Lurie Medical Imaging Research and Innovation Program

Mission: We seek to establish a world-class program strategically focused on pediatric medical imaging research and innovation (PMI-RI) by leveraging and connecting clinical and research resources and human capital existing at Ann & Robert H. Lurie Children's Hospital of Chicago through leadership. Our goals align with the Lurie Children's mission, *"Research into the prevention, causes, and treatment of diseases that affect children."* As illustrated in Figure 1, our mission is to advance and support the following synergistic activities: *innovation, new scientific discovery, training, advocacy, pre-clinical and clinical trials, and patient care.*

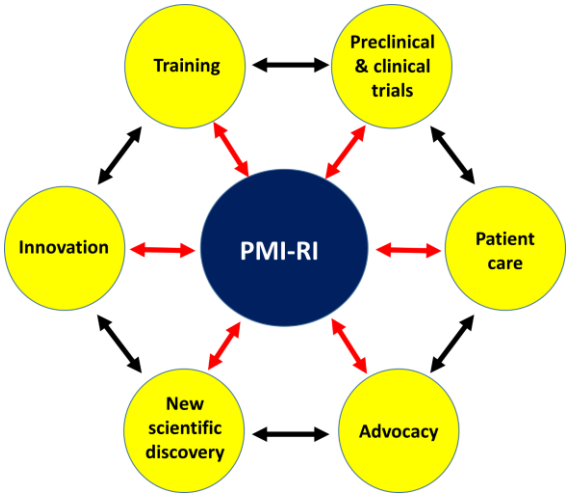

Figure 1. Diagram illustrating how PMI-RI will support synergistic activities as shown.

Collaborative infrastructure and the right culture: We seek to build a collaborative infrastructure and a culture that foster *synergy, creativity, diversity, interaction, teamwork, efficiency, and productivity*. Built on resources provided by Lurie Children's Hospital, this infrastructure will be multi-disciplinary by nature and serve as a liaison to basic science (Stanley Manne) and clinical departments, industry, Feinberg School of Medicine, and external entities (see Figure 2).

