CMR Standardization clinical practice and unmet needs

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U.S. Department of Commerce

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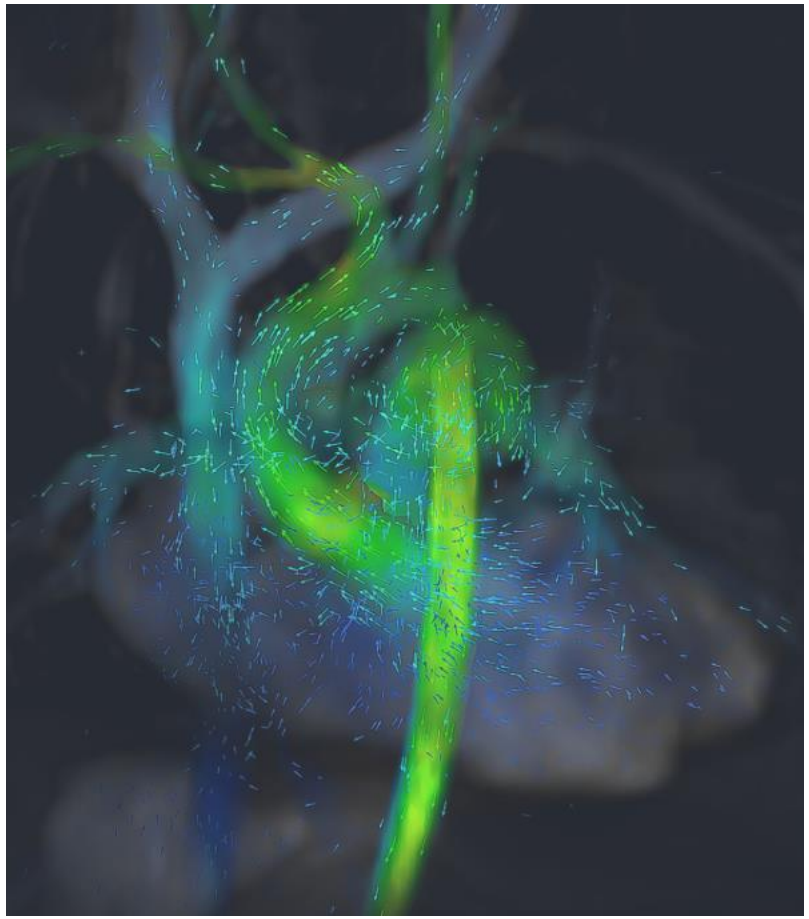
Conflict of Interest Disclosure

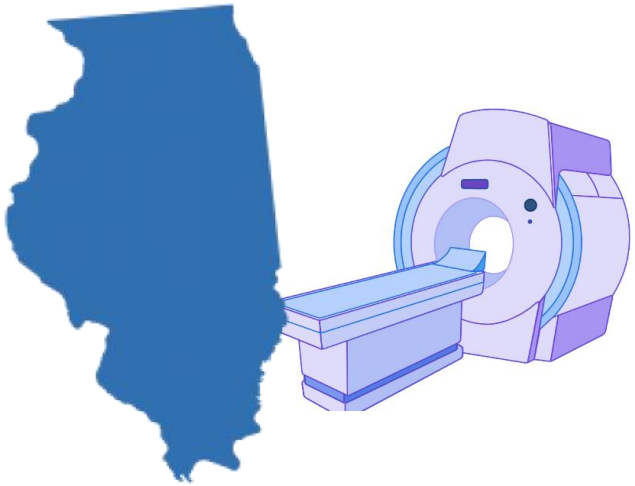
- **I have nothing to disclose.**

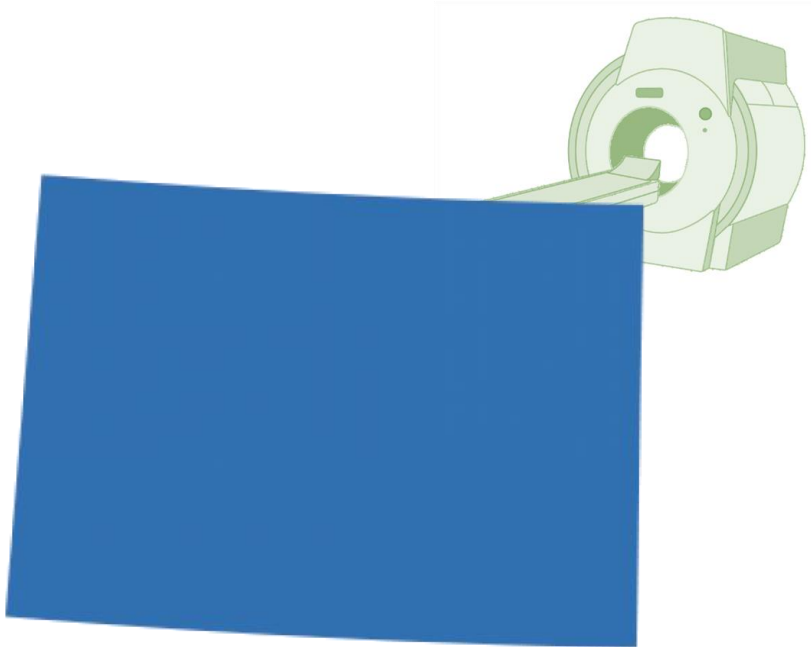
My view of AI for CMR circa 2017



ARTERYS

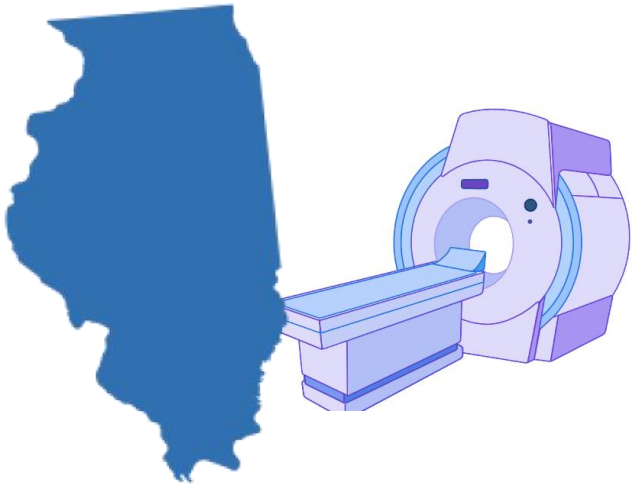
Challenges with 4D flow segmentation via AI





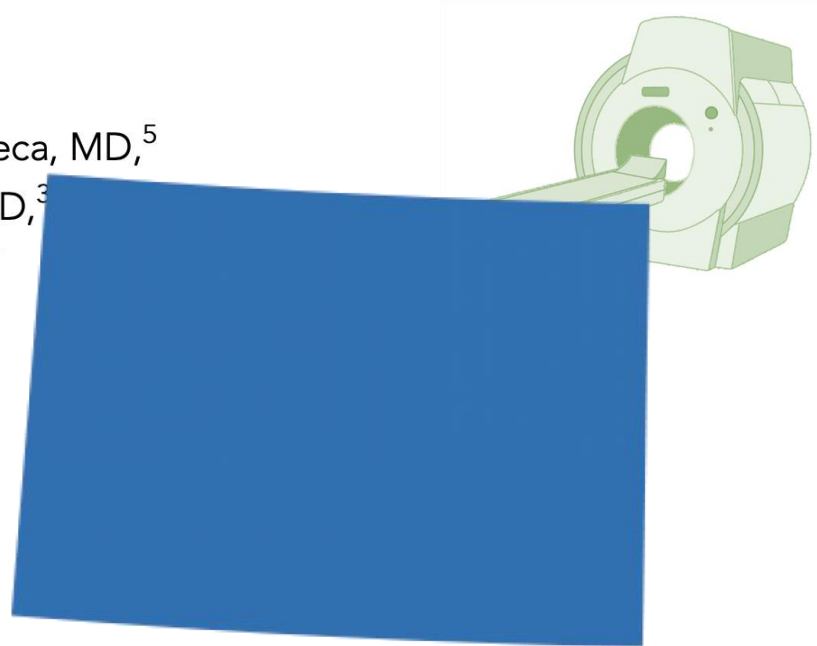
Challenges with 4D flow segmentation via AI

Segmentation of the Aorta and Pulmonary Arteries Based on 4D Flow MRI in the Pediatric Setting Using Fully Automated Multi-Site, Multi-Vendor, and Multi-Label Dense U-Net

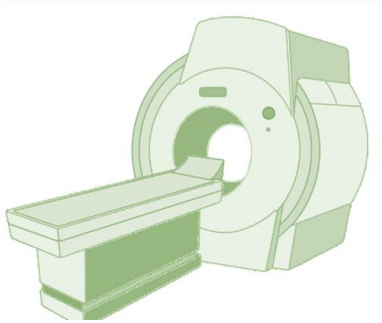


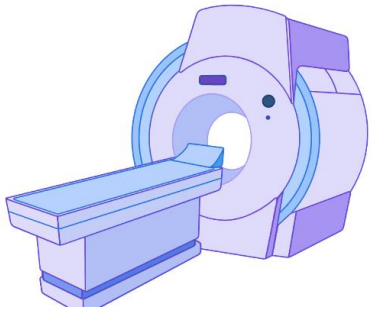
Takashi Fujiwara, PhD,[1*] Haben Berhane, MS,[2]
Michael B. Scott, PhD,[2,3] Erin K. Englund, PhD,[1] Michal Schäfer, PhD,[4] Brian Fonseca, MD,[5]
Alexander Berthusen, MS,[1] Joshua D. Robinson, MD,[3,6,7] Cynthia K. Rigsby, MD,[3]
Lorna P. Browne, MD,[1] Michael Markl, PhD,[2,3] and Alex J. Barker, PhD[1,9]

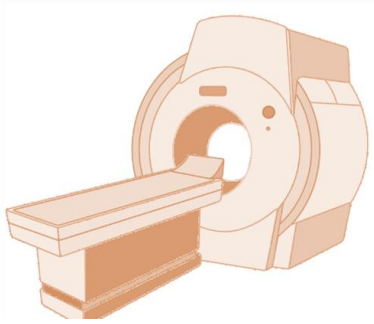
J. MAGN. RESON. IMAGING 2021.



