daniel Sullivan is Professor Emeritus, Department of Radiology at Duke University Medical Center. He held faculty appointments at Yale University Medical Center, Duke University Medical Center, and University of Pennsylvania Medical Center. From 1997 to 2007 Dr. Sullivan was Associate Director in the Division of Cancer Treatment and Diagnosis of the National Cancer Institute (NCI), and Head of the Cancer Imaging Program (CIP) at NCI. In 2007 Dr. Sullivan returned to the Department of Radiology at Duke University. His areas of clinical and research expertise are in nuclear medicine and oncologic imaging, focusing on improving the use of imaging as a biomarker in clinical trials and clinical practice.

Dr. Sullivan was Founder and Chair Emeritus of the Quantitative Imaging Biomarkers Alliance (QIBA) from 2007 to 2023. Subsequently, in 2024, Dr. Sullivan was one of the Founding Directors of the Quantitative Medical Imaging Coalition (QMIC). QMIC coordinates a wide range of national and international activities related to the evaluation and validation of quantitative imaging biomarkers for clinical research and practice.

Invited Speaker Abstract & Bio

Maryellen Giger, Pritzker Distinguished Service Professor of Radiology, University of Chicago

MIDRC: Contributions in Metrology and Standards

Abstract: Artificial intelligence (AI) is transforming medical imaging by enabling computers to extract meaningful information from images and support clinical decision-making. However, to develop trustworthy AI methods with improved repeatability and reproducibility, a recognized need is for large, publicly available, and curated/harmonized imaging data sets. Established in August 2020, Medical Imaging and Data Resource Center (MIDRC, midrc.org) has successfully demonstrated, at scale, its ability to securely and efficiently collect, deidentify, curate, harmonize, store, and share medical images, including an ever-expanding relational data model, reusability procedures, and an interactive user portal to enable cohort building, as it leverages secure cloud infrastructures through the MIDRC FAIR Gen3 platform. A summary will be presented on the various MIDRC tools on metrology and the standardization of data, which are openly available, to demonstrate their role in the development of AI.

Bio: Maryellen Giger, Ph.D. is the A.N. Pritzker Distinguished Service Professor of Radiology, Committee on Medical Physics at the University of Chicago. Her AI research in cancer, neuroimaging, COVID-19, and other diseases for risk assessment, diagnosis, prognosis, and therapeutic response has yielded various translated components, including “virtual biopsies”. She is contact PI on the NIBIB-ARPA-H-funded Medical Imaging and Data Resource Center (MIDRC; midrc.org). Giger is a former president of AAPM and of SPIE; a past member of the NIBIB Advisory Council of NIH; and past Editor-in-Chief of the Journal of Medical Imaging; member of the National Academy of Engineering (NAE), recipient of the AAPM William D. Coolidge Gold Medal, recipient of the SPIE Gold Medal, SPIE Harrison H. Barrett Award in Medical Imaging, and RSNA’s Outstanding Researcher Award, and Fellow of AAPM, AIMBE, SPIE, and IEEE. In 2013, Giger was named by the International Congress on Medical Physics (ICMP) as one of 50 medical physicists with the most impact on the field in the last 50 years. Giger was cofounder of Quantitative Insights, Inc., producing QuantX, the first FDA-cleared, machine-learning-driven CADx system to aid in cancer diagnosis.

Invited Speaker Abstract & Bio

John Boone, Distinguished Professor of Radiology, UC Davis

Metrology for Computed Tomography: Lessons from the Past, Needs for the Future

Abstract: Over 90 million computed tomography (CT) scans are performed each year in the United States, and the technology advances in CT have generally outpaced measurement standards for both radiation dose and image quality metrics. The differences in CT scanner design by manufacturer and model, and the wide range in the age of CT scanners deployed across the U.S. also present considerable challenges to standardizing metrology for both radiation dose and image quality. Accreditation standards, a de facto requirement for clinical CT imaging, are slow to adapt to new CT technologies and new quantitative metrologies, impeding much needed change in the way CT scanner performance is evaluated. This presentation will briefly review advances in CT dosimetry, and then focus on past, present, and potential future image quality metrologies, including those developed by the author and colleagues. It is postulated that the development of promising CT diagnostic methodologies - in light of the rapid technological advances in CT and the large legacy fleet of CT scanners in the US - is compromised by outdated accreditation requirements, slow adoption of more quantitative metrics, and the patchwork of CT regulations governing CT use across states.

Bio: John M. Boone earned a bachelor's degree from UC Berkeley in Biophysics and a doctorate from UC Irvine in Medical Physics. After radiology faculty positions at University of Missouri and Thomas Jefferson University, in 1992 he joined the University of California Davis Radiology department and was appointed to the Biomedical Engineering department in 2003. His research has focused on development of breast computed tomography (CT) instrument-ation, new whole body CT system designs, radiation dosimetry in breast and CT imaging, and the development of radiation dose and image quality metrics for CT imaging. Dr. Boone served as president of the American Association of Physicists in Medicine (AAPM) and was a commissioner and board member of the International Commission on Radiation Units and Measurement (ICRU). He chaired the ICRU report committee 87, “Radiation dose and image quality assessment in computed tomography.” He currently serves as the Editor-in-Chief of Medical Physics.

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Joshua Welsh, Senior Staff Scientist, *Becton Dickinson*

The transition from arbitrary to quantitative flow cytometry assays

Invited Speaker Abstract & Bio

Abstract: Since its inception, flow cytometers by default have displayed their data in arbitrary units. As utilization of flow cytometry has progressively increased, so too has the demand for standardized results. While this started by ensuring a single instrument had consistent longitudinal performance, we are entering a period where inter-instrument and even inter-platform performance consistency is beginning to be expected by customers. For flow cytometry manufacturers, this has resulted in an ever-increasing need for understanding of instrument performance tolerances and how they came be overcome and the reagents being utilized for cellular phenotyping. With this new level of understanding comes a need to outline tiers of assay standardization and the accuracy of current and future reference materials in order to accommodate them. Flow cytometer manufacturer's alignment and collaboration with NIST are essential to the development and adoption of traceable flow cytometry standardization. This talk will cover the current manufacturer driven standardization approaches which aim to provide ergonomic flow cytometry applications for high parameter cellular flow cytometry assays.

Bio: Joshua A. Welsh, Ph.D. is a Senior Staff Scientist in the Advanced Technology Group at Waters Biosciences, formerly BD Biosciences, in Milpitas, California. His work focuses on quantitative flow cytometry, flow cytometry standardization, small particle and extracellular vesicle analysis, and the development of tools and frameworks that improve reproducibility across instruments, sites, and assay contexts. Dr. Welsh's career has bridged academic, government, and industry research. Prior to joining industry, he worked at the U.S. National Institutes of Health, where his research focused on extracellular vesicle characterization and the standardization of small particle flow cytometry. He now leads next-generation standardization initiatives for the FACSDiscover platform within the Advanced Technology Group at Waters Biosciences.