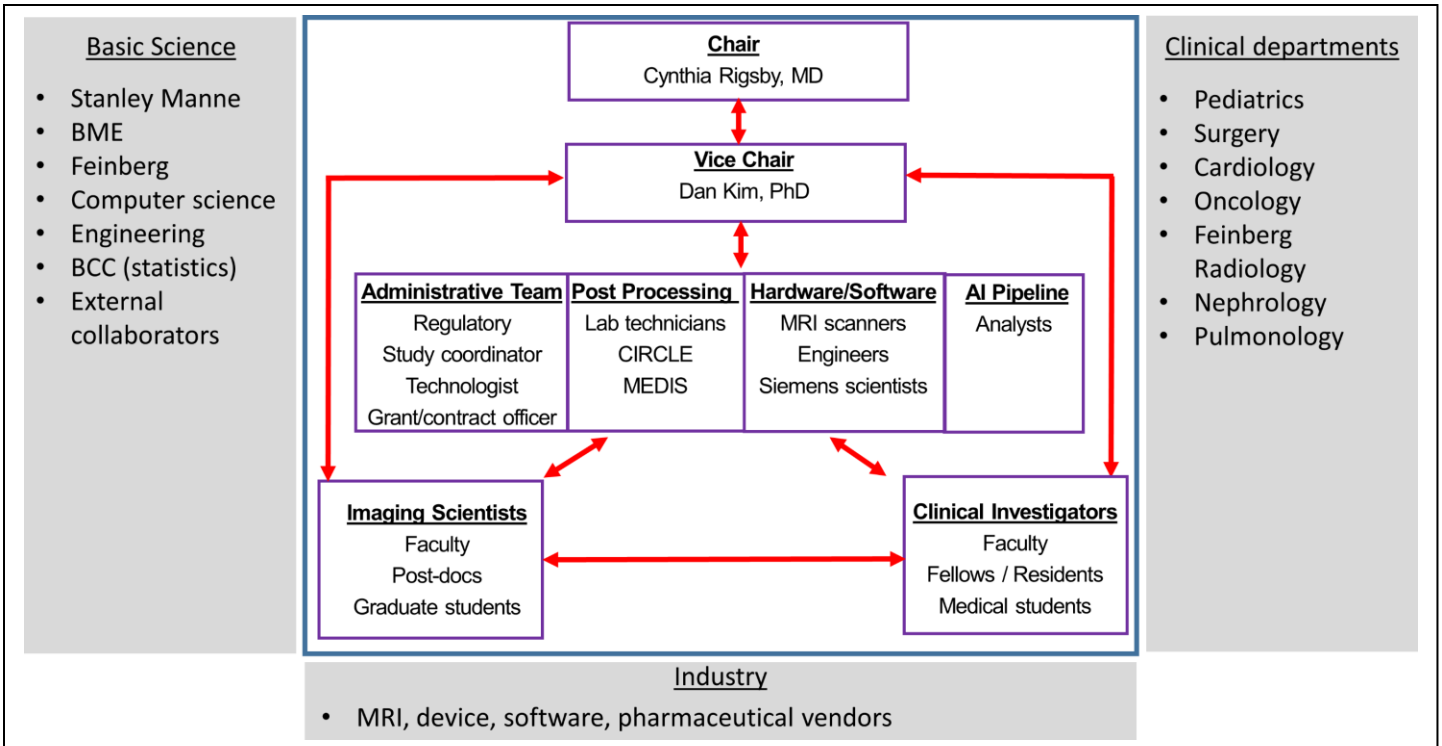

Figure 2. PMI-RI infrastructure under leadership by Chair (Cynthia Rigsby, MD) and Vice-Chair (Dan Kim, PhD). This team of teams concept will foster collaborative innovation and productivity.

Servant leadership: Our PMI-RI program will be led by Chair of Medical Imaging (Cynthia Rigsby, MD) and Vice-Chair of Research (Dan Kim, PhD), who will interact, strengthen each other, create synergy, and together support the PMI-RI mission. Dr. Kim will meet regularly with Dr. Rigsby to update progress and plan for the future. Our leadership will focus on the growth and well-being of our community (Medical imaging staff, trainees, and collaborators), such that our program will grow and multiply organically through strengthening of our human resource. We will focus on serving subspecialty sections to build their research innovation – structural interventional procedures, cardiology, transplant, surgery, pediatrics, and oncology. Our program will be the

“boiler room” that helps to fuel and guide the mother ship. We will preach and practice, “a rising tide lifts all boats!”

Interactive activities to build collaboration: Our program will foster interactions and frequent communication amongst members. Examples include weekly communication, joint lab meeting, journal club, mock grant review workshop, research retreat, hosting regional events, cross collaboration with other departments, including Radiology at Northwestern, and advanced MRI course.

Educational activities to train future leaders: Our PMI-RI program will be committed to training future leaders (MDs and PhDs); activities include attracting talented pool of applicants, building mentoring teams for fellows, shepherding transition plans following completion of fellowship.

Advocacy activities: Our PMI-RI program will be committed to engaging the local community, satellite and affiliates healthcare systems, and patient advocacy groups to champion the value of medical imaging.

Innovation activities: Our PMI-RI program will be committed to advancing medical imaging technologies through active collaboration with basic scientists, clinicians, vendors, and external collaborators. We will also develop internal and external validation platforms to enhance transparency and reproducibility of new medical imaging technologies.

Scientific discovery activities: Our PMI-RI program will be committed to new scientific discovery through active collaboration with basic scientists (Stanley Manne), statisticians, and clinicians. Specific activities include development of targeted therapies and determine response to treatment and machine learning/AI for precision medicine and/or value-based medicine.

Pre-clinical and clinical trials: Our PMI-RI program will be committed to pre-clinical and clinical trials to advance therapy and/or intervention, including those initiated by external academic collaborators and vendors for multi-center trials.

Excellent patient care: Our PMI-RI program will be committed to providing excellent patient care through application of innovative medical imaging technologies. We will be committed to discover/optimize/expand accuracy of diagnosis, disease stratification, and prognosis, and deploy validated AI pipeline for individualized personalized precision medicine with medical imaging evaluation.

AI Pipeline: Our PMI-RI program will be committed to employing AI to enhance medical imaging. An example for advancing the management of heart disease is shown in Figure 3.

