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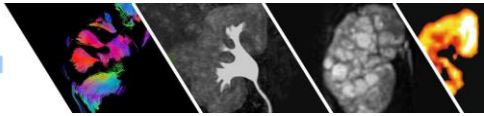
parenchima
COST



Future directions of renal MRI

3d international conference of functional renal imaging

Steven Sourbron

Growth of renal MRI (2015 - 2020)

Bordeaux
Oct 2015

Berlin Oct
Oct 2017

Nottingham
Oct 2019

??? Oct 2021 ???

Drivers for growth of renal MRI

Validation of Plasma Biomarker Candidates for the Prediction of eGFR Decline in Patients With Type 2 Diabetes

Andreas Heinzel[1], Michael Kammer[1,2], Gert Mayer[3], Roman Reindl-Schwaighofer[1], Karin Hu[1], Paul Perco[3], Susanne Eder[3], Laszlo Rosivall[4], Patrick B. Mark[5], Wenjun Ju[6], Matthias Kretzler[6], Peter Gilmour[7], Jonathan M. Wilson[8], Kevin L. Duffin[8], Moustafa Abdalla[9,10,11], M… Heerspink[13], Andrzej Wie…

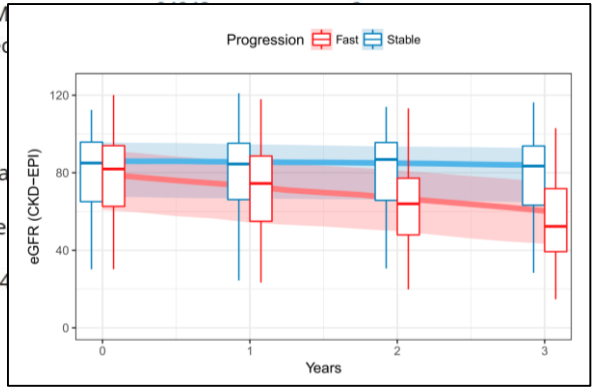
BEAt-DKD Consortium

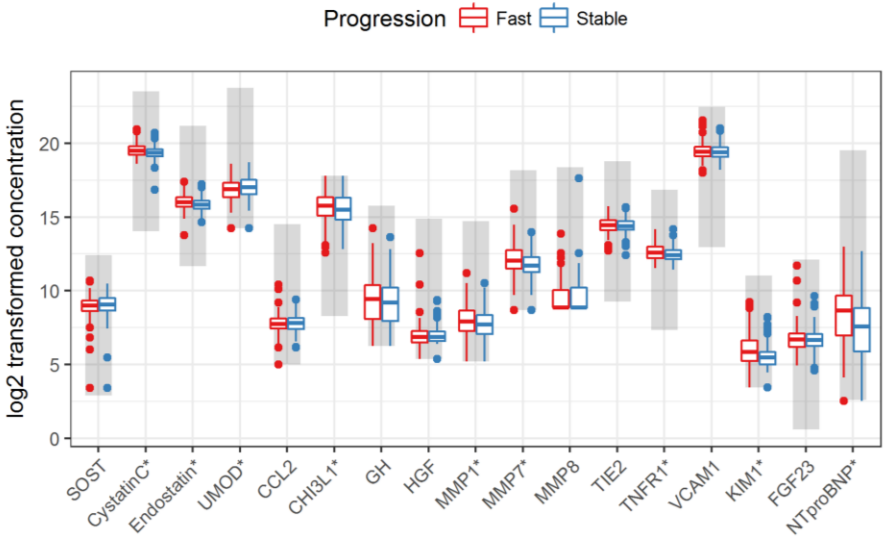
Author Affiliations

Corresponding author: Ra…

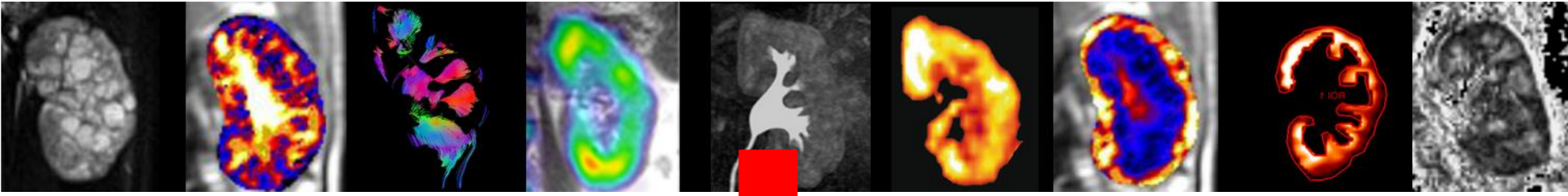
A.H. and M.Ka. contribute…

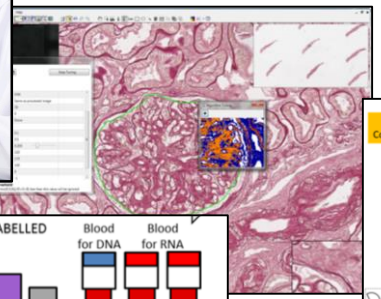
Diabetes Care 2018 Sep; 4…

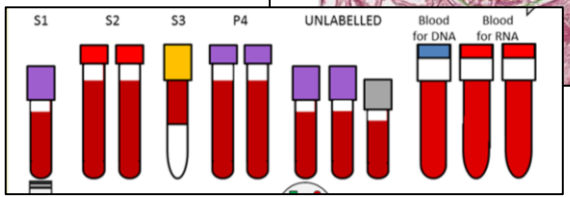


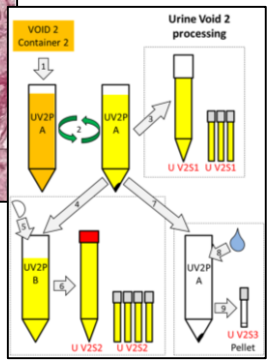


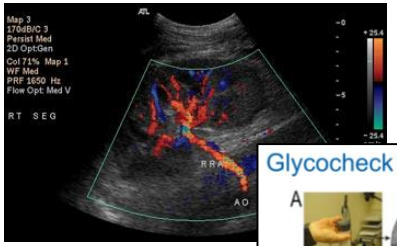
Promises of renal MRI

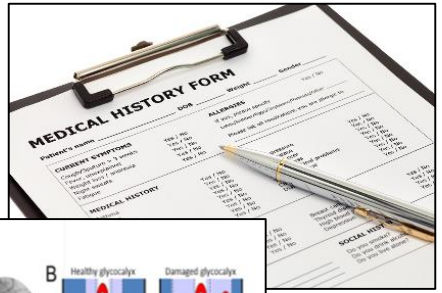


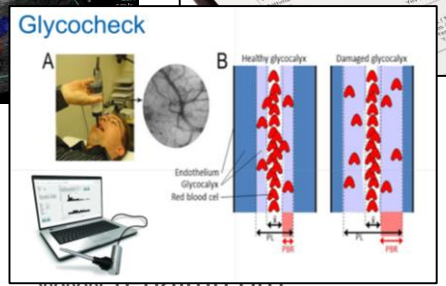




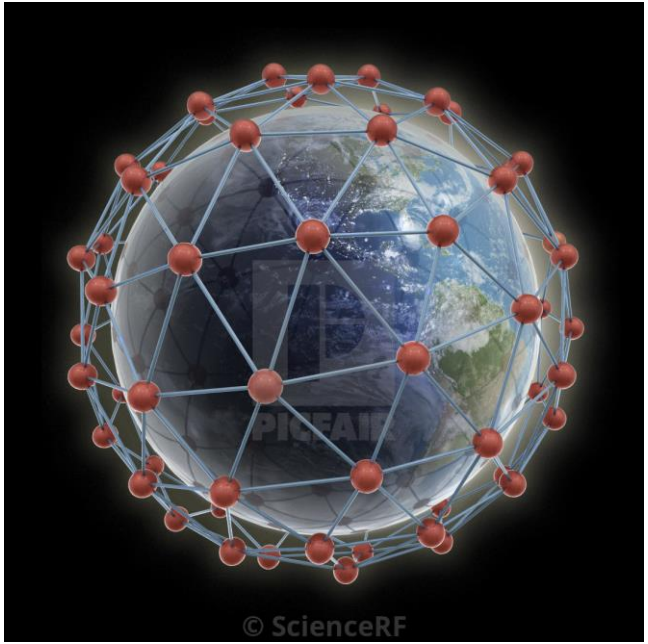








ISRMR 2029 award ceremony
8th international conference on renal MRI



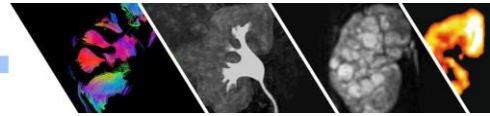
Category I: Novel technologies and contrast mechanisms in renal MRI

Category II: How reliable are MRI biomarkers of the kidney?

Category III: What does renal MRI tell us about kidney structure and function?

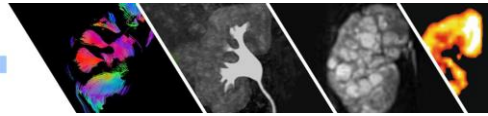
Category IV: How are renal MRI biomarkers useful?

ISRMR 2029 award ceremony



Category I. Novel technologies and contrast mechanisms
Gold award
Silver award
Bronze award

ISRMR 2029 award ceremony



Category I. Novel technologies and contrast mechanisms	
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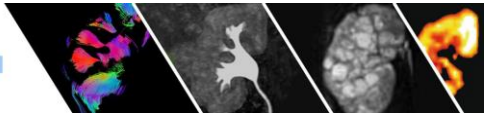
Silver award	