A major focus of Dr. Welsh's work has been the development of community standards, educational resources, and software tools for quantitative cytometry. He led the development of the MIFlowCyt-EV reporting framework and companion educational resources, and has contributed to broader extracellular vesicle standardization efforts including MISEV2023. He also developed FCMPASS, MPAPASS, and RPSPASS, software tools used internationally for flow cytometry calibration and small particle analysis. Dr. Welsh has been an active contributor to ISAC and related societies for more than a decade. He was an ISAC Marylou Ingram Scholar from 2019 to 2023, serves on the ISAC Data Committee, and led the ISAC-ISEV-ISTH Extracellular Vesicle Flow Cytometry Working Group from 2016 to 2024. He has also served as an Associate Editor for Cytometry Part A and Current Protocols in Cytometry, contributed to CYTO tutorials and workshops, and delivered numerous invited talks and educational sessions. https://www.joshuawelsh.co.uk/

Invited Speaker Abstract & Bio

Kyoko Fujimoto, Medical Device/ Safety Consultant

Analysis of US Leadership in Medical Imaging: Research & Development to Marketing Pathway

Abstract: International medical device companies often bypass their domestic markets to launch advanced technologies in the United States first. This is a trend observed in the medical imagingc field as well, where major product debuts frequently occur at US annual trade shows rather than at meetings held in the companies' home countries. This presentation examines the drivers underlying this "US-First" trend and its implications for global leadership by analyzing the research and development (R&D) and commercialization pathways required for US market entry. This trend also illustrates how sustaining global leadership relies on robust, up-to-date standards that keep pace with rapid innovations moving to the market.

Bio: Kyoko Fujimoto Ph.D. is a consultant and subject matter expert in medical devices with a focus on medical imaging and device safety. With a career spanning research and advisory roles across academia, industry, and government, she currently serves as the outgoing Chair of the ISMRM MR Safety Study Group and holds affiliated and adjunct faculty appointments at US universities. She received a B.A. in Physics from Boston University, as well as an M.S. and Ph.D. in Electrical Engineering from the University of Hawai‘i at Mānoa.

Invited Speaker Abstract & Bio

Joseph Naegele, Principal Software Engineer, *Microsoft Research, Health Futures*

The Future of Diagnostic Imaging: AI, Cloud Computing, and Intelligent Systems

Abstract: Diagnostic Imaging is among the first medical fields undergoing a broader transition from standalone instruments to connected, software-defined systems. These systems can work directly with raw acquisition data, preserving information that is reduced or discarded when finished images are produced, and can combine it with relevant clinical context, such as a patient's history and prior examinations. Yet our healthcare standards and infrastructure were largely designed to exchange finished images and reports, not the data and computational steps behind them. For intelligent instruments to make decisions that are trustworthy, reproducible, and open to scrutiny, we need interoperable access to the original measurements, together with the context and provenance required to understand how those measurements were acquired and processed. This foundation could support earlier and better-informed clinical decisions, more efficient and personalized imaging workflows, and wider access to high-quality diagnostic care.

Bio: Joe Naegele is a Principal Software Engineer at *Microsoft*, where he develops automated diagnostic imaging workflows, cloud-native signal processing pipelines, and intelligent medical instruments. His work focuses on applying AI, cloud computing, and data infrastructure to transform how diagnostic measurements are acquired, processed, and translated into clinical insight.

Joe helped develop the ISMRM Raw Data standard (ISMRMRD) and the *Gadgetron* medical image reconstruction framework at the National Institutes of Health. These open-source projects improved interoperability and accelerated innovation in MR image reconstruction. Building on this foundation, he later contributed to the development of *Tyger*, a framework for distributed signal processing, and *Yardl*, a schema language for describing and exchanging scientific data.

Prior to joining *Microsoft*, Joe led engineering teams at *Grier Forensics* across defense research programs involving large-scale web analytics, cyber defense, AI-driven digital forensics, geospatial intelligence, and enterprise cybersecurity.

Invited Speaker Abstract & Bio

Joshua Pfefer, Biomedical Research Engineer, FDA/CDRH

Performance Standardization of Emerging Biophotonic Imaging and Sensing Technologies

Abstract: In recent decades, biophotonic imaging and sensing technologies such as pulse oximetry, optical coherence tomography and fluorescence imaging have become integral to modern medicine. As light-based devices continue to advance, there is growing recognition that standardized performance test methods can be beneficial for accelerating development and clinical translation. Several consensus documents for biophotonic devices have been published which describe test targets, protocols, analysis techniques and performance metrics adapted from photography or established medical imaging modalities. The FDA's Office of Science and Engineering Laboratories (OSEL) in the Center for Devices and Radiological Health (CDRH) supports development of regulatory science tools (RSTs) such as tissue-simulating phantoms to facilitate objective, quantitative device characterization. This presentation outlines key consensus documents and regulatory science research in OSEL, and identifies several research topics that can help establish the scientific foundation necessary for efficient, clinically relevant performance testing of emerging biophotonic technologies.

Bio: Joshua Pfefer, Ph.D. is a Research Biomedical Engineer focusing on biophotonic imaging and sensing at FDA's Center for Devices and Radiological Health. Dr. Pfefer received his doctorate in Biomedical Engineering from the University of Texas at Austin in 1999, and performed postdoctoral research at Harvard Medical School before joining FDA. Over his career he has published a total of more than 100 journal articles and book chapters on a wide range of topics in biophotonics, including laser ablation, photothermal therapy, fluorescence spectroscopy and imaging, optical coherence tomography, photoacoustic imaging, IR thermography, pulse oximetry, computational modeling, and optical property measurements. This work addressed clinical issues in dermatology, gastroenterology, oncology, surgery, anesthesiology and emergency medicine. Most recently, his group's research has focused on development of phantom-based performance test methods. As a subject matter expert for FDA, he has provided expertise on hundreds of regulatory submissions, assisted in the development of guidance documents, standards and official agency communications, and presented at FDA panel meetings. His contributions to the field of biophotonics include serving as a topical editor of Optics Letters, participating in review panels for NIH and NSF, organizing technical conferences, and serving on a White House OSTP committee. In recognition of these achievements, Dr. Pfefer has been named a Fellow of SPIE and AIMBE.

Invited Speaker Abstract & Bio

Passley Hargrove-Grimes, Program Officer, Office of Special Initiatives, NIH Tissue Chip Program

Metrology and Standards Priorities for New Approach Methodologies: Building an Infrastructure for Tissue Chips and Human-Relevant Drug Testing

Abstract: The shift toward New Approach Methodologies (NAMs) — tissue chips, organoids, and other microphysiological systems (MPS) — as human-relevant alternatives to animal testing requires a coordinated national metrology and standards infrastructure that does not yet fully exist. Drawing on three federally supported efforts, this abstract identifies priority measurement and standardization needs and proposes future directions for a national roadmap.