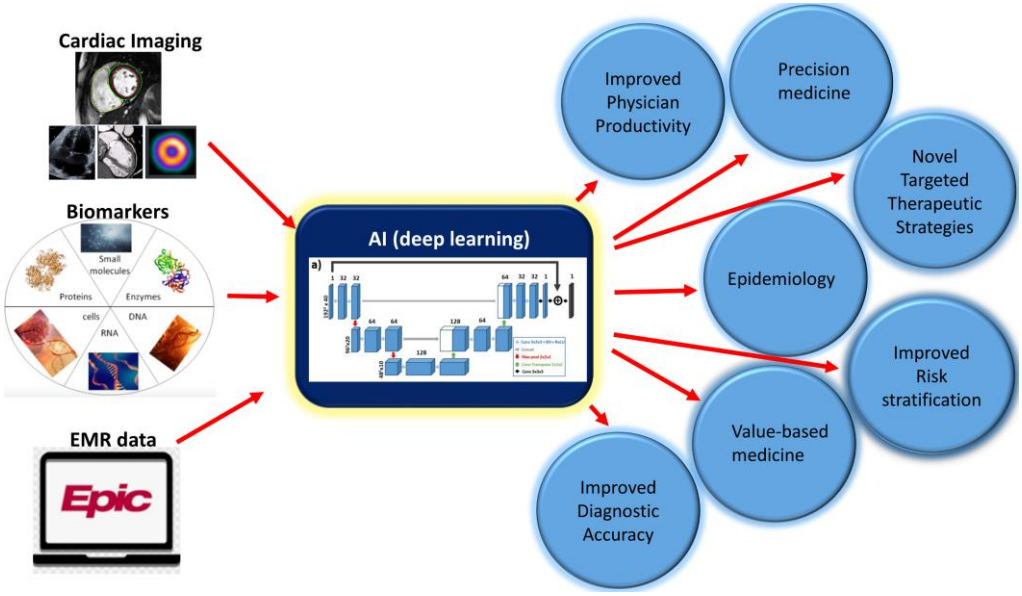

Figure 3. Example AI pipeline for advancing the management of heart disease.

Partnership with NU Radiology: Our PMI-RI program will be committed to a strategic partnership with NU Radiology. As shown in Figure 4, this partnership will leverage valuable infrastructure and resources existing at NU Radiology and enable Lurie to build PMI-RI with less cost (e.g. research dedicated MRI scanners) and more quickly than going solo. The stakeholders (Drs. Rigsby and Kim [Lurie] and Drs. Carr and Markl [NU]) will work together to foster synergy and mutual edification.

Figure 4. Strategic NU-Lurie partnership to enhance PMI-RI.

Timeline and milestones: Given resources, we will build and grow our PMI-RI program to one of the leading pediatric radiology research sites in a 5-year period with the following milestones:

Timeline	Milestones
Year 1	Recruit talented faculty (PhD, MD-PhD, MD) to grow the extramural funding base of the department.
Year 1	Engage Siemens to secure greater commitment of a scientist on site; engage Siemens for joint development and evaluation projects
Year 1	Encourage, incentivize, and enable existing medical Imaging faculty to conduct research; initial grant workshop and mock study section; mentor faculty to write NIH grants.
Year 1	Establish collaboration with clinical and research colleagues within Lurie; attract talented investigators within Lurie and Feinberg to collaborate with us
Year 1	Begin the process of developing, validating, and translating novel medical imaging methods
Year 1	Begin the process of initiating or supporting pre-clinical (large animals) and clinical trials
Year 1	Establish collaboration with NU computer science department for creating an AI pipeline for precision medicine and/or value-based medicine
Year 2	Apply for and secure NIH S10 Instrumentation Grant. Need conditional (grant) commitment from hospital to donate an old (about to retire) 1.5T Siemens scanner for research; “ramp-down” the magnetic field strength to 0.55T; upgrade RF systems to 32 channels; establish a state-of-the art low field MRI system, which would be equivalent to the system existing at NHLBI (Dr. Campbell-Washburn). This system would open opportunities for developing new technologies for interventional MRI, imaging patients with devices, and lung MRI.
Year 2	Apply for and secure T32 training grant (e.g. pediatric cardiac MRI or cardiac imaging)
Year 3	Establish advanced (standardized) MRI protocols throughout Lurie system and satellite hospitals. Export said protocols to external collaborators on Siemens platform
Year 4	Apply for and secure multiple NIH R01 grants (Vice-Chair + other Medical Imaging investigators)
Year 4	Establish advanced pediatric CMR course for outsiders (education + income)
Year 5	Given growth and extramural funds, hire new academic faculty (clinical, research) for expanding the scope and expertise of the program; secure more NIH grants.