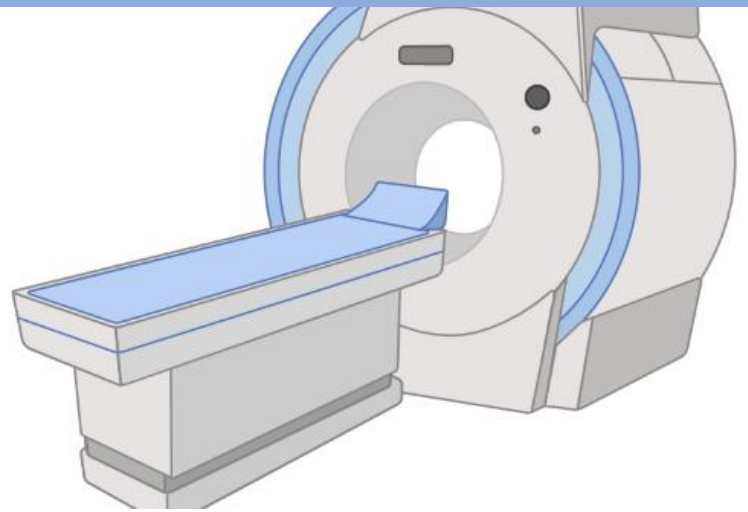
The need for CMR standardization



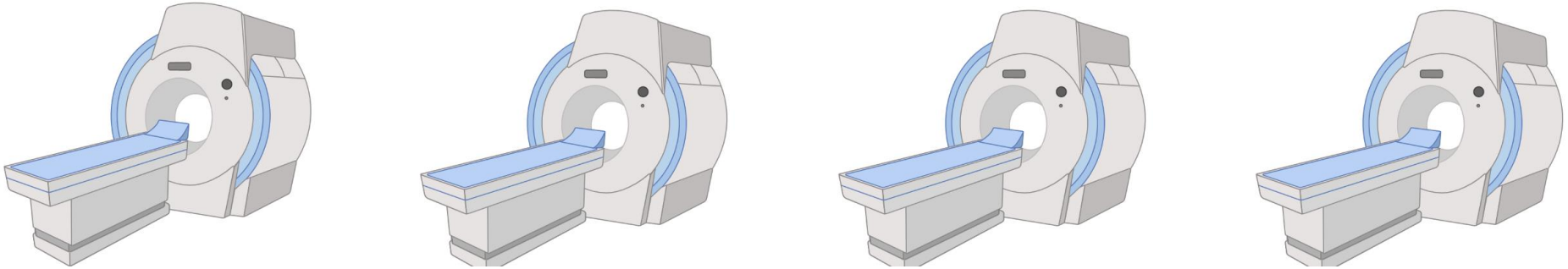




Can we compare methods across systems?

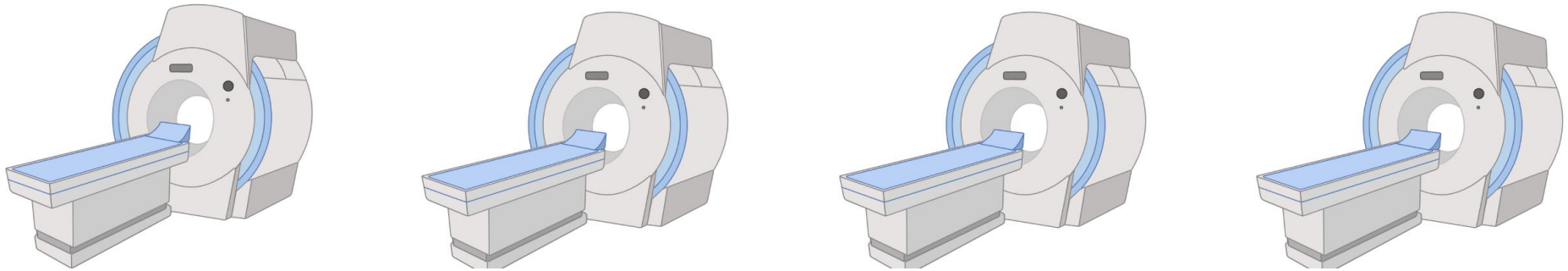


The need for CMR standardization



Time

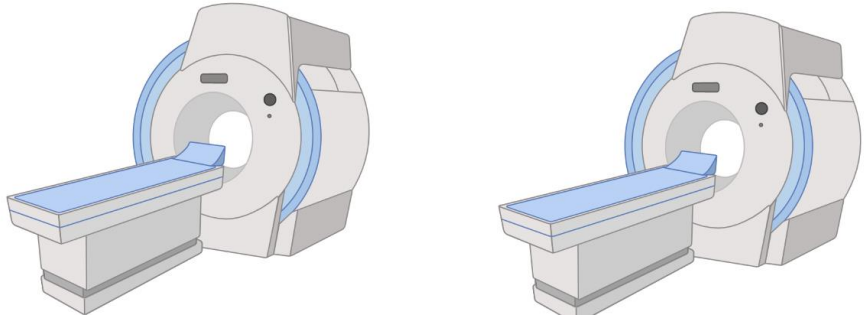
The need for CMR standardization



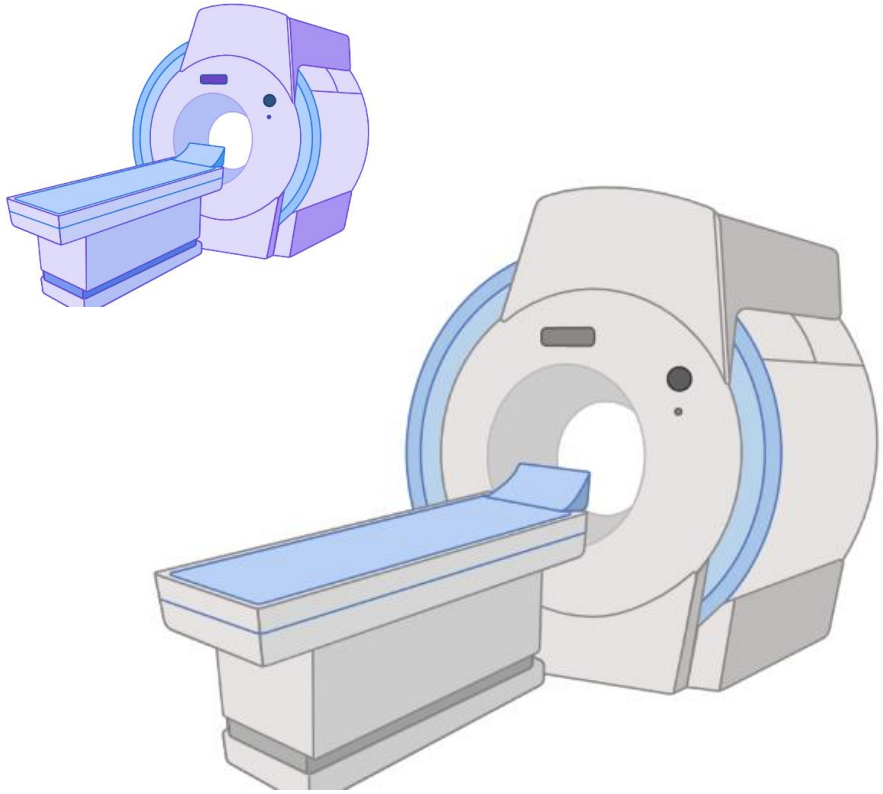
Time

How repeatable are CMR methods over time?