My talk will focus on three major areas within NAMs development. Firstly, the NIH/NCATS Tissue Chip Testing Centers (TCTCs) provided independent, third-party validation of tissue chip platforms for robustness, reproducibility, reliability, and relevance — demonstrating that independent validation, not self-reported performance alone, builds the confidence needed for broader adoption. Secondly, the Translational Centers for Microphysiological Systems (TraCe MPS) Resource Cores centralize specialized fabrication technologies, biological materials, and technical expertise, and coordinate SOPs to help transition MPS platforms toward regulatory context-of-use — a model for shared infrastructure that reduces duplication and harmonizes practice across labs. Thirdly, the Complement-ARIE NAMs Data Hub and Coordinating Center, administered by NIEHS and the Common Fund, and led by Gustavo Stolovitzky, PhD (NYU Grossman School of Medicine) with Sage Bionetworks, is building a FAIR-compliant data ecosystem — including an adaptive FUSION ontology framework — showing that NAMs standardization is a *data* metrology challenge as much as a physical one.

Coordinated metrology and standards stand to reduce costly late-stage drug failures, shorten development timelines through regulatory acceptance of qualified platforms, lower duplicative capital investment via shared reference materials, and strengthen U.S. leadership as international regulators increasingly favor non-animal methods.

We propose the roadmap prioritize: (1) reference materials and inter-laboratory standards for common tissue chip and NAMs readouts; (2) harmonized data/metadata standards bridging TraCe MPS SOPs, the NAM Hub's FUSION framework, and FDA guidance; (3) sustained independent validation capacity modeled on the TCTCs; and (4) clearer pathways from validated NAMs data to regulatory-ready qualification packages. Diverse stakeholder input — from developers, resource core operators, data scientists, regulators, and industry — will be essential to sequencing these priorities.

Bio: Passley Hargrove-Grimes, PhD, is a Program Officer at the U.S. Department of Health and Human Services' National Institutes of Health, at the National Center for

Invited Speaker Abstract & Bio

Advancing Translational Sciences. At NCATS, she is contributing to efforts that advance translational science and innovative approaches to drug development. With a focus on emerging biomedical technologies, Hargrove-Grimes works at the intersection of research, policy, and regulatory science to support the development and adoption of more predictive and human-relevant models for evaluating medical products. Hargrove-Grimes has been involved in initiatives related to microphysiological systems (MPS), also known as tissue chips or organs-on-chips, which aim to improve the efficiency and success rates of therapeutic development. This work includes supporting programs that foster collaboration among academic institutions, federal agencies, and industry partners to accelerate the translation of novel technologies into practical tools for drug discovery and development. Through contributions to cross-sector partnerships and translational research programs, Hargrove-Grimes helps advance strategies that bridge early-stage innovation with regulatory acceptance and real-world application. Areas of interest include improving preclinical model predictivity, advancing precision medicine approaches, and enabling the integration of new technologies into established biomedical research and regulatory frameworks. Hargrove-Grimes is committed to supporting scientific innovation that enhances public health outcomes by reducing drug development risk, improving safety assessment, and accelerating the delivery of effective therapies to patients.

Invited Speaker Abstract & Bio

Ron Tosh, Radiation Physicist, NIST

Evolving Dosimetry Standards at NIST

Abstract: Accuracy of clinical radiation dosimetry in the US is established *via* an unbroken traceability chain of calibrations connecting a given measurement device used in the clinic with one of the primary standard instruments maintained by the National Institute of Standards and Technology (NIST). Given the multiplicity of dosimetry devices and measurement settings that arise in the clinic, it is remarkable that calibration accuracy can be assured for so many by traceability to so few primary standard instruments. This is possible only through carefully designed protocols and dissemination architectures that require continuous refinement as clinical technologies and measurement standards evolve. This talk will highlight examples of NIST's work to advance existing measurement standards in response to needs expressed by external stakeholders in medical physics, like AAPM and CIRMS, and touch upon exploratory work the NIST Dosimetry Group is doing to adapt imaging methods for therapy-level dosimetry and, in collaboration with other groups at NIST, to use DNA to realize biologically relevant dosimetry.

Bio: Ron Tosh is a physicist in the Radiation Physics Division, working in the Dosimetry Group on standards and instrumentation for absorbed dose from ionizing radiation. Having joined NIST in 2004, he has decades of experience working with the national primary standard calorimeter for absorbed dose to water, in therapy-level beams of gamma rays, high-energy x-rays, high-energy electrons and protons. He also has served for many years on task groups and standards committees within AAPM and ASTM related to the use and development of measurement standards for ionizing radiation applied to medicine and transportation security. His standards development and research interests are focused on dosimetry in radiation fields with large spatial gradients and high dose rates, with applications to therapeutic and diagnostic radiation, irradiation of surfaces, and radiosensitivity of semiconductor microdevices and biological systems.

Invited Speaker Abstract & Bio

Katy Keenan, Project Leader, Quantitative MRI, NIST

What is needed to enable the coming impact of Quantitative MRI?

Abstract: Twenty years ago, a similar joint workshop occurred between NIH and NIST, and one outcome of that workshop was the creation of the quantitative MRI program at NIST. That workshop identified a need of the pharmaceutical industry to evaluate the stability of MRI systems and develop tools (phantoms) to assess the repeatability and reproducibility of measurements from MRI. This talk will present the progress to date, including the actual use of phantom data to support MRI outcome measures in a clinical trial used for FDA-approval of a drug. While NIST did not directly contribute to that particular phantom, the NIST quantitative MRI program did build the ecosystem that has researchers, clinicians, and the medical community asking what level of accuracy and precision can be expected from quantitative MRI measurements. The NIST effort, in collaboration with NIBIB, FDA, and the VA, expanded beyond MRI to include CT and optical phantoms. The talk will conclude with highlights of the possible impacts of quantitative MRI, asking how NIST can support the future needs of the pharmaceutical industry, medical imaging research, and clinical quantitative imaging.

Bio: Kathryn Keenan, PhD is the Quantitative Magnetic Resonance Imaging (MRI) Project Leader in the Applied Physics Division, where she works to improve the repeatability and reliability of MRI. Dr. Keenan started at NIST as an NRC post-doctoral scholar and created an MRI reference object (phantom) for assessing the accuracy and comparability of breast cancer imaging methods. Currently, she is developing methods to validate advanced quantitative MRI techniques. Dr. Keenan was a 2019 PECASE recipient, and along with her colleagues Dr. Michael Boss, Dr. Stephen Russek and Dr. Karl Stupic, she won the 2015 CO-LABS Governor's Award for High-Impact research, public health & life sciences, a 2016 Department of Commerce Gold Medal, as well as the inaugural Department of Commerce Excellence in Innovation Award. This year Dr. Keenan will receive the 2026 Flemming Award.

Invited Speaker Abstract & Bio

Toni Litorja, Senior Scientist, Sensor Science Division, NIST

Optical Imaging Measurements and Traceability to the SI

Abstract: Optical imagers are light collectors, yet we often see light quantities expressed in arbitrary units. The conversion of arbitrary units into units traceable to the international system of units (SI) requires a calibration step, a worthwhile exercise that enables quantitative comparisons across instruments, locales and time. I will show an overview of the SI-traceability pathway of optical measurements and the NIST facilities and standardization research that serve various scientific measurement communities which enable such calibrations.