Bronze award	A 10-minute MRI acquisition protocol for renal anatomy, diffusion-tensor imaging, tractography, intravoxel incoherent motion, blood oxygenation-level dependent imaging, T1- and T2 mapping, magnetisation transfer contrast, chemical exchange saturation transfer, angiography, phase contrast, hyperpolarised MRI, MR renography, multiple inversion time arterial spin labelling, elastin expression, time-resolved MRI spectroscopy, Sodium MRI, quantitative susceptibility mapping and MR urography.



Contents lists available at ScienceDirect

Journal of Magnetic Re

journal homepage: www.elsevier.c

ELSEVIER

JMR

Ultimate MRI

Lawrence L. Wald *

Athinoula A. Martinos Center for Biomedical Imaging, Dept. of Radiology, Harvard Medical School, Massach
Harvard-Massachusetts Institute of Technology Division of Health Sciences and Technology, Cambridge, MA

ARTICLE INFO

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Accepted 8 July 2019
Available online 9 July 2019

Keywords:

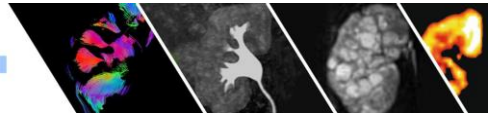
ABSTRACT

The basic principles of Magnetic Resonanc
medical imaging for over 40. At this point, i
imaging. But we are by no means confined
revolution can come to old technologies. T
olution constraint imposed by a seemingly
erated a 500 year old modality Progress comes from re-examining old ways and sidestepping

Highlights

- MRI is moving toward a more generalized approach with added degrees of freedom in the RF reception, transmission and encoding fields, and relying on generalized model based reconstructions that can use this information and reconstruct an image from just about anything.
- Model-based reconstructions, together with their streamlined approach to adding prior knowledge will increase opportunities for faster imaging and imaging with relaxed hardware constraints, ultimately extending the performance and reach of MRI.

ISRMR 2029 award ceremony



Category I. Novel technologies and contrast mechanisms	
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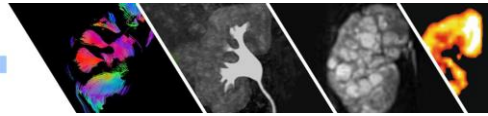
Silver award	
Bronze award	A 10-minute MRI acquisition protocol for renal anatomy, diffusion-tensor imaging, tractography, intravoxel incoherent motion, blood oxygenation-level dependent imaging, T1- and T2 mapping, magnetisation transfer contrast, chemical exchange saturation transfer, angiography, phase contrast, hyperpolarised MRI, MR renography, multiple inversion time arterial spin labelling, elastin expression, time-resolved MRI spectroscopy, Sodium MRI, quantitative susceptibility mapping and MR urography.