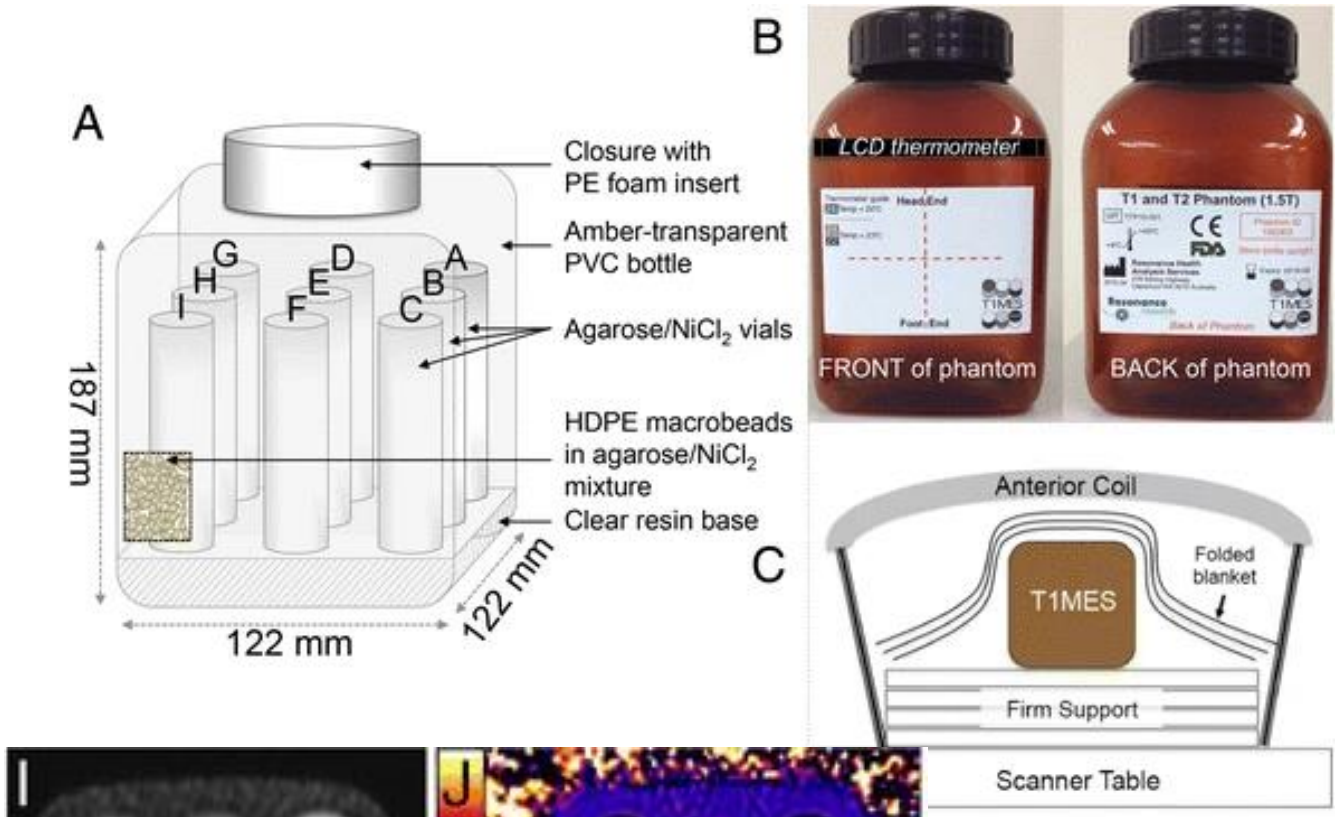
The need for CMR standardization

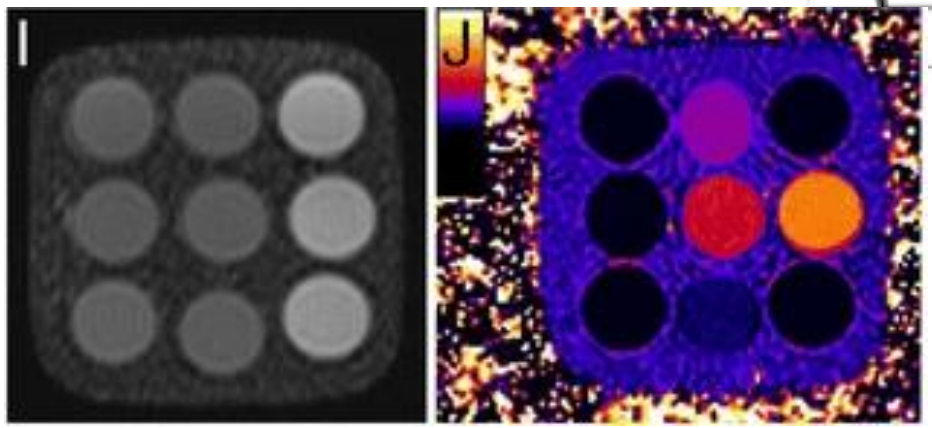


Time



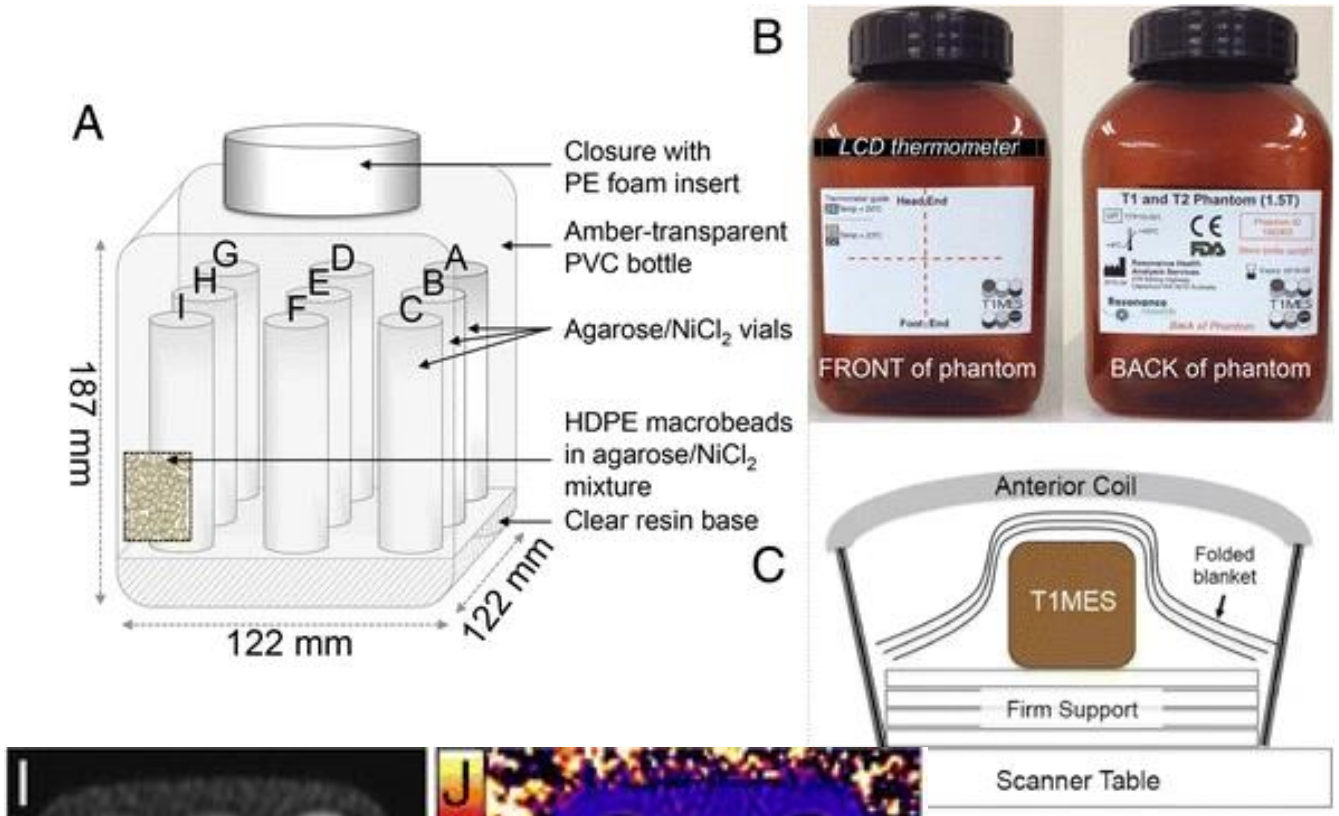
CMR phantoms

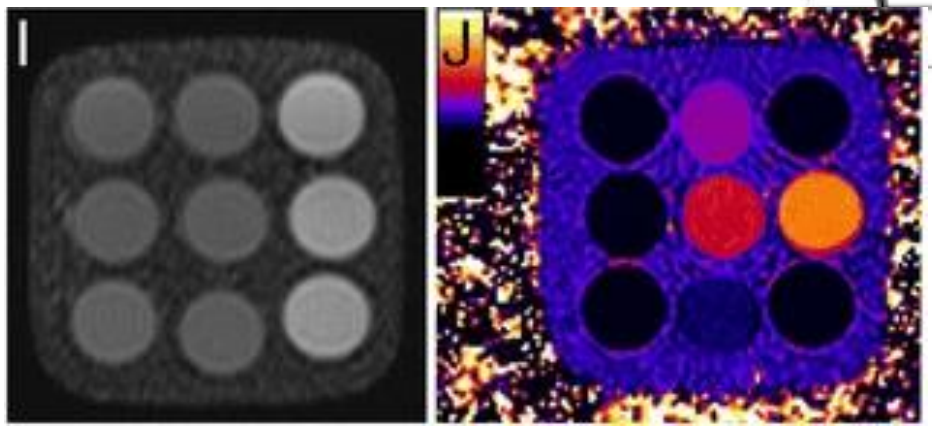


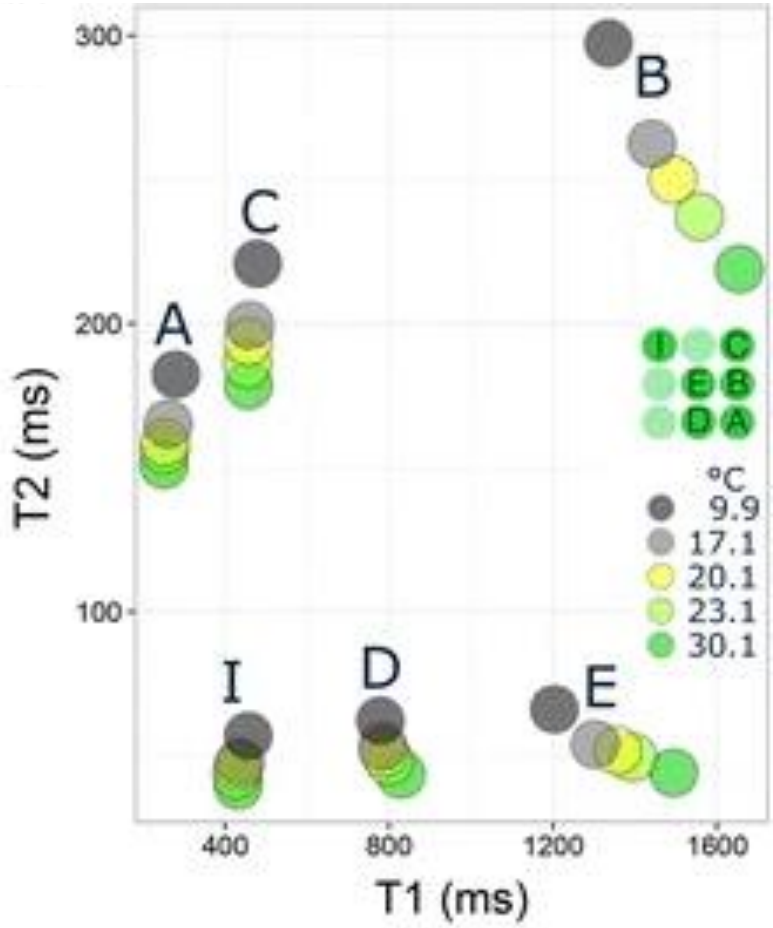


Captur et al JCMR 2016

CMR phantoms





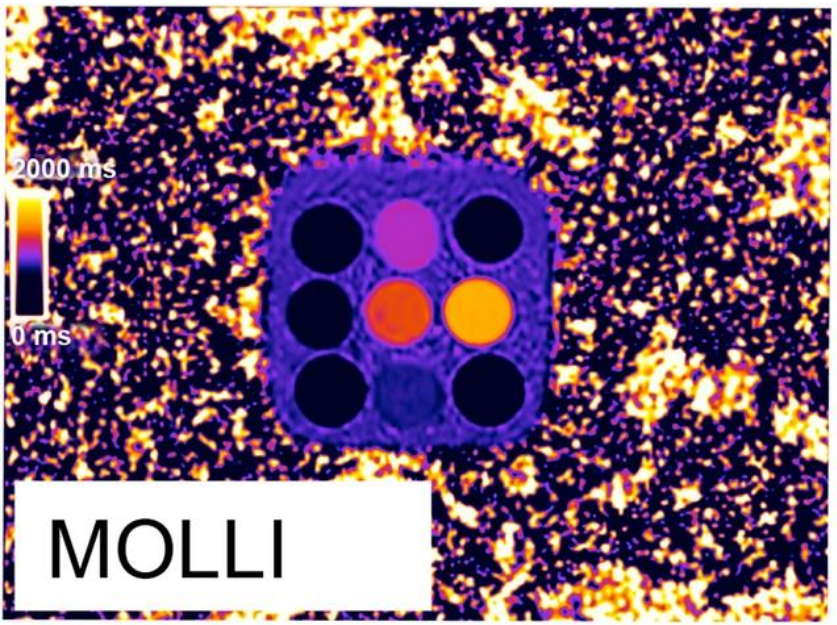


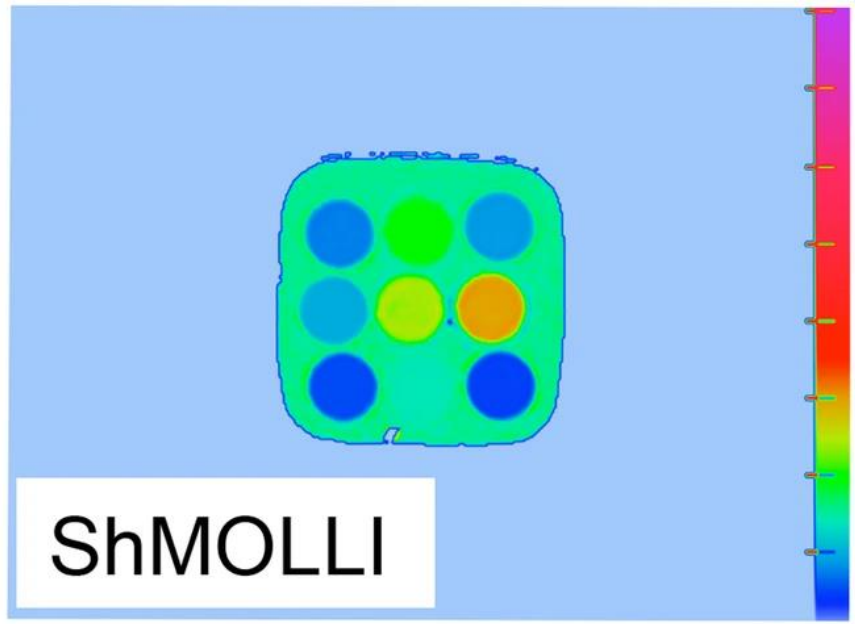
Captur et al JCMR 2016

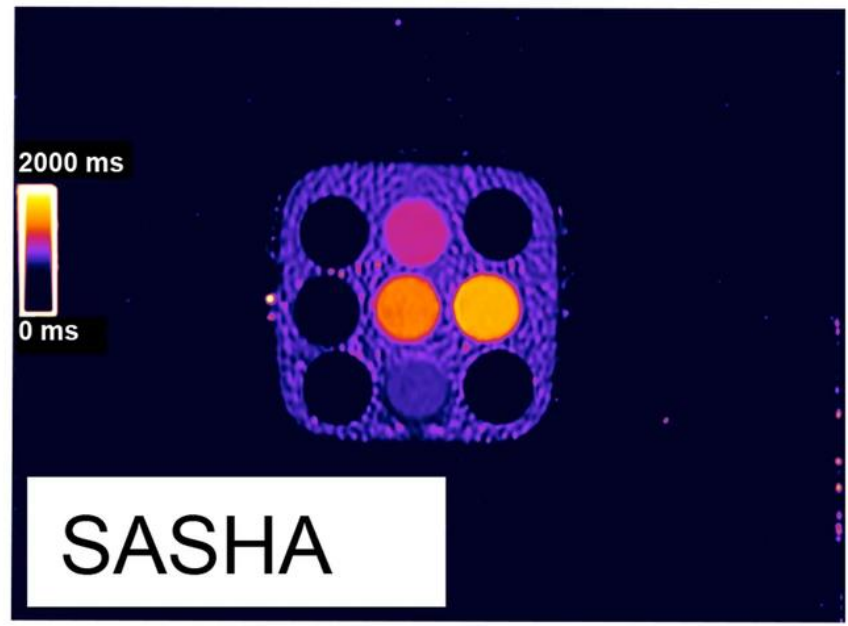
T_1 mapping performance and measurement repeatability: results from the multi-national T_1 mapping standardization phantom program (T1MES)