Bio: Toni Litorja is a scientist in the Physical Measurement Laboratory at NIST. She works on determining metrological traceability pathways for field measurement applications ranging from clinical optical imaging to electric vehicle fast charging and on finding the appropriate tools and methods for the dissemination of the SI in diverse applications of optical technologies.

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Invited Speaker Abstract & Bio

Matt DiSalvo, Biomedical Engineer, Biophysical and Biomedical Measurement Group, NIST

Microsystems for Medical Metrology

Abstract: Physical measurement science plays a critical role in establishing trust and reproducibility for complex biomedical measurement systems. We demonstrate that bottom-up design of serial flow cytometers enables uncertainty quantification, performance comparability, and access to novel single-cell phenotypic measurements. Uncertainty-aware microsystems, SI traceability, and high-quality data generation will serve as essential pillars for developing transferable biomedical models.

Bio: Matthew DiSalvo, PhD, is a staff biomedical engineer in the Biophysical and Biomedical Measurement Group at NIST. His research bridges laboratory automation, fluidics, optics, and measurement science to solve foundational metrology challenges in healthcare and biotechnology. His recent work in high-throughput cell analysis leverages droplet microfluidics, ultra-high temporal resolution neuromorphic sensors, and quality cytometry data generation. Dr. DiSalvo's contributions to the world's first serial flow cytometer have been recognized by a Department of Commerce Gold Award and the Ron Brown Excellence in Innovation Award, and he was named an ISAC International Innovator (2025–2028) for his work to resolve fundamental metrology and comparability challenges in flow cytometry.

Invited Speaker Abstract & Bio

Paul Kinahan, Professor of Radiology, Radiation Oncology, and Bioengineering, Vice-Chair of Radiology Research, University of Washington

QUIC Implementation Roadmaps for translation of quantitative imaging biomarkers to clinical practice

Abstract: The RSNA Quantitative Imaging Committee (QUIC) was established following the transition from the Quantitative Imaging Biomarker Alliance (QIBA) to accelerate the clinical adoption of quantitative imaging biomarkers (QIBs). While QIBA Profiles provide technical specifications and performance metrics for biomarker acquisition and measurement, barriers remain to routine implementation in clinical practice. QUIC developed a new framework, termed an Implementation Roadmap, to facilitate translation of QIBs from technical validation into real-world clinical deployment.

Implementation Roadmaps identify motivations, indications, technical requirements, stakeholders, barriers, financial considerations, data-flow requirements, and metrics for success. The framework extends beyond imaging acquisition and analysis to include integration with electronic health records, radiology reporting systems, hospital information technology infrastructure, regulatory considerations, reimbursement pathways, and communication with referring physicians and patients.

Initial QUIC efforts identified several high-priority 'Use Cases' and four were selected for development as Implementation Roadmaps: breast density assessment in cancer screening (mammography), amyloid plaque imaging in Alzheimer's disease (PET), quantitative assessment of chronic liver disease including liver fat, fibrosis, and MASH (MR and US), and coronary plaque characterization (CT). Two of the Implementation Roadmaps are published, and completion of the other two is anticipated by the end of 2026.

Bio: Paul Kinahan, PhD, is Professor of Radiology, Bioengineering, and Radiation Oncology and Vice-Chair for Research at the University of Washington, where he leads the Imaging Research Laboratory and serves as Director of Clinical PET/CT Physics. He was a member of the team that developed the first PET/CT scanner, and was a founding member and Chair of the NIH-NCI Quantitative Imaging Network and the RSNA Quantitative Imaging Biomarkers Alliance. He is a PI of the NIH-supported Medical Imaging and Data Resource Center (MIDRC) where he chairs the Data Quality and Harmonization Committee.

Invited Speaker Abstract & Bio

Dan Sullivan, Professor Emeritus, Dept. of Radiology, Duke University Medical Center

Quantitative Medical Imaging Coalition (QMIC)

Abstract: The Quantitative Medical Imaging Coalition (QMIC) formed in 2025 as the successor to the RSNA-sponsored Quantitative Imaging Biomarkers Alliance (QIBA). RSNA is also retiring its Quantitative Imaging Committee (QUIC), leaving a gap in the standardization infrastructure the imaging community has relied on. QMIC will carry that work forward toward improving the value and practicality of quantitative imaging biomarkers (QIB) by integrating measurement science (metrology) into medical imaging.

QMIC's mission is to further advance the science and implementation of quantitative imaging (QI) in clinical practice and trials.

From a foundation of rigorous measurement science (metrology), QMIC's goals are to:

- Develop QI guidelines, including QIB guidelines
- Enable implementation of QI guidelines in clinical practice and research
- Collaborate with education programs that foster the application of QI

QMIC is a volunteer organization of international quantitative imaging experts in 15 Biomarker Committees (BC). QMIC builds consensus-based guidelines that define the conditions under which a QI measurement will have known bias and precision.

Although the physical bases and clinical applications of CT, MRI, NM, and ultrasound are different, the fundamental metrology challenge to ensure that a measurement means the same thing wherever and whenever it is obtained is universal.

To that end, QMIC is actively engaging clinical, imaging, research, regulatory, data science and AI organizations, and industry partners from imaging hardware, software and AI companies, pharma, and biotech.

QI Benefits:

- Improved Patient Care: Building trust in imaging data improves confidence in measurements for precision medicine.
- Accelerated Innovation: Consistent and transparent imaging data accelerates the development and implementation of AI.

QI Challenges:

- QI measurements are analogous to clinical laboratory assays; the QA/QC standards developed for lab assays must be adapted to QI.
- This presentation will also describe other significant cultural and economic barriers.

QMIC's work is compelled by three converging forces:

- Imaging-derived measurements now guide treatment eligibility and monitor response, so measurement accuracy directly affects patients.
- The global imaging ecosystem lacks the standardization infrastructure that clinical laboratories established decades ago.
- AI tools are creating unprecedented capability to extract quantitative information from medical images, yet these tools are only as reliable as the underlying data.

This

presentation will review QMIC's organizational structure and priorities, flagship examples of QI standards moving into clinical practice, and principal impediments to broader adoption. It will close with specific recommendations for how federal and professional stakeholders can support QI standardization to build the metrology foundation needed for accurate, reproducible imaging data and the safe, viable use of AI.

Bio: Dr. Daniel Sullivan is Professor Emeritus, Department of Radiology at Duke University Medical Center. He held faculty appointments at Yale University Medical Center, Duke University Medical Center, and University of Pennsylvania Medical Center. From 1997 to 2007 Dr. Sullivan was Associate Director in the Division of Cancer Treatment and Diagnosis of the National Cancer Institute (NCI), and Head of the Cancer Imaging Program (CIP) at NCI. In 2007 Dr. Sullivan returned to the Department of Radiology at Duke University. His areas of clinical and research expertise are in nuclear medicine and oncologic imaging, focusing on improving the use of imaging as a biomarker in clinical trials and clinical practice.