ISRMR 2029 award ceremony



Category I. Novel technologies and contrast mechanisms	
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Silver award	A dedicated low-field MRI scanner for AKI assessment on the intensive care ward.
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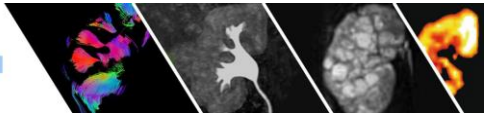
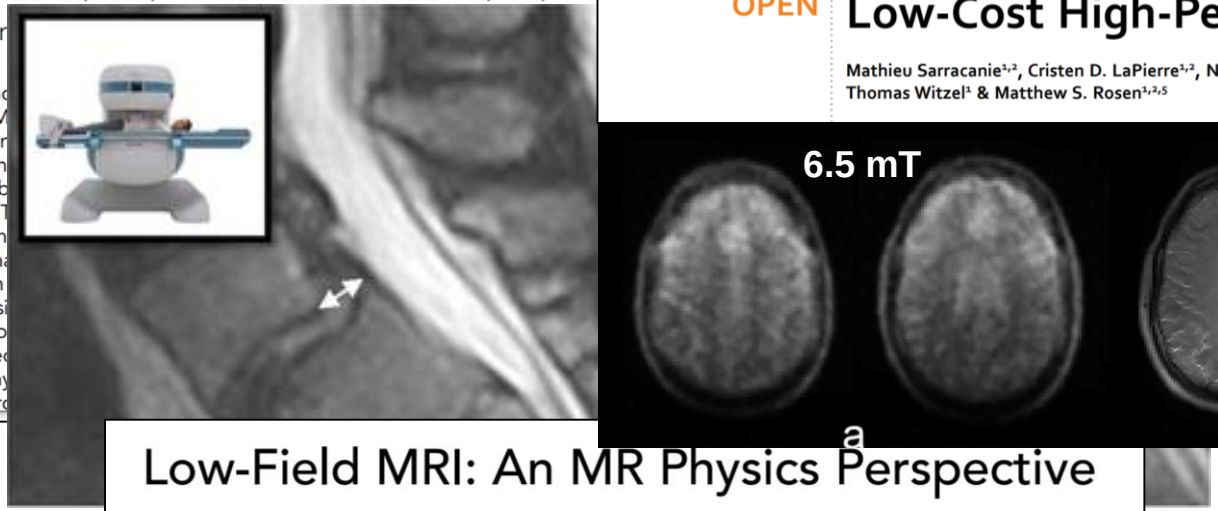


REVIEW ARTICLE

Low-Cost and Portable

Lawrence L. Wald, PhD,[1,2,3*] Patrick C. McDaniel, MS,[1,4] T
Jason

Research in MRI techno
mentation to enable M
resolution, or expandi
direction, extending th
by increasing the numb
quent and varied use. T
monitoring application
been considered, we ha
scanners and quantum
reduction of cost and si
ners) have not been co
scanner in a centralize
computed tomography
recent advances in hard



SCIENTIFIC REPORTS

OPEN

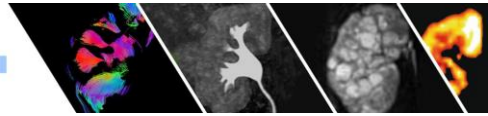
Low-Cost High-Performance MRI

Mathieu Sarracanie[1,2], Cristen D. LaPierre[1,2], Najat Salameh[1,2,3], David E. J. Waddington[1,2,4], Thomas Witzel[1] & Matthew S. Rosen[1,2,5]

Low-Field MRI: An MR Physics Perspective

José P. Marques,[1*] Frank F.J. Simonis,[2] and Andrew G. Webb, PhD[3]

ISRMR 2029 award ceremony



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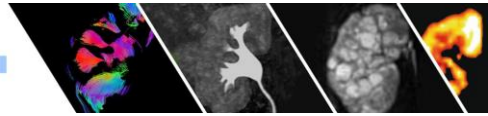
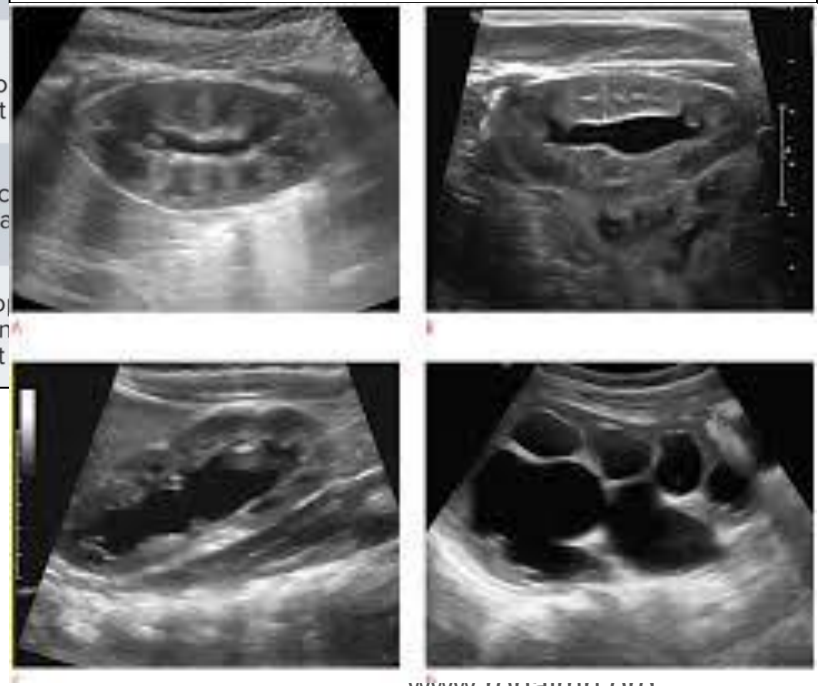
ISRMR 2029 award ceremony

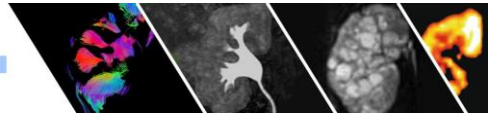


Category I. Novel technologies and contrast mechanisms	
Gold award	A novel MRI method for the prenatal measurement of single-kidney function.
Silver award	A dedicated low-field MRI scanner for AKI assessment on the intensive care ward.
Bronze award	A 10-minute MRI acquisition protocol for renal anatomy, diffusion-tensor imaging, tractography, intravoxel incoherent motion, blood oxygenation-level dependent imaging, T1- and T2 mapping, magnetisation transfer contrast, chemical exchange saturation transfer, angiography, phase contrast, hyperpolarised MRI, MR renography, multiple inversion time arterial spin labelling, elastin expression, time-resolved MRI spectroscopy, Sodium MRI, quantitative susceptibility mapping and MR urography.