Gabriella Captur, Abhiyan Bhandari, ... on behalf of the T1MES Consortium + Show authors

Journal of Cardiovascular Magnetic Resonance **22**, Article number: 31 (2020) | Cite this article







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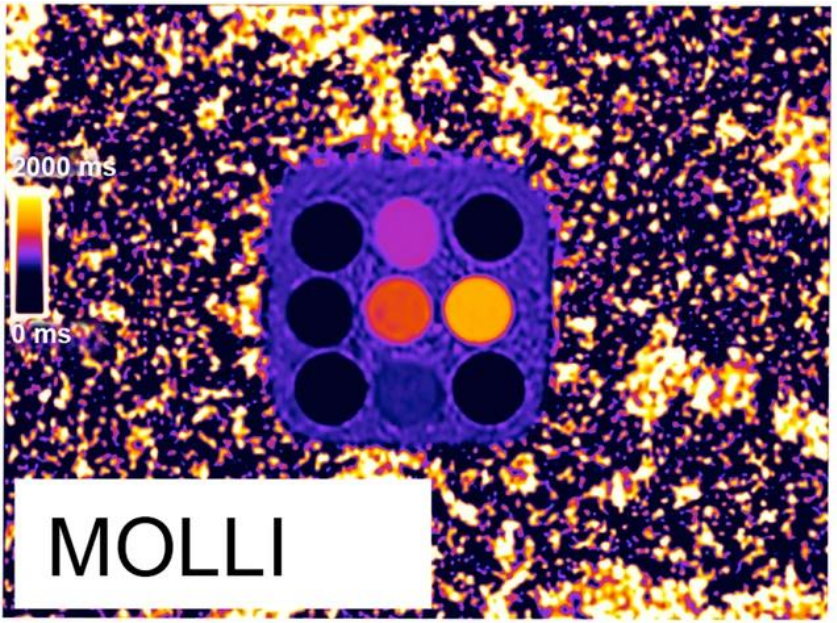
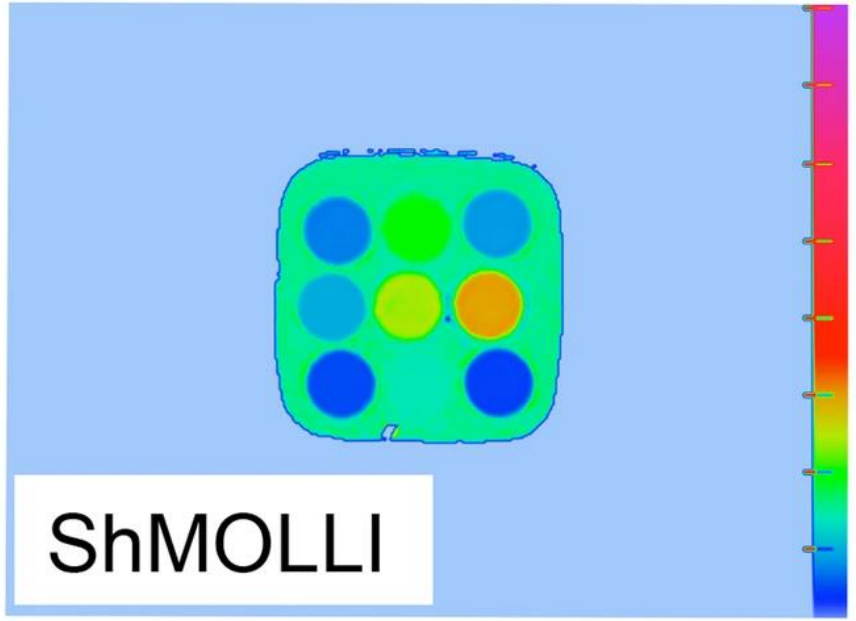
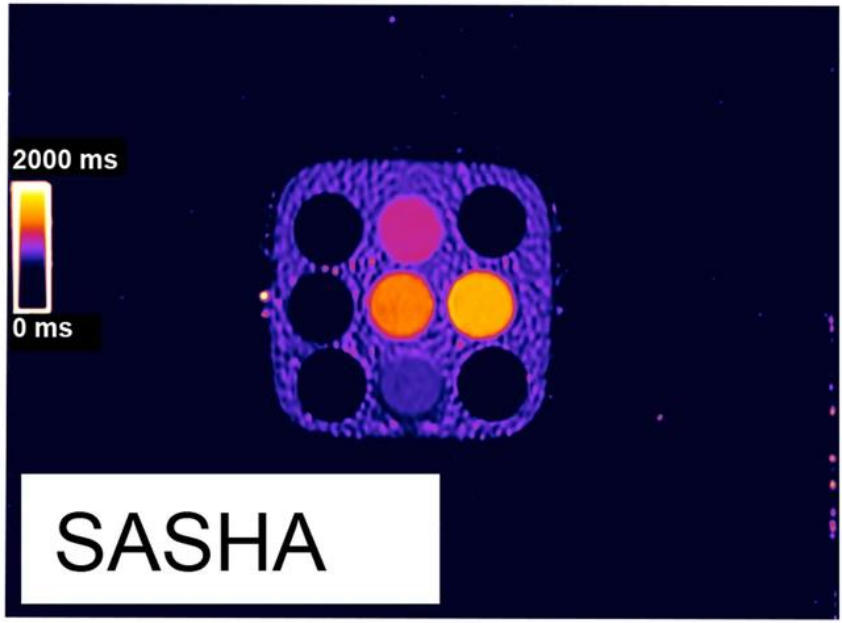
Journal of Cardiovascular Magnetic Resonance **22**, Article number: 31 (2020)

Primary issue: changes with software upgrades







What about T2?