Dr. Sullivan was Founder and Chair Emeritus of the Quantitative Imaging Biomarkers Alliance (QIBA) from 2007 to 2023. Subsequently, in 2024, Dr. Sullivan was one of the Founding Directors of the Quantitative Medical Imaging Coalition (QMIC). QMIC coordinates a wide range of national and international activities related to the evaluation and validation of quantitative imaging biomarkers for clinical research and practice.

Invited Speaker Abstract & Bio

Florence Hudson, Executive Director, Northeast Big Data Innovation Hub at Columbia University, Vice Chair, IEEE Engineering in Medicine and Biology Society

US Leadership in healthcare and medical technology: TIPPSS, AI and Beyond

Abstract: Healthcare is increasingly leveraging advanced technology to improve insights and outcomes, including new devices and data methods, metrology, artificial intelligence, machine learning, knowledge networks, and digital twins. The application of new technologies also increases risk, adding attack vectors that can be exploited to compromise and negatively impact data, devices, and systems. We must provide guidance and rigor for designing and using technology in healthcare to improve the elements of Trust, Identity, Privacy, Protection, Safety and Security (TIPPSS) of data, algorithms, devices, and systems, and to better protect the humans we serve. The IEEE Engineering Medicine & Biology Society Standards Committee is dedicated to working across the ecosystem of medicine and biology devices, data, processes, institutions and humans to nurture and publish international standards to address the opportunities and risks in medicine and biology in pursuit of our mission "Advancing Technology for Humanity".

Bio: Florence Hudson, Executive Director of the Northeast Big Data Innovation Hub, Interim Executive Director for Sponsored Research in the Data Science Institute at Columbia University, leads $30M in research projects funded by NSF, NIH, DOT and DARPA. Former *IBM* VP & CTO, *Internet2* SVP & Chief Innovation Officer, NSF Cybersecurity Center of Excellence, NASA aerospace engineer. She is Vice Chair of the IEEE Engineering Medicine & Biology Society Standards Committee, leader of IEEE/UL standards for Trust, Identity, Privacy, Protection, Safety, Security (TIPPSS), a Mechanical & Aerospace Engineer from Princeton University, and earned certificates from Harvard Business School and Columbia University.

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Invited Speaker Abstract & Bio

Rock Mackie, Emeritus Professor, Medical Physics and Human Oncology, University of Wisconsin

Novel Dosimetry Systems for Radiation Oncology

Abstract: Novel detectors for radiation oncology stem from the need for real-time, non-invasive treatment verification and the very high dose rates for a promising new modality called FLASH. Photon radiotherapy is now delivered with highly complex intensity modulated beams that requires high temporal response. Particle beam radiotherapy (protons or heavier ions) relies on an exact placement of the Bragg peak so that small anatomical perturbations of like bowel gas can move the position equal to the change in pathlength. Cerenkov and photo-acoustic approaches share the appeal of measuring dose *as* delivered, inside or just on the patient, rather than relying purely on pre-treatment quality assurance or post-therapy reconstruction, which is a long-standing gap for particle beam therapy. FLASH is a promising radiotherapy modality that delivers radiation bursts of 10 Gy at rates that exceed 40 Gy/s. Conventional detectors saturate or under-respond at the extreme dose rates FLASH uses. Approaches include real-time scintillation dosimetry spanning detector technologies live plastic scintillators, YAG-based 2D sheets, fiber-optic beam monitors.

Bio: Thomas "Rock" Mackie has a BSc in Physics (1980) from the University of Saskatchewan and a PhD in Physics (1984) from the University of Alberta. He was a Professor of Medical Physics at the University of Wisconsin from 1987 to 2014. He was made an Honorary Member of the European Society of Therapeutic Radiology and Oncology (ESTRO) 2010. He has been awarded the Coolidge Gold Medal from the AAPM (2014), the Gold Medal from ASTRO (2019) and the John Mallard Award for Innovation from the IOMP (2019) and is a Fellow of the National Academy of Inventors. He is a commissioner of the International Commission on Radiation Units and Measurements (ICRU) as well as the Vice-Chair of its Board. He is best known for *Pinnacle*, a radiation therapy treatment planning system as well as *TomoTherapy*, a CT-guided intensity modulated radiotherapy company. He is a co-founder of *Leo Cancer Care*, which is developing upright radiotherapy. He is a co-founder of *Asto CT*, the developer of the first weight-bearing CT scanner for horses. *Leo Cancer Care* and *Asto CT* are subsidiaries of *Centaur Medical* and Dr. Mackie is the Chairman of the Board.

Invited Speaker Abstract & Bio

Kishore Rajendran, Associate Professor of Radiological Sciences, UCLA

Medical Imaging Metrology—Perspectives from the AAPM Working Group on the Physics of Quantitative Imaging

Abstract: Imaging physics and metrology play a central role in the development and validation of quantitative tools, techniques, and technologies used in diagnostic imaging. The AAPM Working Group on the Physics of Quantitative Imaging (WGPQI) was formed in 2024 to provide guidance and expertise on the physics aspects of diagnostic imaging—this includes image acquisition, image formation, and post-processing, and analytical tools used in quantitative imaging tasks. The output from WGPQI includes modality- and task-specific Quantitative Physics Imaging Document (QPID) that defines measurands, tools and technologies, test conditions, and summarizes quantitative findings in terms of precision, bias, repeatability and reproducibility. QPID will not include discovery, validation, or translation of imaging biomarkers themselves but provide physics-driven methods to estimate their quantitative magnitude. In this talk, Dr. Rajendran will discuss the scope and goals of AAPM WGPQI, current activities and their significance in imaging metrology. He will present results from a WGPQI-led multicenter study assessing the repeatability and reproducibility of spectral CT measurements from first-generation photon-counting CT.

Bio: Dr. Kishore Rajendran is an Associate Professor of Radiological Sciences at the David Geffen School of Medicine at University of California Los Angeles, California. He serves as the Chair of the Working Group on the Physics of Quantitative Imaging at the American Association of Physicists in Medicine. Dr. Rajendran is a CT physicist with research interests and expertise in photon-counting detectors, imaging biomarkers, and quantitative CT.

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Poster #	Presenter	Institution	Email	Title
1	Akbar Alipour	Icahn School Of Medicine M.Sinai	AKBAR.ALIPOUR@MSSM.EDU	Enhancing Prostate Diffusion MRI with Wireless Coils for Improved ADC Precision
2	Madison Brookfield	NIBIB	madison.brookfield@nih.gov	National Medical Phantom Library
3	Jason Chang	American Institute for Medical and Biological Engineering	jason.marvin@aimbe.org	
4	Gregory Cooksey	NIST	gregory.cooksey@nist.gov	Uncertainty Quantification for Flow Cytometry
5	Zeyno Dodd	AlgiSense	zdodd@algisense.com	Objective Pain Intelligence for Clinical Research and Digital Health
6	Robert Gougelet	Global Resonance Technologies LLC	rgougelet@globalresonancetechnologies.com	Medical Applications of Alanine Dosimetry
7	Ravi Hadimani	Virginia Commonwealth University	rhadimani@vcu.edu	Anatomically accurate human and animal brain phantoms for neuromodulation testing and analysis
8	Matthew Hall	NPL	matt.hall@npl.co.uk	MRI Metrology and Standardisation at NPL
9	Ethan Phillip LaRochelle	QUEL Imaging	ethan@quelimaging.com	Building the Physical Ground Truth for Biomedical Innovation: Reproducible Tissue Phantoms for Optical, Acoustic, Wearable, and AI-Enabled Health Technologies
10	Maritoni Litorja	NIST	litorja@nist.gov	Optical Imaging Measurements and Traceability to the SI