- 25% of all prenatal US detect congenital abnormalities of the genitourinary tract.
- The impact on kidney function is difficult to determine (no blood & urine)
- Fetal MRI is very difficult (size, motion)

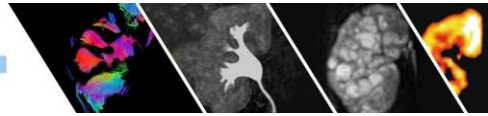


ISRMR 2029 award ceremony



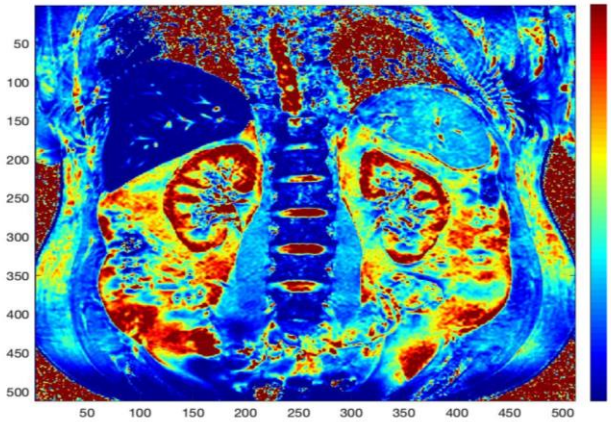
Category II. Accuracy and precision of renal MRI biomarkers
Gold award
Silver award
Bronze award

ISRMR 2029 award ceremony

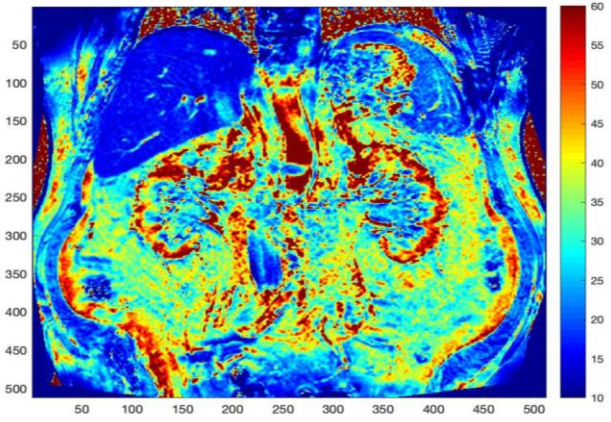


Category II. Accuracy and precision of renal MRI biomarkers	
Gold award	
Silver award	
Bronze award	Normal reference ranges for 45 renal MRI biomarkers: a UKRIN imaging biobank study in 5000 healthy subjects

45 yr old, male, healthy



74 yr old, male, Type 2 diabetes

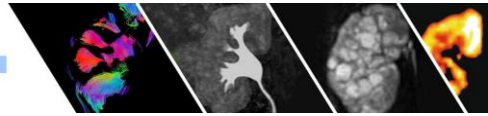


72 yr old, male, Healthy

??

T_2* mapping

ISRMR 2029 award ceremony



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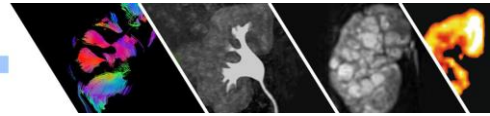
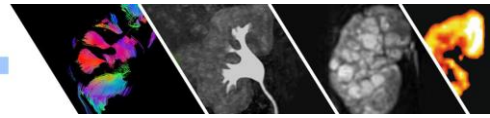
ISRMR 2029 award ceremony



Category II. Accuracy and precision of renal MRI biomarkers	
Gold award	
Silver award	Patient-specific error estimates in cortical fractional anisotropy with a 5% confidence.
Bronze award	Normal reference ranges for 45 renal MRI biomarkers: a UKRIN imaging biobank study in 5000 healthy subjects



LabCorp
Laboratory Corporation of America

Specimen Number	Patient ID	Control Number	Account Number	Account Phone Number	Rte
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	

Patient Last Name: [redacted]
Patient First Name: [redacted]
Patient Middle Name:
Patient SS#:
Patient Phone:
Total Volume:
Age (Y/M/D): 40/[redacted]
Date of Birth: [redacted]
Sex: M
Fasting: No
Patient Address:

Private MD Labs
93 MATHIS DRIVE
DICKSON, TN 370

Date and Time Collected	Date Entered	Date and Time Reported	Physician Name
05/18/12 14:50	05/18/12	05/19/12 07:17ET	PLUNK, O

Tests Ordered
CBC With Differential/Platelet;Comp. Metabolic Panel (14);Testosterone, Serum
S;FSH, Serum;Estradiol

General Comments
PID: W 24954

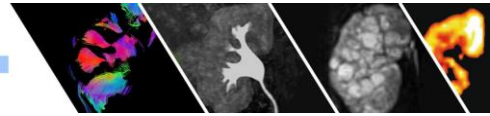
TESTS	RESULT	FLAG	UN
CBC With Differential/Platelet			
WBC	5.9		x10
RBC	5.40		x10
Hemoglobin	16.9		g/
Hematocrit	**50.3**	**High**	
MCV	93		f
MCH	31.3		p
MCHC	33.6		g/
RDW	13.2		
Platelets	215		x10
Neutrophils	52		
Lymphs	36		
Monocytes	10		
Eos	2		
Basos	0		

%	0-3	01	

MRI Biomarker Panel

TEST	*RESULT*	*UNIT*	*FLAG*
Volumetry			
Kidney Volume	250	ml	
Cystic volume	70	%	**High?**
Renography			
SK-GFR:	65	ml/min	
Blood Flow:	644	ml/min	
Extraction Fraction:	18	%	
Blood Volume:	22	%	**Low?**
Transit Time:	2.2	min	
Functional Volume:	212	ml	
Diffusion			
ADC (medulla):	2.84	10^{-3} mm^2/s	
ADC (cortex):	2.55	10^{-3} mm^2/s	
FA (medulla):	39	%	
FA (cortex):	22	%	
BOLD			
T2* (medulla)	54	ms	**High?**
T2* (cortex)	66	ms	
Reserve (medulla)	13	%	
Reserve (cortex)	12	%	