Radiology

ORIGINAL RESEARCH · EVIDENCE-BASED PRACTICE

T2 Relaxation Times at Cardiac MRI in Healthy Adults:
A Systematic Review and Meta-Analysis

Christopher A. Hanson, MD • Akshay Kamath, MD • Matthew Gottbrecht, MD • Sami Ibrahim, MD • Michael Salerno, MD, PhD, MSc

Table 2: Results of Meta-Analysis according to Subgroup

Vendor	Field Strength (T)	Pulse Sequence	No. of Studies	No. of Healthy Adults	Mean T2 (msec)*	Mean T2 (msec) ± 2 SD*
All	All	All	46	954	50 (49, 51)	40 ± 60
All	1.5	All	32	770	52 (51, 53)	45 ± 59
Siemens	1.5	T2P	21	465	51 (49, 52)	45 ± 57
Philips	1.5	T2P	2	40	52 (50, 53)	50 ± 54
Philips	1.5	GRASE	8	236	55 (54, 57)	50 ± 60
All	3.0	All	15	361	46 (44, 48)	37 ± 55
Siemens	3.0	T2P	9	190	44 (42, 46)	37 ± 51
Philips	3.0	T2P	1	30	44 (43, 45)	38 ± 50
Philips	3.0	GRASE	5	141	50 (46, 54)	42 ± 58

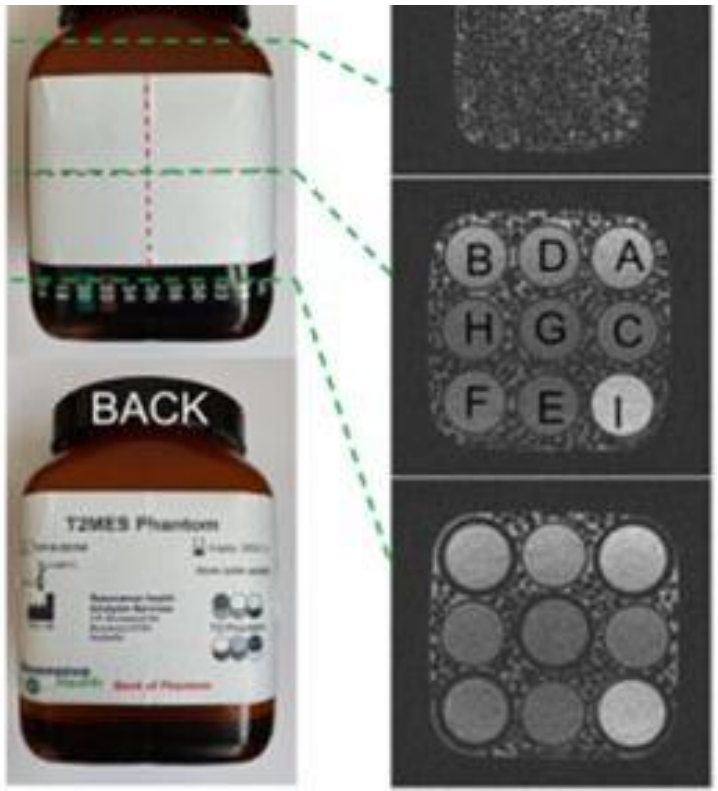
Note.—Numbers in parentheses are 95% confidence intervals. GRASE = gradient and spin echo, SD = standard deviation, T2P = T2 prepared.

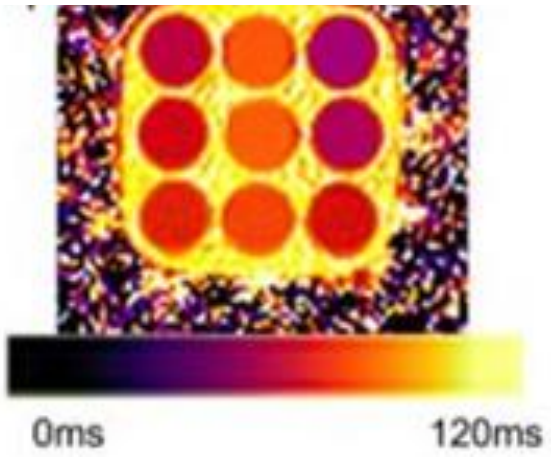
*Pooled means and confidence intervals are not intended to be used as normal references values nor as the upper and lower limits of a reference range.

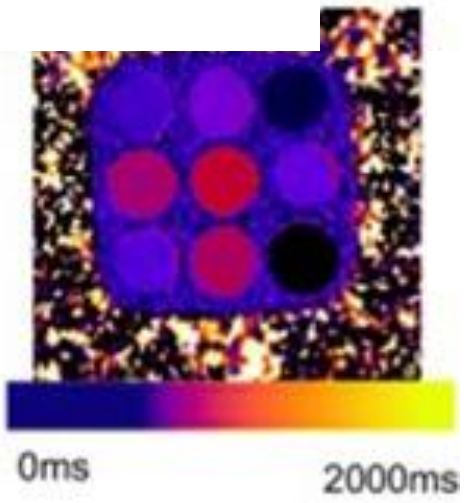
CMR phantom for T2 measurement

A medical device-grade T2 phantom for quality assurance of inflammation imaging by CMR

Massimiliano Fornasiero [1], Iain Pierce [2, 3], Matthew Webber, Kathryn E Keenan [6], Karl F Stupic [6], Rüdiger Bruehl [7], Bernd Ittermann [7], Wenjie Pang [8], Alun D Hughes [3, 5], Reza Nezafat [9], Peter Kellman [10], James C Moon [2, 3], Gabriella Captur [3, 4, 5]