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Poster #	Presenter	Institution	Email	Title
11	Jacqueline Mann	NIST	jmann@nist.gov	Community-Driven Reference Material (RM) Development for Metal Isotopes in Clinical Matrices
12	Jessica Martinez Martinez	NIST	jessica.martinezmartinez@nist.gov	Toward Device Testing At 0.55 T: Tissue-Equivalent Media Assessment For Lead Heating
13	Lucas McCullum	Boston Children's Hospital and Harvard Medical School	Lucas.McCullum@childrens.harvard.edu	Technical Development, Optimization, and Clinical Implementation of Quantitative Magnetic Resonance Imaging Methods for Radiation Oncology
14	Peter Noel	University of Pennsylvania	pbnoel@upenn.edu	PixelPrint - Lifelike computed tomography phantoms
15	Stephen Ogier	NIST	stephen.ogier@nist.gov	The Trouble with T2: Well-defined T2 Measurements of Complex Materials
16	Aaron Oliver-Taylor	Gold Standard Phantoms Limited	aaron.oliver-taylor@goldstandardphantoms.com	Preliminary results from PREDICT Trial (PRostate Cancer Enhanced DIagnosis by Calibration Technology)
17	Julian Rey	NIH	julian.rey@nih.gov	Physical and Virtual Phantoms for Magnetic Resonance Elastography
18	Alberto Ruiz	QUEL Imaging	alberto@quelimaging.com	Fluorescence Imaging Transform (FIT): A Radiometric Framework for SI-Traceable Quantitative Imaging
19	Walter Schneider	University of Pittsburgh	wws@pitt.edu	VA CHIPS Program to deliver advanced lifelong calibrated MRI to Veterans

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Poster #	Presenter	Institution	Email	Title
20	Brandon Stacks	NIST	brandon.stacks@nist.gov	In-plane Hydrodynamic Focusing of Nanoparticles to Estimate Particle Size and Velocity in Microfluidic Devices
21	Karl Stupic	NIST	karl.stupic@nist.gov	NIST MRI Biomarker Calibration Service
22	Clarissa Weiant	CaliberMRI, Inc.	cweiant@qmri.com	CaliberMRI - The Global MRI Data Harmonization Platform Transforming Medical Imaging in the Age of AI and Precision Medicine
23	Shoujun Xu	UForce Biotechnology	shoujun.xu@uforcebiotech.com	Quantum Plate Readers Based on Super-Resolution Force Spectroscopy for Drug Development
24	Kishore Rajendran	AAPM	KRajendran@mednet.ucla.edu	AAPM Physics of Quantitively Imaging
25	Florence Hudson	IEEE EMBS	fh2417@columbia.edu	IEEE Engineering Medicine & Biology Society Standards Committee Activities
26	Katya Delak	Office of Weights and Measures	katya.delak@nist.gov	Role of the NIST Office of Weights and Measures in Medical Metrology and Standards
27	Johanna Camara	NIST	johanna.camara@nist.gov	Development of candidate Standard Reference Material® 1950a Metabolites in Frozen Human Plasma
28	Eunkyoung Kim	IBBR	Eunkyoung Kim <ekim@umd.edu>	IBBR Development of Metrology and Standards for Redox Assays for Mental Health
29	Stephen Adler	Frederick National	sadler@mail.nih.gov	The micro-dose calibrator, filling the need for gamma

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Poster #	Presenter	Institution	Email	Title
		Laboratory for Cancer Research		counting precision activity measurements in preclinical and RPT dose measurements
30	Petr Bruza	DoseOptics LLC	Bruza@doseoptics.com	Quantitative Optical Metrology for Radiotherapy: Integrating Cherenkov Imaging and Scintillation Dosimetry
31	Ruifeng Dong	NIH	dongr2@nih.gov	Evolution of the NIH Spherical Uniform Polyvinylpyrrolidone (PVP) Phantom for Diffusion MRI Calibration
32	Taylor Froelich	Mayo Clinic	froelich.taylor@mayo.edu	Rapid Multiparametric Phantom QC Appended to the Weekly ACR Scan: Week-to-Week Stability at 1.5T and 3.0T
33	Robert McCurdy	CU Boulder	maccurdy@colorado.edu	Automated medical model design and fabrication via OpenVCAD and inkjet 3D printing
34	Michael Nelson	NIST	michael.nelson@nist.gov	
35	Brian Pogue	Dartmouth		
36	Seiichi	Takamatsu	stakamatsu@binghamton.edu	
37	Fergal Kerins	PreOperative Performance	Fergal Kerins <FKerins@preoperativeperformance.com>	A Novel Framework for Standardizing Diffusion MRI Measurements Using a Physical: Anisotropic Diffusion Phantom
38	Jessica Ramella	Florida International University & Polarimed LLC	andrrodr@fiu.edu	Modular Optical Phantoms for Metrology and Validation of Wearable Biomedical Sensors: From Static Characterization to

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Poster #	Presenter	Institution	Email	Title
				Dynamic Physiologic Models
39	Ella Wilczynski, Peter Basser, Julian Rey	NICHD	Wilczynski, Ella (NIH/NICHD) [F] <ella.wilczynski@nih.gov>	Quantitative T1-T2 phantom measurements at 0.064 T

Poster 14: PixelPrint: From Patient Images to Patient-Based CT Phantoms

Jessica Im, Pouyan Pasyar, Dylan Corbett, Leening Liu, Michael Geagan, Kai Mei, Peter B. Noël
Department of Radiology, Perelman School of Medicine, University of Pennsylvania

CT research and quality assurance depend on phantoms, yet conventional phantoms are geometrically simple objects that cannot reproduce the anatomical detail, tissue texture, and pathology that determine clinical image quality and quantitative performance. PixelPrint bridges this gap by converting patient CT images directly into physical phantoms. Using fused filament fabrication, PixelPrint continuously modulates the printed line width within each voxel so that partial-volume averaging between filament and air reproduces the attenuation of the corresponding image voxel. The resulting phantom matches the source scan in both geometry and Hounsfield units, capturing fine parenchymal texture, vasculature, and lesions rather than idealized inserts.

Validation studies of PixelPrint lung phantoms across clinical scanners have demonstrated close agreement with patient attenuation values alongside realistic texture and radiomic behavior. The platform has since expanded beyond the lung: novel filaments extend the attainable attenuation range toward soft tissue and bone, iodine-doped materials enable contrast-enhanced and spectral applications, and deformable designs introduce respiratory motion for 4D imaging.