ISRMR 2029 award ceremony



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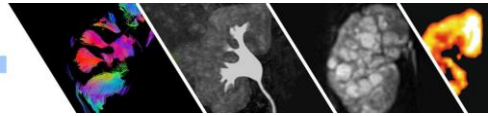
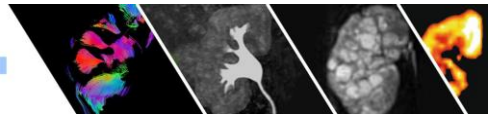
ISRMR 2029 award ceremony



Category II. Accuracy and precision of renal MRI biomarkers	
Gold award	Implementation of renal MRI biomarker results traceable to the SRMR international reference standard.
Silver award	Patient-specific error estimates in cortical fractional anisotropy with a 5% confidence.
Bronze award	Normal reference ranges for 45 renal MRI biomarkers: a UKRIN imaging biobank study in 5000 healthy subjects



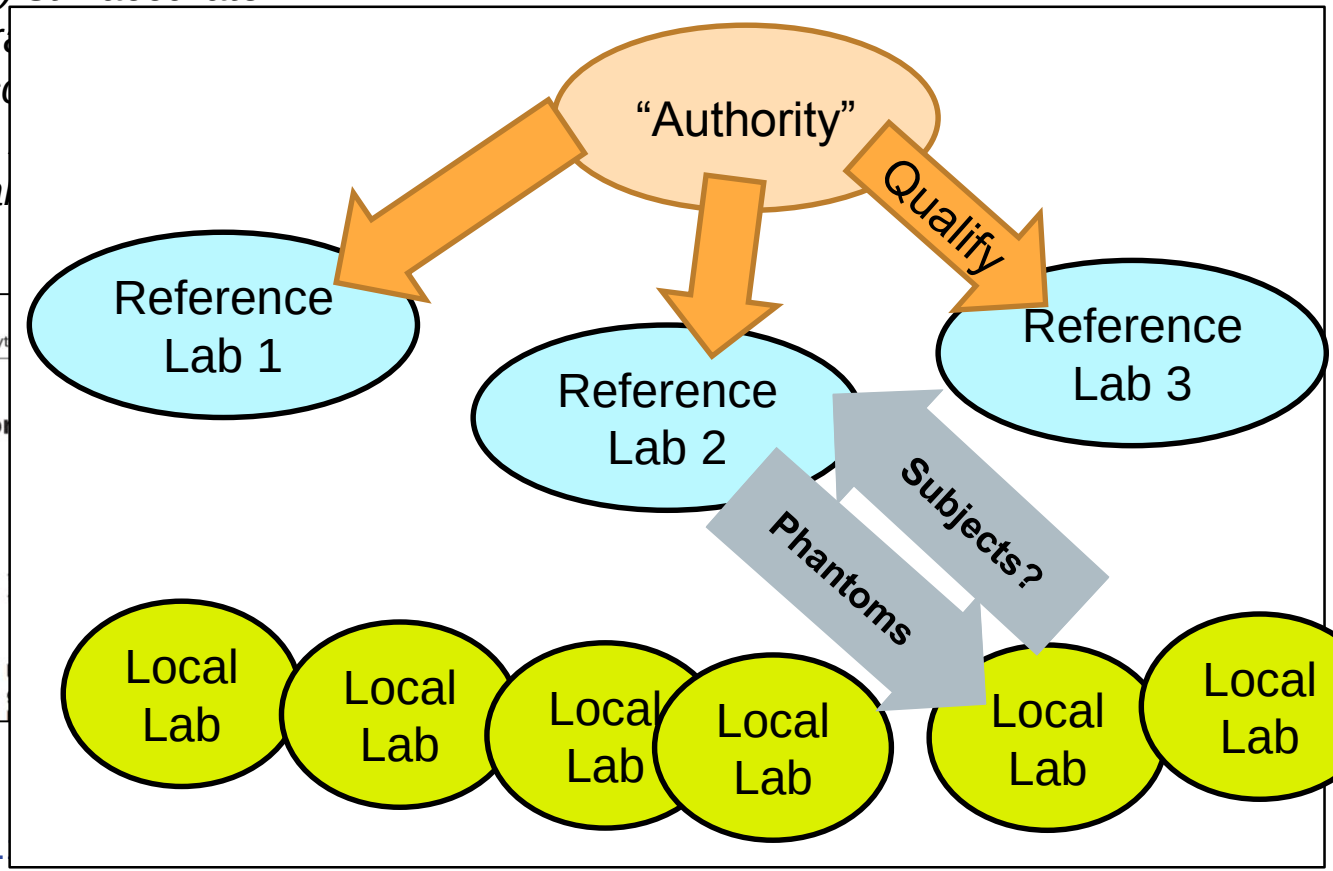
- *Is my new machine (assay) well calibrated?*
- *Is my machine (assay) still accurate?*
- *Has my software upgr*
- *Is this new product ac*
- *Should I buy machine*
- *Are the values from la*

Clin Chem Lab Med 2002; 40(1):78–89 © 2002 by Walter de Gruyt

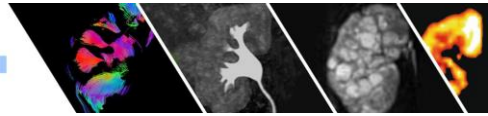
Approved IFCC Reference Method fo
of HbA_{1c} in Human Blood

International Federation of Clinical Chemistry and Laboratory Medicine (IFCC)[1)2)]

Scientific Division
Working Group on HbA_{1c} Standardisation[3)] and
Network of Reference Laboratories for HbA_{1c}[4)]

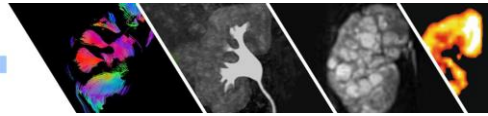


ISRMR 2029 award ceremony



Category III. Biological sensitivity & specificity of renal MRI
Gold award
Silver award
Bronze award

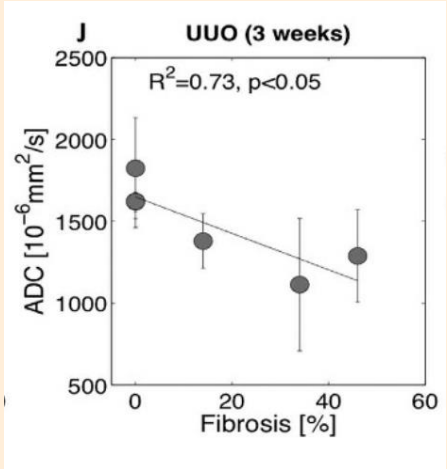
ISRMR 2029 award ceremony



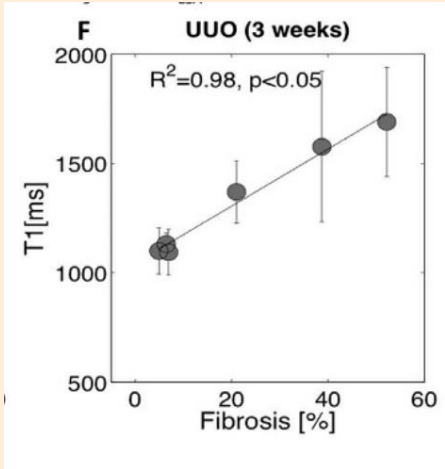
Category III. Biological sensitivity & specificity of renal MRI	
Gold award	
Silver award	
Bronze award	A non-invasive MRI biomarker shows 95% specificity to tubulo-interstitial fibrosis.