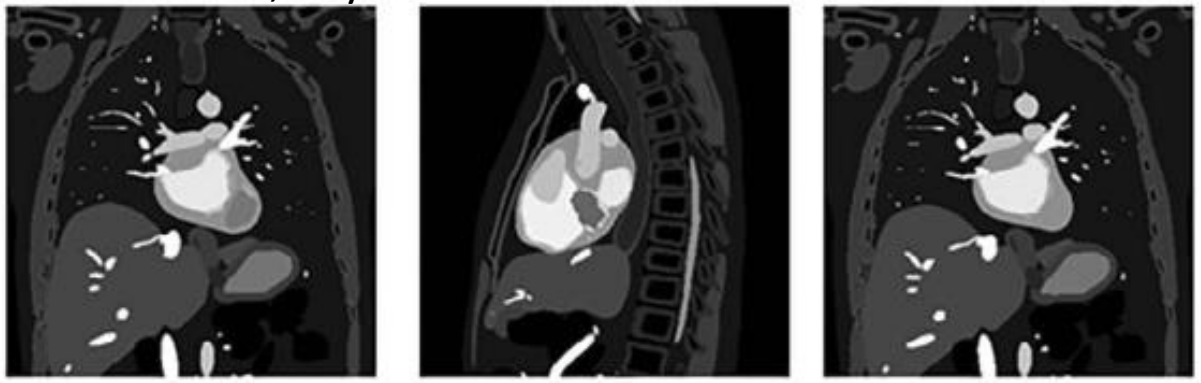


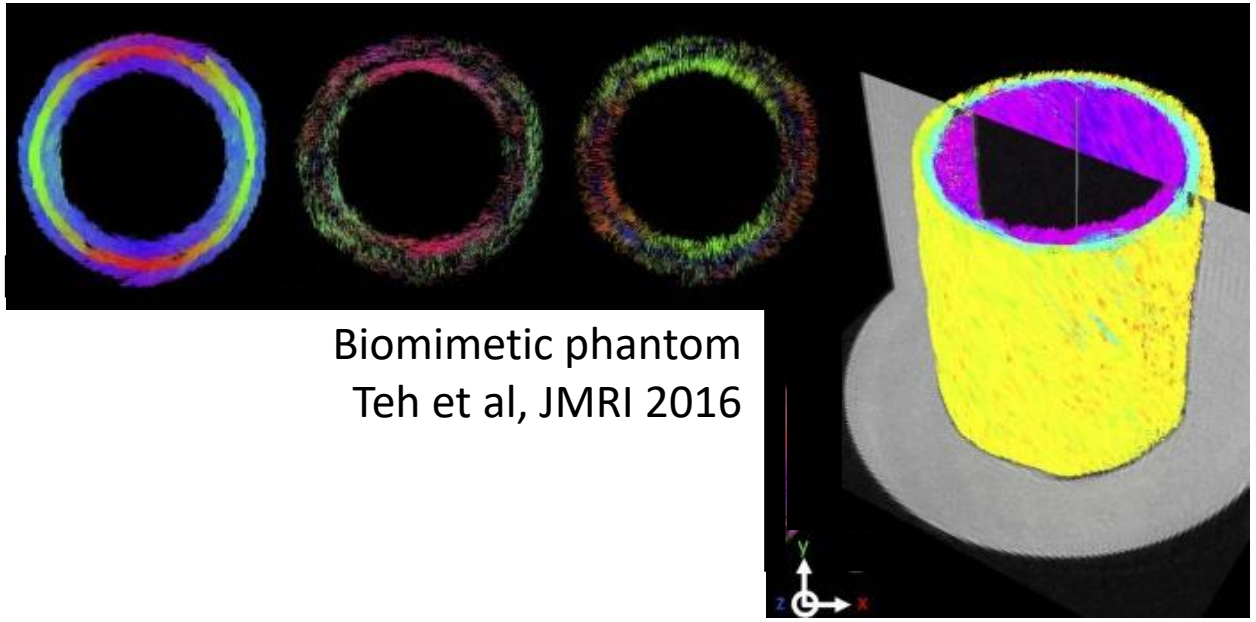




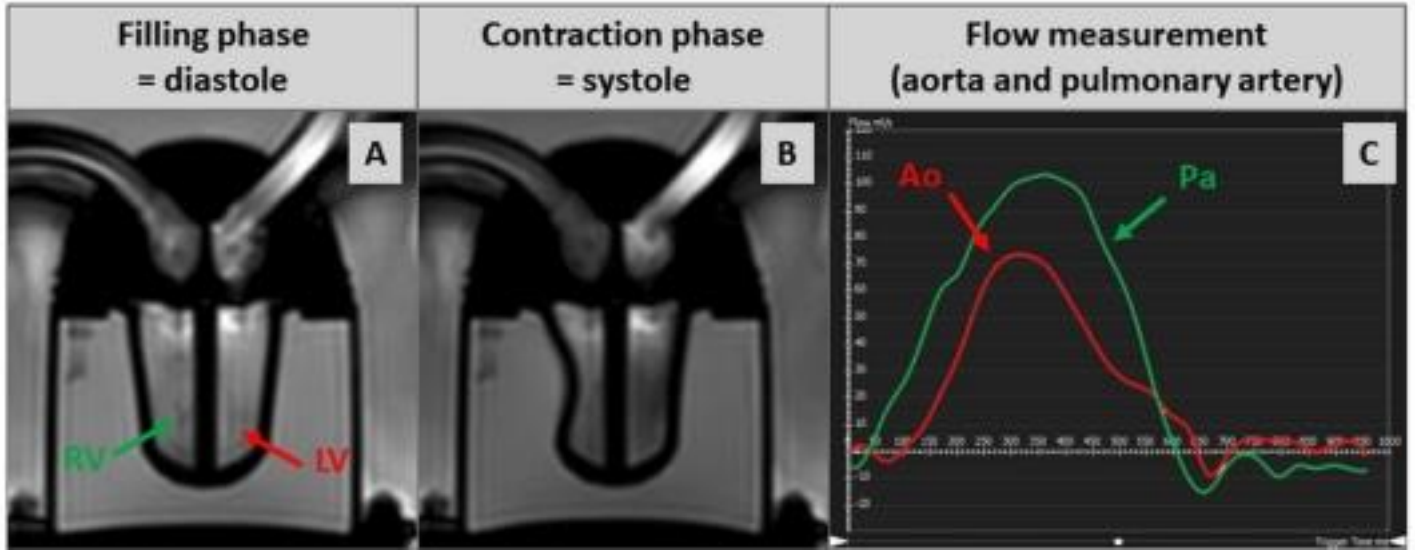
Other CMR phantoms

XCAT digital phantom
Lowther et al, Physica Medica 2018





Biomimetic phantom
Teh et al, JMRI 2016



CMR flow phantom
Bietenbeck et al, Scientific Reports 2019

Take the time to measure repeatability

Short-Term Repeatability of in Vivo Cardiac Intravoxel Incoherent Motion Tensor Imaging in Healthy Human Volunteers

Xiu-Shi Zhang PhD, En-Hui Liu MD, Xin-Yu Wang MD, Xin-Xiang Zhou MD, Hong-Xia Zhang MD, Yue-Min Zhu PhD, Xi-Qiao Sang PhD, Zi-Xiang Kuai PhD

Take the time to measure repeatability

Pediatr Radiol (2011) 41:1000–1007
DOI 10.1007/s00247-011-2033-3

ORIGINAL ARTICLE

Repeatability of cardiac-MRI-measured right ventricular size and function in congenital heart disease

Rowan Walsh · Yishay Salem · Amee Shah · Wyman W. Lai · James C. Nielsen

Short-Term Repeatability of in Vivo Cardiac Intravoxel Incoherent Motion Tensor Imaging in Healthy Human Volunteers

Xiu-Shi Zhang PhD, En-Hui Liu MD, Xin-Yu Wang MD, Xin-Xiang Zhou MD, Hong-Xia Zhang MD, Yue-Min Zhu PhD, Xi-Qiao Sang PhD, Zi-Xiang Kuai PhD

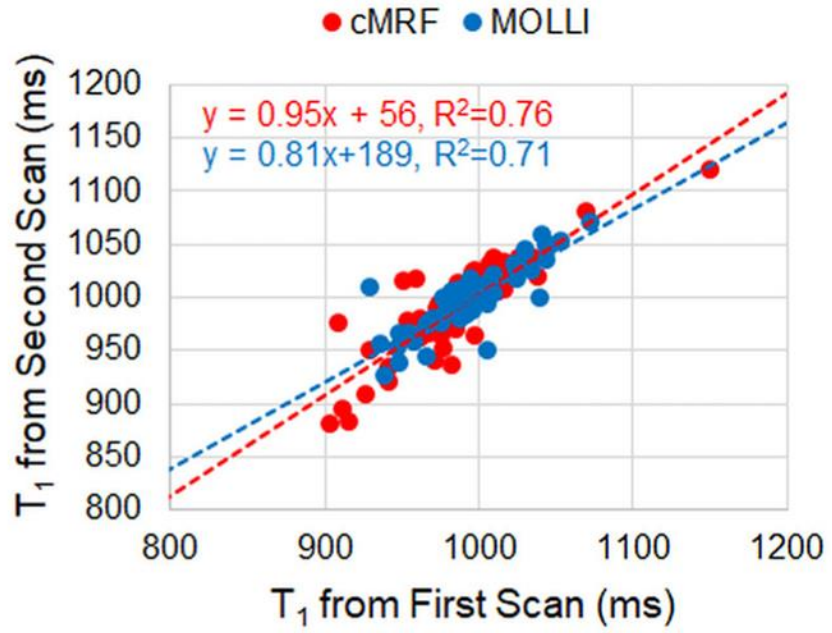
Take the time to measure repeatability

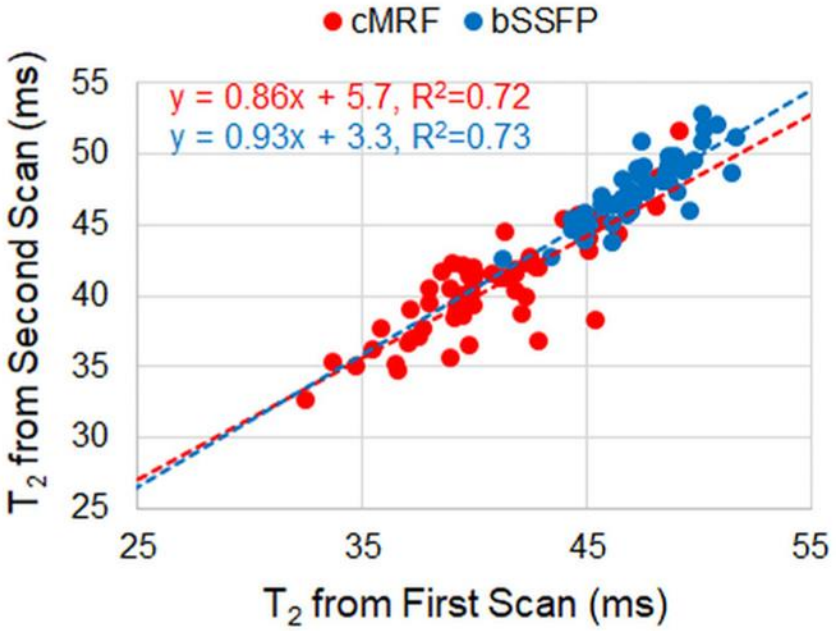
JMRI Journal of Magnetic Resonance Imaging | ISMRM | ONE COMMUNITY FOR CLINICIANS AND SCIENTISTS

Original Research

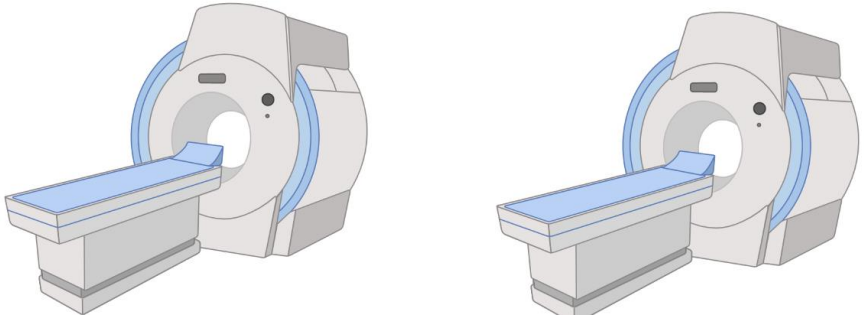
Simultaneous Mapping of T_1 and T_2 Using Cardiac Magnetic Resonance Fingerprinting in a Cohort of Healthy Subjects at 1.5T