Because PixelPrint phantoms are patient-derived yet reproducible, they support experiments that are impossible in patients: repeated scanning under varied dose and reconstruction settings, head-to-head comparison of scanners including photon-counting CT, ground-truth-based development and testing of AI and quantitative imaging tools, and harmonization of protocols across sites. Identical copies can be printed and shared, making PixelPrint a practical vehicle for multi-institutional standardization and education. Together, these capabilities establish PixelPrint as a scalable pathway from patient image to physical phantom, bringing clinical realism into technical evaluation and accelerating the translation of new CT technology into practice.

Poster 23: Quantum Plate Reader Based on Super-Resolution Force Spectroscopy for Drug Development

Shoujun Xu1,2

1UForce Biotechnology, LLC.
2Department of Chemistry, University of Houston, Houston, TX 77204

We present a new type of microplate reader for biomolecular diagnostics and drug development—UForce Quantum Plate Reader® (QPR). It is based on the invention of the super-resolution force spectroscopy (SURFS) technique, which integrates quantum sensing with acoustic radiation force to provide unprecedented sub-piconewton resolution for noncovalent bonds between biological molecules. We demonstrate the prototype apparatus with a sample inlet system for standard 96-well plates. Initial characterization has confirmed the satisfactory operation of the quantum magnetometer under this configuration. The SURFS results on drug-DNA interactions indicate the ability to resolve the effects of single-nucleotide methylation, which cannot be revealed by other technical platforms. Unexpected drug selectivity was also revealed due to dual methylation. By combining the new QPR hardware and AI-based software, we demonstrate that high-precision, high-throughput drug screening is feasible using the new parameter of molecular binding force.

Selected Poster Abstracts

Poster 29: The micro-dose calibrator, filling the need for gamma counting precision activity measurements in preclinical and RPT dose measurements

Stephen Adler[1], Peter Choyke[2]

[1]Frederick National Laboratory for Cancer Research, Frederick, MD

[2]NCI Molecular Imaging Branch, Bethesda, MD

Introduction: Studying radioligands at the pre-clinical stage requires accurate radioisotope activity measurements raging from single Bq up to the MBq levels of activity. The current instruments used in pre-clinical laboratories are the gamma counter and ion chamber dose calibrator. Neither instrument provides sub percent level accuracy for ^{18}F between 20 kBq and 200 kBq. The micro-dose calibrator[1] was designed to provide sub percent accuracy for measurements as high as 1 MBq. Although designed for everyday pre-clinical radioligand drug discovery, the underlying design of the device can be extended to clinical dose measurement levels used in RPT using different scintillation materials.

Material and Methods: The micro-dose calibrator is a segmented well counter made up of 8 trapezoid shaped NaI(Tl)/PMT detector modules which form an octagon with a sampling well 50 mm wide and 100 mm deep. The detector modules are readout independently using a CAEN DT5725S, 14 bit, 4ns sampling digitizer. 1 to 8 fold coincident events are formed from the 8 singles data stream in software using a pipeline coincidence forming algorithm. Deadtime correction is done using an extended deadtime algorithm.
Activity linearity measurements were made using a 3.7MBq decaying ^{18}F source, sampling the activity every minute for 1.5 ksec. Volumetric linearity measurements were made with a standard pre-clinical .5 mL syringe and a 20 mL glass filled with increasing volumes of ^{18}F and ^{99m}Tc.

Results: The maximum activity range for ^{18}F is 1.2MBq (32μCi). The residuals to an exponential fit to the decay curve were under .5%. When fitting the decay curve up to 200 kBq, the residuals are under .2%. The syringe and 20 mL vial volumetric tests showed a linear regression fit of R^2 >= 0.9998 over a volume change of 0.05 - .5 mL (syringe) and 1-20 mL (vial).

Conclusion: The micro-dose calibrator is an instrument which has the measurement precision of a gamma counting device with an extended range 100 times greater than a gamma counter maintaining ^{18}F activity measurement accuracy of .5% or less. Other isotopes have similar performance, and the range depends on the gamma emission factor of the isotope. This makes the micro-dose calibrator ideal for the study of alpha and beta emitters used in RPT which tend to have low gamma emissions. Work on extending the dynamic range to clinical doses is ongoing.

Selected Poster Abstracts

Poster 29: The micro-dose calibrator, filling the need for gamma counting precision activity measurements in preclinical and RPT dose measurements

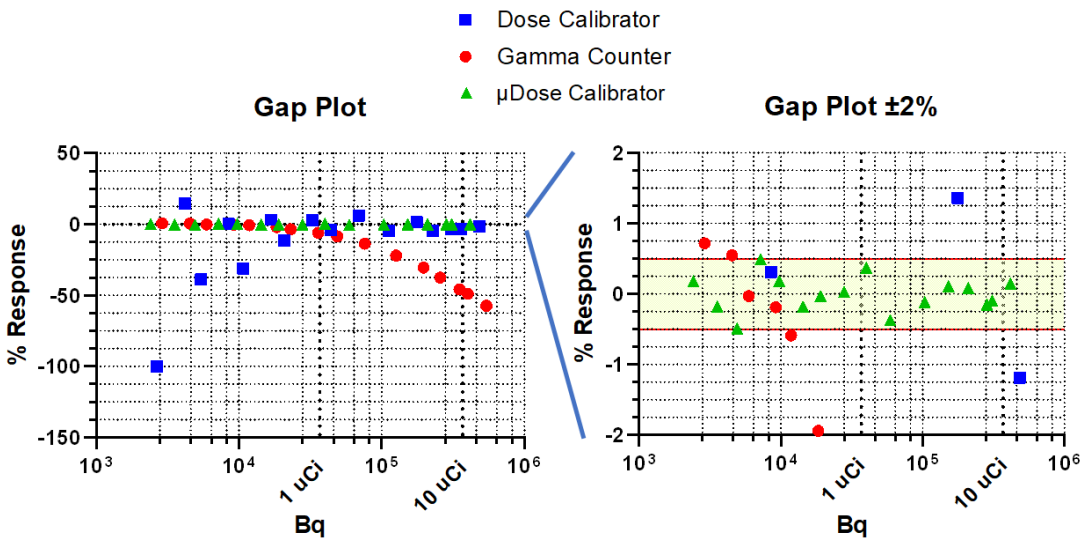

Figure 1. The percent residuals (AKA % response) are plotted for ^{18}F activities ranging from 2kBq up to 400 kBq for the dose calibrator, gamma counter and microdose calibrator. The right side plots has the Y axis magnified to ±2% to better visualize the .5% accuracy of the micro-dose calibrator through the range of activites.