☺ Fibrosis changes => Biomarker changes
☹ Biomarker changes => fibrosis changes

"Fibrosis reduces extracellular water => reduces ADC"



"Fibrosis increases extracellular water => increases T1"



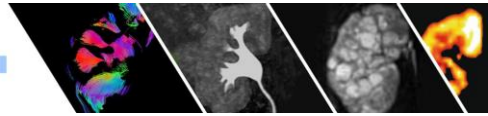
Friedli 2016

Diffusion-Weighted MRI Does Not Reflect Kidney Fibrosis in a Rat Model of Fibrosis

Peter Boor, MD, PhD,[1,2,3,4]* Michael Perkuhn, MD, MS,[5,6] Martin Weibrecht, MS,[5,6] Stephanie Zok, MS,[2] Ina V. Martin, PhD,[2] Jürgen Gieseke, MS,[7] Felix Schoth, MD, PhD,[5] Tammo Ostendorf, PhD,[2] Christiane Kuhl, MD,[5] and Jürgen Floege, MD[2]

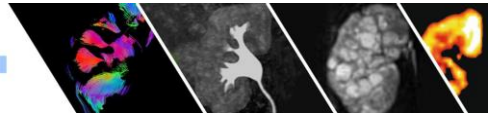
nephron. The reduced ADC in patients with chronic kidney diseases likely represents secondary changes associated with fibrosis, either being reduced perfusion or reduced renal function (directed water transport), but not fibrosis per se.

ISRMR 2029 award ceremony



Category III. Biological sensitivity & specificity of renal MRI	
Gold award	
Silver award	
Bronze award	A non-invasive MRI biomarker shows 95% specificity to tubulo-interstitial fibrosis.

ISRMR 2029 award ceremony



Category III. Biological sensitivity & specificity of renal MRI	
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Silver award	Dual-agent MRI of the ultrafiltrate measures elevated albumin in normo-albuminuric diabetic nephropathy.
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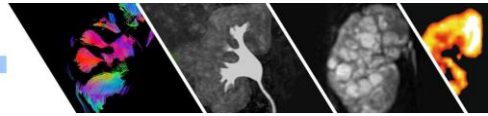
ISRMR 2029 award ceremony



Category III. Biological sensitivity & specificity of renal MRI	
Gold award	Mapping single nephron GFR across the human kidney: a validation study.
Silver award	Dual-agent MRI of the ultrafiltrate measures elevated albumin in normo-albuminuric diabetic nephropathy.
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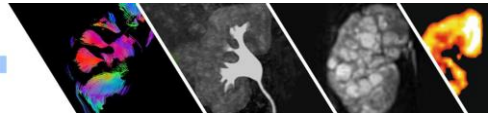
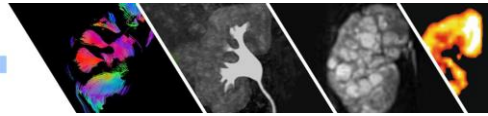
ISRMR 2029 award ceremony



Category IV. Utility of renal MRI in drug development and clinical practice
Gold award
Silver award
Bronze award

ISRMR 2029 award ceremony



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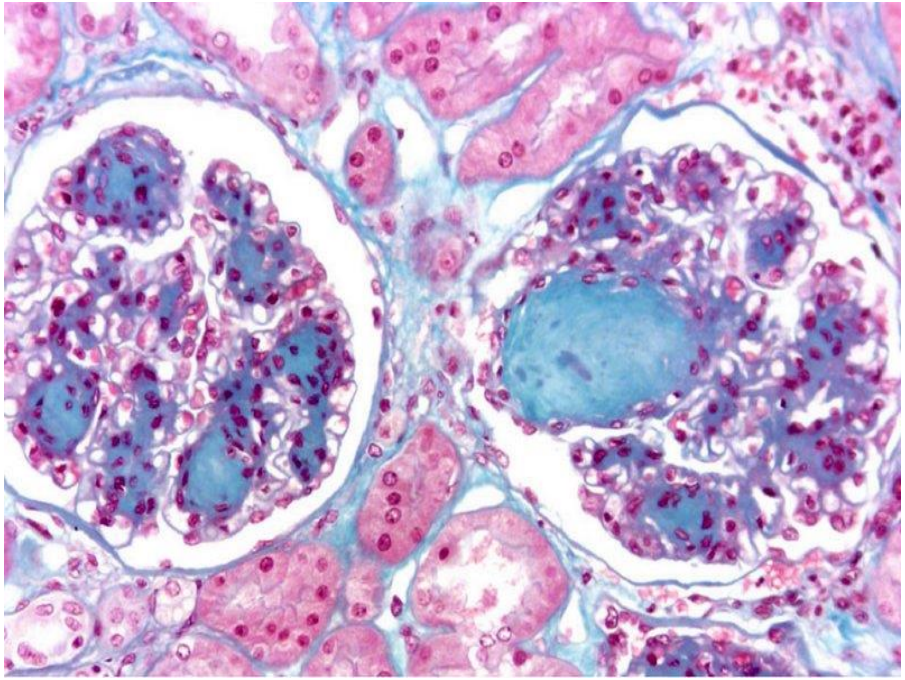
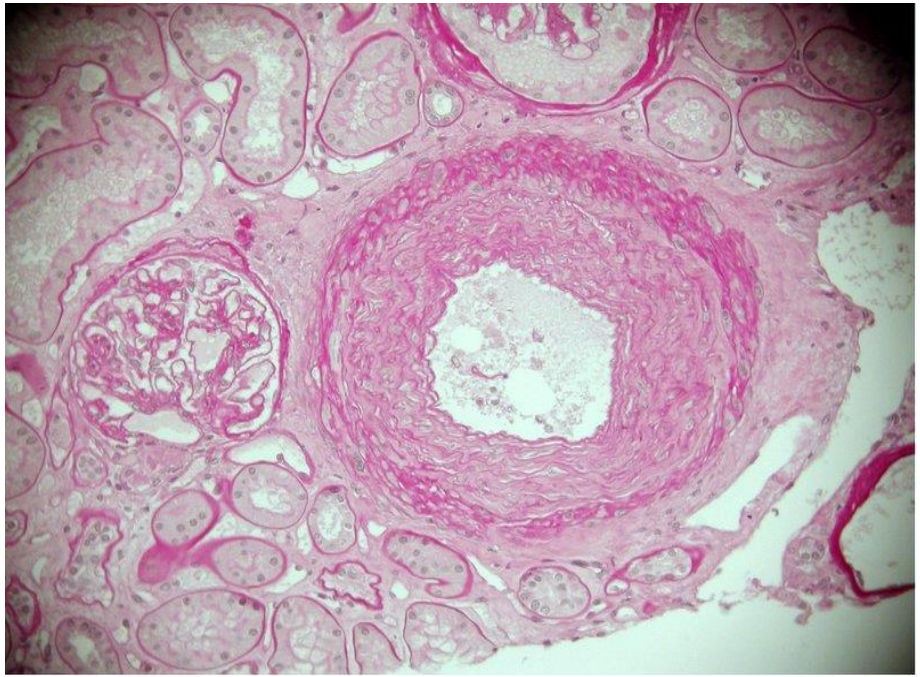
Bronze award	Virtual MRI biopsy distinguishes diabetic glomerulosclerosis from hypertensive microvascular disease.