Jesse I. Hamilton PhD ✉, Shivani Pahwa MD, Joseph Adedigba BS, Samuel Frankel MD, Gregory O'Connor MD, Rahul Thomas MD, Jonathan R. Walker MD, Ozden Killinc MD, Wei-Ching Lo MS, Joshua Batesole BASc , Seunghee Margevicius PhD, Mark Griswold PhD, Sanjay Rajagopalan MD, Vikas Gulani MD, PhD, Nicole Seiberlich PhD

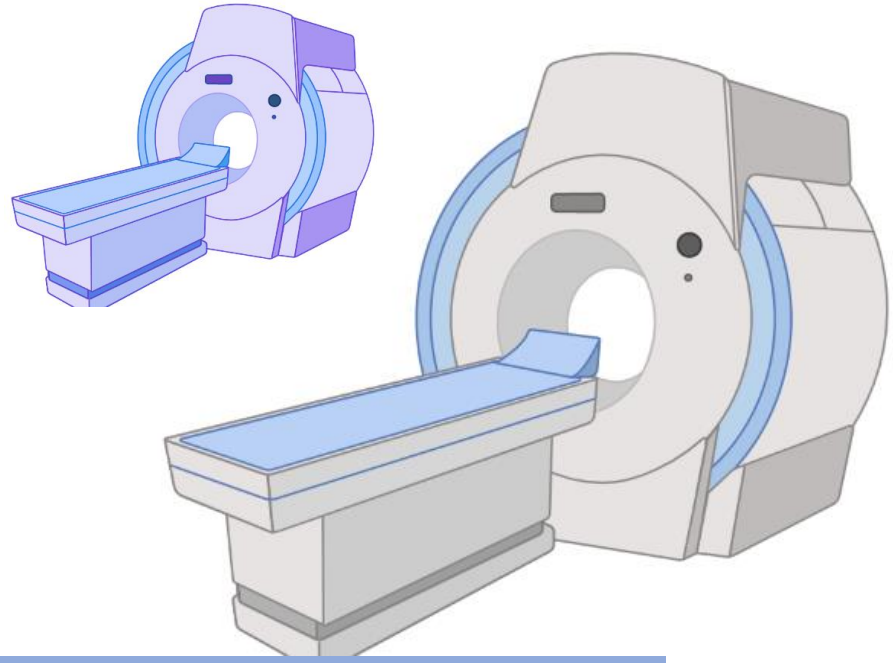




CMR standardization

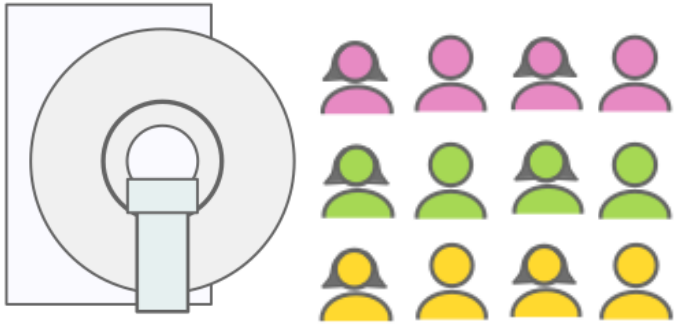


Time

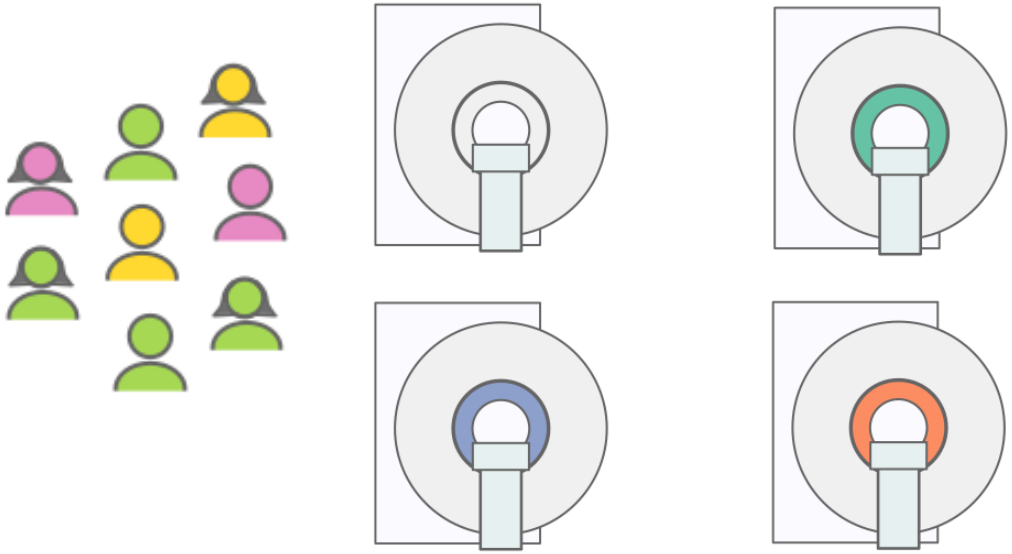


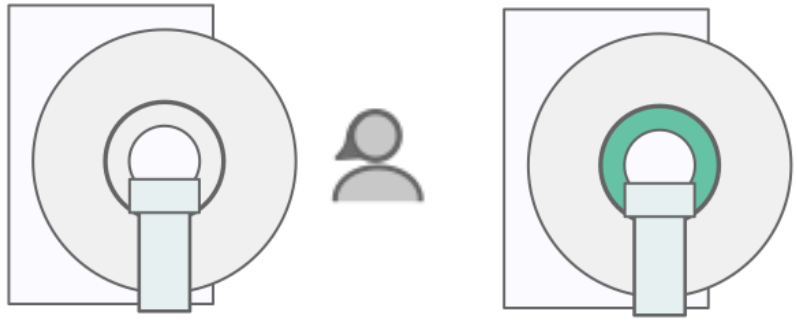
Cannot always compare data across system nor over time

Data from clinical trials to researchers



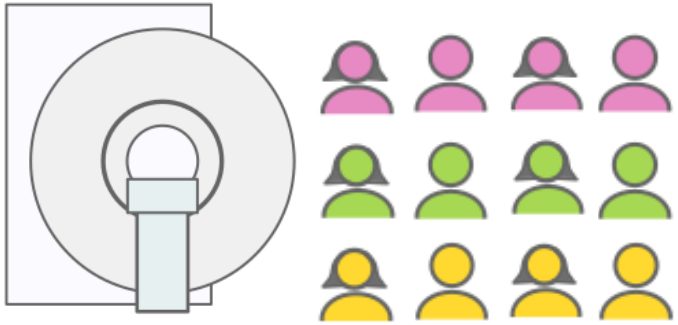
Data to define “normal” values





Data “just” for clinical diagnostics

Data from clinical trials to researchers



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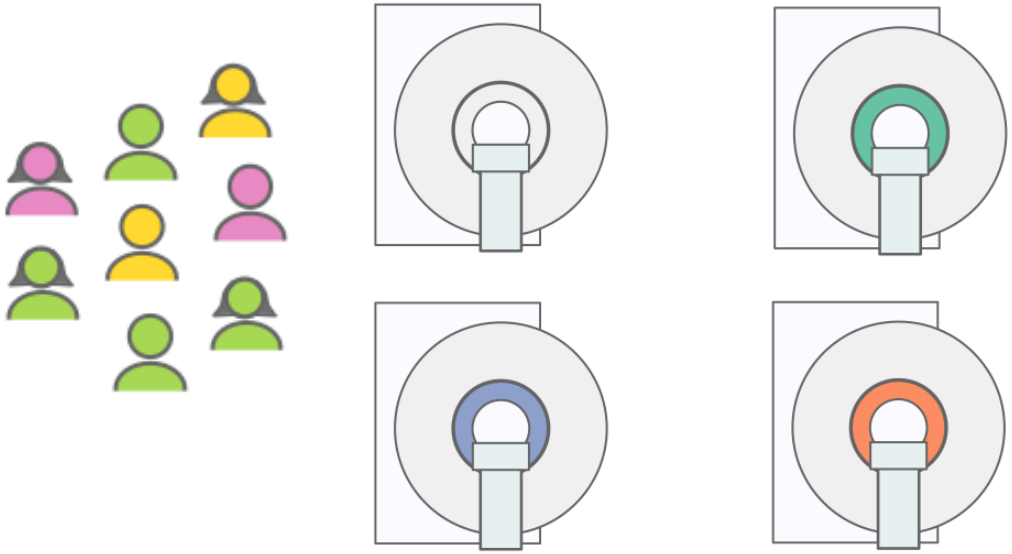
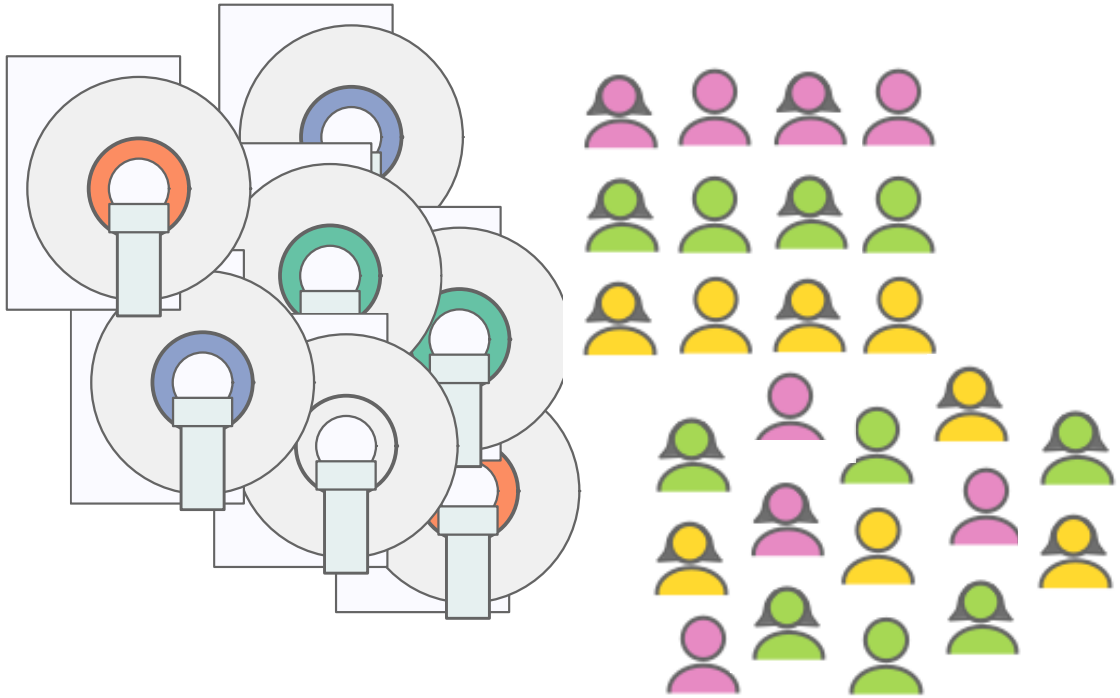
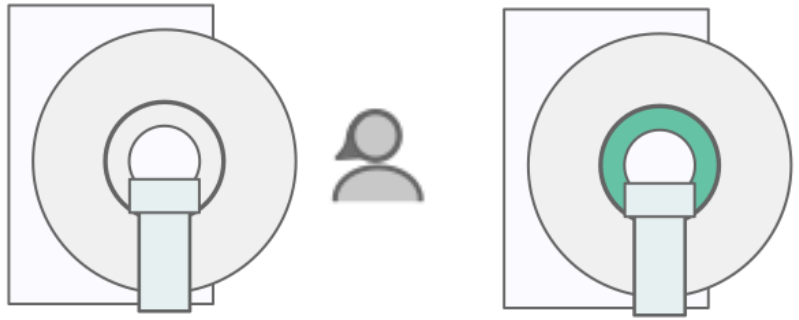