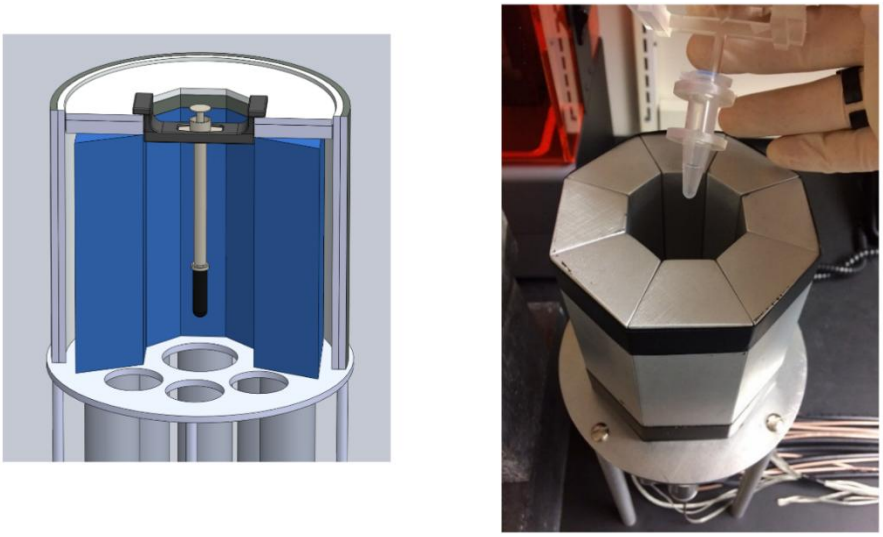

Figure 2. CAD and photo of the micro-dose calibrator demonstrating the large sampling well allowing for the measurement of a full syringe, which cannot be done with the current gamma counters found in pre-clinical radioligand development laboratories.

1. Adler, S. & Choyke, P. Design and performance of the micro-dose calibrator. *Physics in Medicine & Biology* **63**, 185004 (2018).

Funded by the NCI Contract No. 75N91019D00024.

Poster 31: Evolution of the NIH Spherical Uniform Polyvinylpyrrolidone (PVP) Phantom for Diffusion MRI Calibration

Ruifeng Dong, Alan Seth Barnett, Mustafa Okan Irfanoglu, Carlo Pierpaoli
Laboratory on Quantitative Medical Imaging, National Institute of Biomedical Imaging and Bioengineering, National Institutes of Health, Bethesda, MD, USA

Background: Diffusion MRI (dMRI) allows non-invasive measurement of water diffusivity and is widely used clinically and in research. Although dMRI is intrinsically quantitative, scanner-related factors—gradient miscalibration and gradient nonlinearity—can compromise accuracy.

More than 15 years ago, NIH researchers proposed using aqueous polyvinylpyrrolidone (PVP) solutions in diffusion phantoms to measure and correct these effects [1,2]. PVP solutions exhibit monoexponential diffusion-weighted signal attenuation, with diffusivity tunable across a tissue-relevant range via concentration, plus long-term stability and low toxicity; they are now used in several commercial MRI phantoms.

The original phantom's spherical shape and size (~17 cm, matching the brain imaging field of view) are equally important. Homogeneity ensures spatially uniform true diffusivity, allowing systematic spatial variation in measured signal to be mapped, while the spherical shape minimizes susceptibility-related field variations and image distortion. Here we summarize work by the NIH intramural team (NICHD and NIBIB) to further characterize and develop this phantom.

Establishing a Reference Diffusivity: We characterized water diffusivity as a function of PVP concentration and temperature, D(C,T) [3], yielding a formula that predicts diffusivity from known concentration and temperature [5].

Noninvasive Determination of Temperature and Reference Diffusivity: Since diffusivity depends on both concentration and temperature, we developed an MR spectroscopy method to measure PVP temperature noninvasively [4]. The chemical-shift–temperature relationship was highly reproducible within scanners and across 3T systems from GE, Siemens, and Philips, with mean inter-scanner differences ≤~0.4°C.

Mapping Spatial Gradient Nonlinearity: We used the homogeneous phantom to map spatial variation in diffusion sensitization from gradient nonlinearity [5]. Diffusion-weighted images acquired along the X, Y, and Z axes were fit to a model yielding a spatial solid-harmonic representation of the gradient fields [5].

Measuring Sequence-Specific Effects: Most recently, we modeled and measured the contributions of imaging gradients and gradient miscalibration to diffusion sensitization using a multi-shell acquisition [6]. Fitted parameters were used to correct b-matrices for an independent multidirectional dMRI acquisition.

Conclusions: These studies confirm the usefulness of the NIH spherical homogeneous PVP phantom for dMRI calibration, aiming at improved harmonization of measurements in multi-site trials.

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5. Barnett et al. *Magn Reson Med.* 2021;86:3259–3273. doi:10.1002/mrm.28890.
6. Dong et al. *Proc Intl Soc Mag Reson Med.* 2025:4071.

Poster 32: Rapid Multiparametric Phantom QC Appended to the Weekly ACR Scan: Week-to-Week Stability at 1.5T and 3.0T

Taylor Froelich[1], Ian D. Langenfeld[1], Abby J. Hubbard[1], Emily A. Kramer[1], Jenna E. Kleinow[1], Todor Karaulanov[2], William Hollander[2], and Joshua D. Trzasko[1]

[1] Mayo Clinic, Department of Radiology, Rochester, MN; [2] CaliberMRI, Boulder, CO

Introduction: Standard weekly MRI quality control via the ACR phantom evaluates geometry and uniformity but fails to isolate subsystem drift (transmit/receive chains, static field, gradients). Addressing the clinical need for continuous constancy tracking, we propose a rapid, 2.5-minute quantitative acquisition appended to the ACR protocol to strictly evaluate relative week-to-week subsystem stability.

Methods: A *CaliberMRI* qDisc phantom was affixed to the standard ACR phantom (Figure 1). A single quantitative slice intersecting 16 tissue-mimicking vials was acquired using SPGR (six flip angles), SSFSE (five echoes, 30–112 ms), and PROPELLER diffusion (b=0,1000 s/mm2). Total added scan time was 2.5 minutes. Per-vial $T1$, $T2$, water-referenced proton density (PD), and apparent diffusion coefficient (ADC) were extracted and trended as percentage changes from baseline. Identifiability was rigorously restricted to valid physiologic ranges.

Results: Weekly testing was conducted on clinical 3.0 T (16 sessions) and 1.5 T (5 sessions) scanners. At 3.0 T, median inter-session coefficients of variation (CoV) were 3.3% for $T1$, 2.8% for PD, and 1.6% for ADC. $T2$ achieved a 3.9% CoV across 7 vials (59–232 ms), restricted due to the limitation imposed by the fast-acquisition echo train. The 1.5 T system demonstrated comparable stability (CoVs: 2.1%, 1.7%, 1.2%, 1.2%). SNR remained within 6% reproducibility, and Cartesian ghosting was suppressed to below 0.6% (Figure 2).

Discussion: Longitudinal trending demonstrated variations largely confined within a ±5% margin, establishing a tight reproducibility baseline to reliably identify subsystem drift. Appending this protocol necessitates intrinsic trade-offs: the rapid 2.5-minute acquisition introduces innate measurement limitations, notably restricting $T2$ identification strictly to the sampled echo train.

Conclusion: By isolating hardware subsystem performance at 1.5 T and 3.0 T, this 2.5-minute framework addresses a unique monitoring gap without disrupting clinical workflows, thereby establishing a robust, objective foundation for continuous monitoring of subsystem drift.

Selected Poster Abstracts