Diabetic glomerulosclerosis

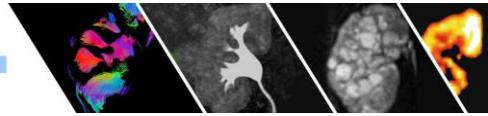


Vascular wall thickening



Courtesy Loreto Gesualdo

ISRMR 2029 award ceremony



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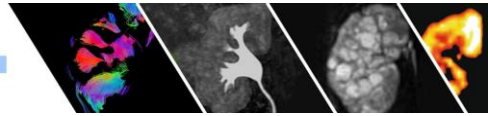
ISRMR 2029 award ceremony



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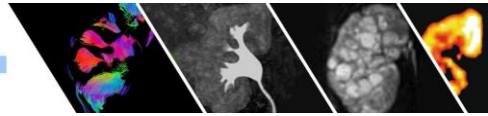

SCIENCE TRANSLATIONAL MEDICINE | RESEARCH ARTICLE

KIDNEY FIBROSIS

Elastin imaging enables noninvasive staging and treatment monitoring of kidney fibrosis

Qinxue Sun[1,2]*, Maike Baues[3]*, Barbara M. Klinkhammer[1,4]*, Josef Ehling[3], Sonja Djud
Natascha I. Drude[3,5], Christoph Daniel[6], Kerstin Amann[6], Rafael Kramann[4], Hyojin Kim
Julio Saez-Rodriguez[7,8], Ralf Weiskirchen[9], David C. Onthank[10], Rene M. Botnar[11],
Fabian Kiessling[3], Jürgen Floege[4], Twan Lammers[3,12†], Peter Boor[1,4,13,14†]

Fibrosis is the common endpoint and currently the best predictor of progression of chronic ki
(CKDs). Despite several drawbacks, biopsies remain the only available means to specifically asses
renal fibrosis. Here, we show that molecular imaging of the extracellular matrix protein elastin a
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FDA U.S. FOOD & DRUG ADMINISTRATION

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/ Reviews: Qualification of Biomarker: Total Kidney Volume in Studies for Treatment of Autosomal Dominant Polycystic Kidney Disease

Reviews: Qualification of Biomarker: Total Kidney Volume in Studies for Treatment of Autosomal Dominant Polycystic Kidney

Volume (PDF

Qualification

CDRH

submission

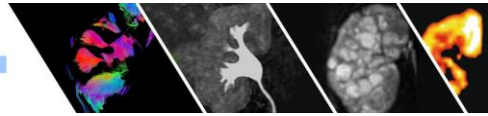
Clinical Outcome Assessments (COA) Qualification Submissions

- Statistical Review and Evaluation: Biomarker Qualification Total Kidney Volume (TKV) (PDF - 1,324KB)
- Secondary Statistical Review: Total Kidney Volume (TKV) (PDF - 350KB)

f. BQRT Recommendations

Based upon consideration of the strengths and limitations of the data, the BQRT recommends that Total Kidney Volume (TKV) determined at baseline, in combination with patient age and baseline eGFR, can be qualified as a prognostic enrichment biomarker for autosomal dominant polycystic kidney disease (ADPKD) subjects at high risk for a progressive decline in renal function, defined as a confirmed 30% decline in eGFR.

ISRMR 2029 award ceremony



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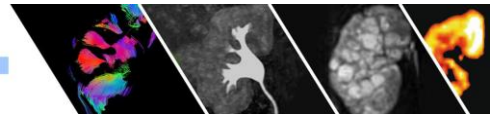
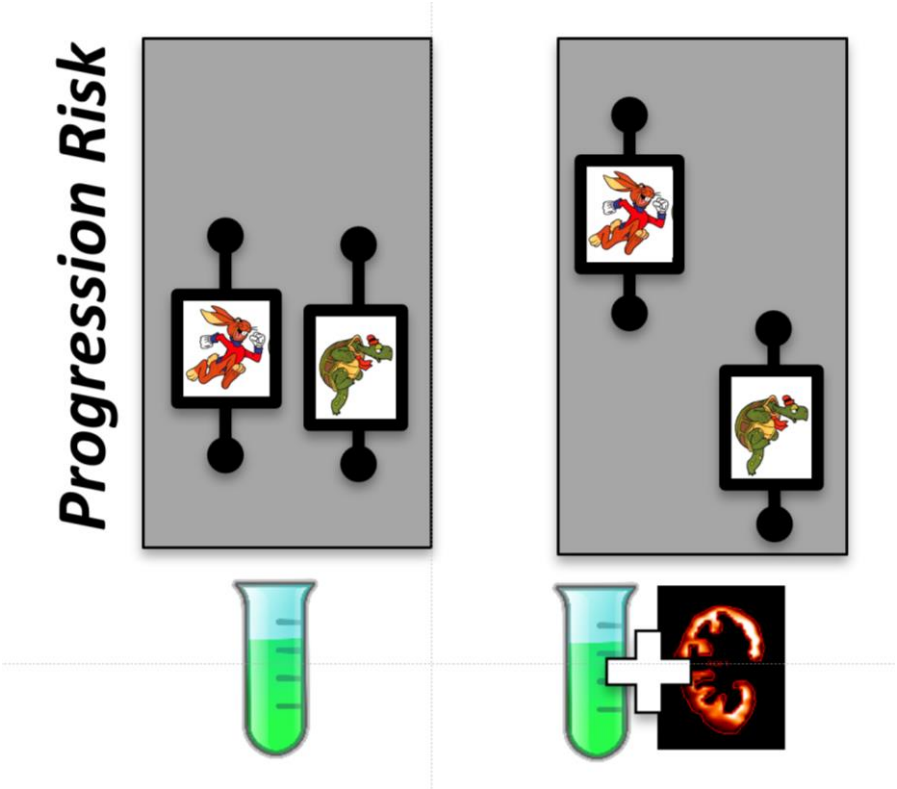
ISRMR 2029 award ceremony