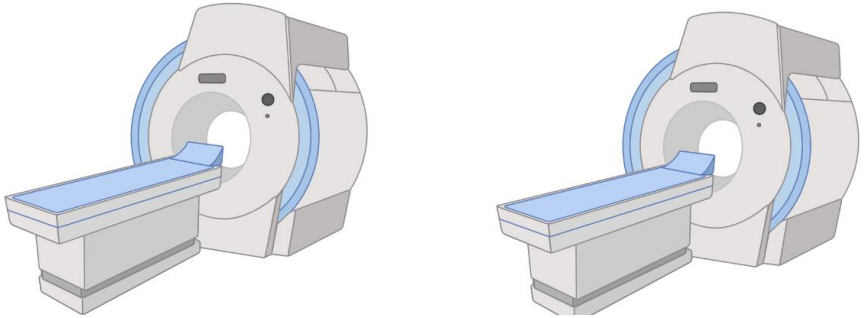


Data going in to AI pipelines

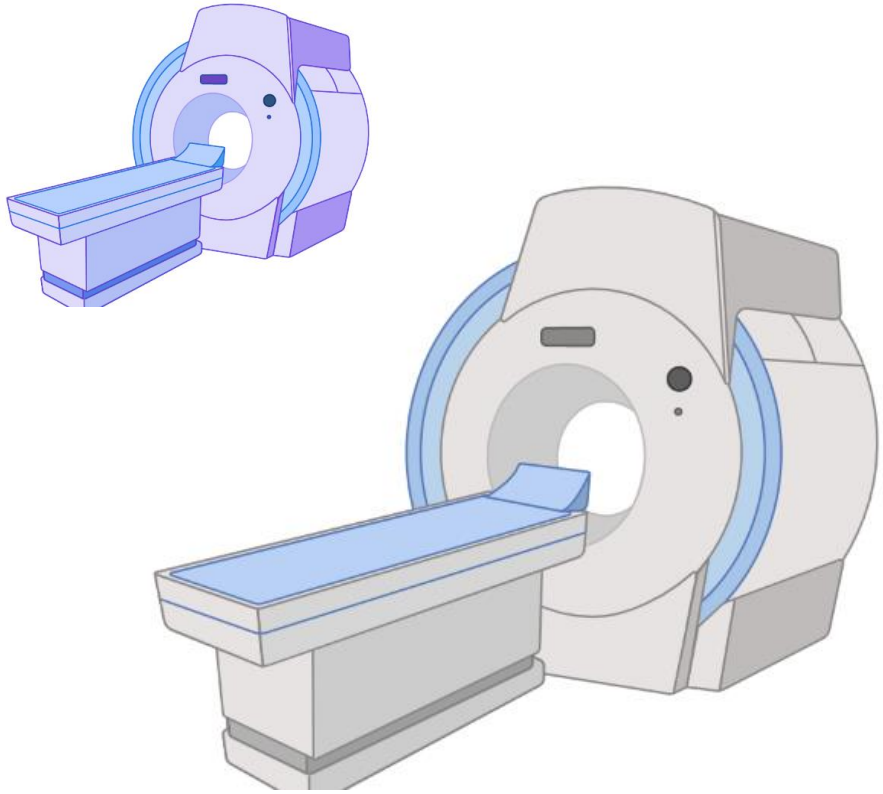


Data “just” for clinical diagnostics

CMR standardization



Time



Thanks to all who contributed

NIST

Magnetic Imaging Group

Andrew Dienstfrey
Mark Ferris
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John Lundstrom
Michele Martin
Sam Oberdick
Stephen Ogier
Adele Peskin
Megan Poorman
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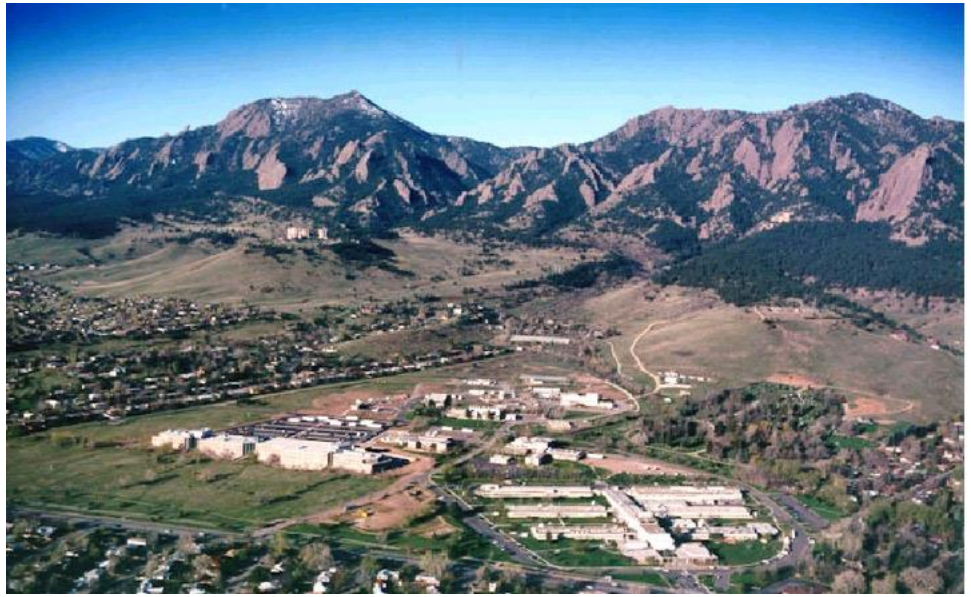
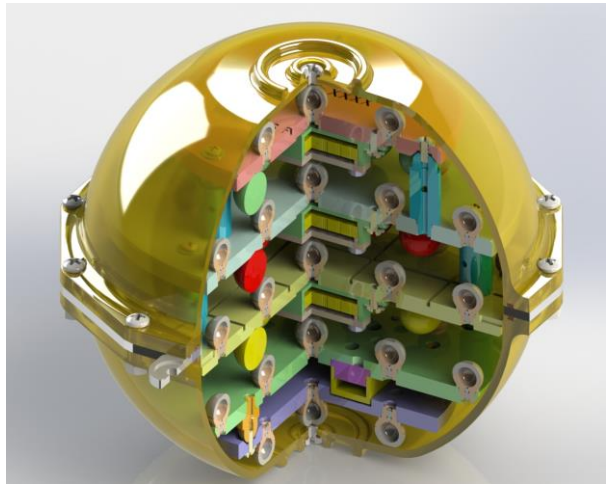


NIST in Boulder, CO

NIST's efforts in quantitative MRI



National Institute of Biomedical Imaging and Bioengineering
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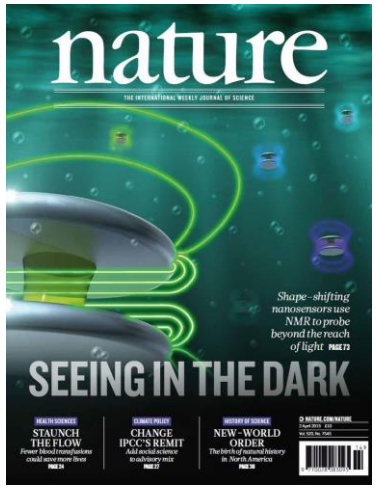
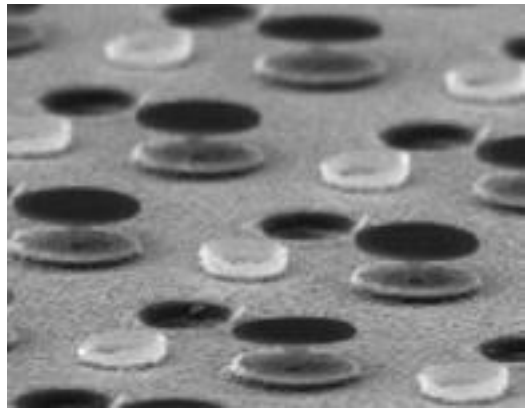
Quantitative Imaging Biomarkers Alliance RSNA





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