Budget Justification for Building PMI-RI

Dual-Appointment: Dr. Kim requests to have dual appointment with Medical Imaging at Lurie (0.5 FTE; 0.5 FTE salary support for first 5 years; 0.3 FTE hard money support in perpetuity thereafter) and NU Radiology (0.5 FTE). The amount of FTE that Dr. Kim is able to "buy out" with extramural funds on Lurie's side, he would like to bank that FTE as an additional start-up fund to reinvest into growing his laboratory at Lurie's side.

Start-Up Package for Dr. Kim's Lab (excluding Dr. Kim's salary support): Dr. Kim is requesting $2,000,000 start-up package to support personnel, equipment, supplies, and other direct cost over a 5-year period. The proposed budget enables Dr. Kim to invest in technical infrastructure and human capital needed to build and grow a strong portfolio of pediatric CMR research. After this 5-year period, the said personnel is expected to be supported by extramural funding.

PERSONNEL:

TBD, PhD, Research Scientist (100%, 12 months effort). A research scientist will assist Dr. Kim implement innovative CMR methods, focusing more on implementation than new development. He/she will also support Dr. Kim mentor other trainees and serve as lab manager. He/she will be given opportunity to pursue independent NIH funding starting in year 3.

TBN, Post-Doctoral Research Fellow (100%, 12 months efforts). A post-doctoral fellow will assist Dr. Kim advance new CMR methods. He/she will also mentor graduate students. He/she will be given opportunity to pursue K99/R00 NIH award to transition towards a faculty position, either at Lurie or elsewhere.

TBN, Graduate Research Assistant (100%, 12 months effort). A doctoral student will assist Dr. Kim implement novel CMR pulse sequences and image reconstruction methods. Tuition is also requested for this student.

TBN, Lab Technician (100%, 12 months effort). A lab technician will perform data anlaysis using CIRCLE, MEDIS, or custom-made software. This person will also perform data management. This person will be made available to support other investigators in Medical Imaging, in order to enable them to focus on the "science."

EQUIPMENT:

GPU: $200,000 (year 1 only)
We request funding to purchase a high-end GPU server to develop deep learning networks for rapid image reconstruction and automated image segmentation and analysis. This server will be housed in Lurie's data center and be connected Siemens MRI scanners, CIRCLE, and MEDIS workstations via fast Ethernet. This equipment will be made available to other Medical Imaging investigators who wish to conduct deep learning research.

CIRCLE: $55,000 (year 1 only)
We request funding to purchase two research dedicated CIRCLE workstations. These research workstations are necessary for trainees and lab tech to perform image analysis without disrupting clinical workstations.

SUPPLIES:

Computers: $9,500 (year 1 only)
We request funding to purchase five desktops (@$1,500 per individual) and one additional laptop (@$2,000) for Dr. Kim. A computer will be given to each individual to perform tasks, including implementing methods and performing data and statistical analyses.

MRI Scans: $50,000 ($10,000 per year)
Dr. Kim requests funding to pay for acquiring pilot data from patients on MRI scanners. Preliminary data will be used to pursue new NIH funding.

TRAVEL:

$10,000 is requested annually for travel to scientific meetings (e.g., ISMRM, SCMR, RSNA, AHA) for the Vice-Chair, staff, and trainees to disseminate findings and interact with scientific peers.

Additional Resources Essential for building the PMI-RI Program

Resources to Hire Two New Faculty: It is paramount that we attract and hire talented faculty candidates who will be devoted to securing extramural funds and supporting clinical translational projects. We will target strategically focused areas of research where talented clinical radiologists with research interest are already in place. This pairing will foster synergy and sustained productivity.

Grant/Finance Officer: This person will provide administrative support for submitting grants and managing finances post award.

Research Operation Manager: This person will oversee study coordinators and regulatory coordinator.

Regulatory Coordinator: This person will handle IRB submissions, data safety monitoring plan, and liaise with IRB on audits.

Study Coordinators: Two coordinators will schedule and consent patients, and maintain study materials and notes. These individuals will be made available to all investigators in Medical Imaging, but priority will be given to funded studies.

Pilot Grant: A pilot fund (e.g. $10,000) would be valuable for Medical Imaging investigators to generate preliminary for submitting grant proposals.

Greater Commitment from Siemens: It is paramount that we strengthen our relationship with Siemens by engaging them on joint development and evaluation projects. We should request more attention from their scientists on site at NU Radiology.