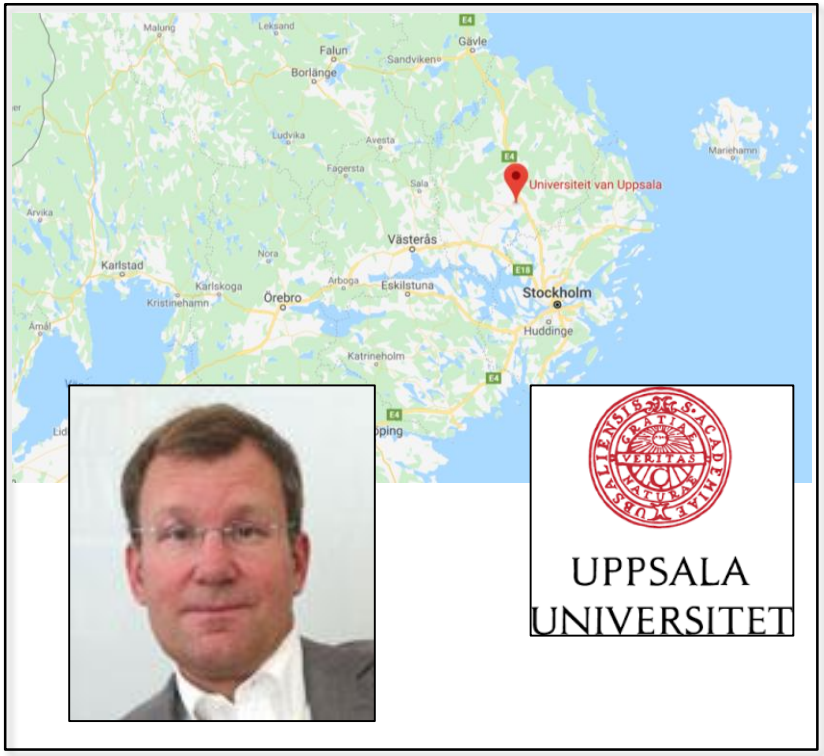


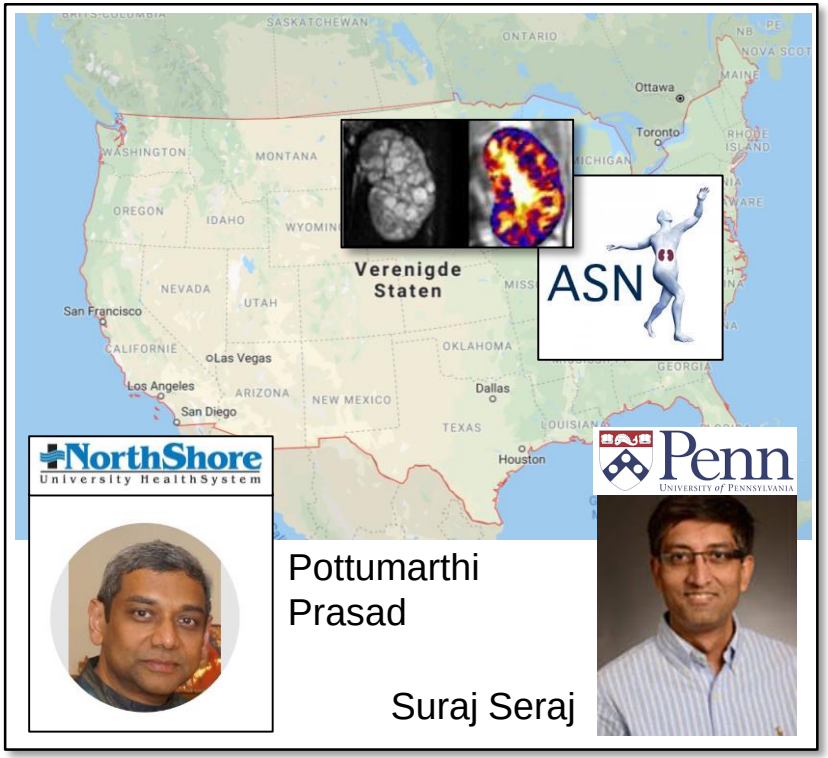
Category IV. Utility of renal MRI in drug development and clinical practice	
Gold award	MRI biomarkers improve the prediction of eGFR decline in patients with Type 2 diabetes – the iBEAt study
Silver award	FDA qualification of a fibrosis-specific MRI contrast agent as surrogate endpoint in clinical trials.
Bronze award	Virtual MRI biopsy distinguishes diabetic glomerulosclerosis from hypertensive microvascular disease.

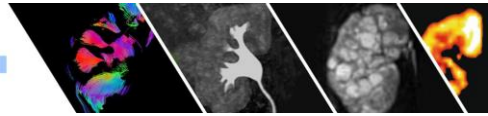

Progression Risk

Fourth international renal imaging meeting 2021

2021 International Meeting







Plenary discussion

Location next meeting (2021)?

- Somewhere in US (ASN satellite)
- Sweden, Uppsala

Frequency of future meetings?

- Continue with October time bi-annual meetings?
- Ad-hoc planning?

Thank you to the organisers!!

Susan Francis

Nick Selby

Maarten Taal