



CAIRIBU BPH RESEARCH INTEREST GROUP (BPH RIG)

KNOWLEDGE EXCHANGE

EXECUTIVE SUMMARY 9/9/2026

Goal: Facilitate knowledge exchange and spur collaborations in BPH research and adjacent fields

Shane Wells, MD

Image-Based Biomarkers for the Lower Urinary Tract

Clinical Needs and Current Challenges with Lower Urinary Tract Dysfunction (LUTD):

- **Dr. Shane Wells:** LUTD is common and increases in frequency and severity with age. Delaying treatment can lead to permanent bladder detrusor dysfunction. But **there is a gap in non-invasive diagnostic tools linking symptom severity and pathophysiology**, he said.
- He stressed the need to focus beyond the prostate, noting that functionally, the bladder and bladder outlet form an interdependent physiologic dyad. Though Uroflow is an option, it cannot differentiate bladder outlet obstruction (BOO) and detrusor underactivity.
- Urodynamic studies can establish BOO detrusor function but are invasive and not routinely used for BPH.

Image-Based Biomarkers:

- Dr. Wells hypothesized that in patients with LUTD, image-based biomarkers are sensitive to histologically confirmed tissue changes occurring in the bladder and prostate. His goal, therefore, is to **use imaging to improve risk stratification and guide personalized diagnosis and treatment**.
- Quantitative imaging produces reproducible data to assess disease severity and treatment response.

Using Magnetic Resonance Elastography (MRE) to Characterize Prostate Biomechanics and Stiffness:

- Changes in physiological properties of the prostate from aging may contribute to altered physiology and anatomy of the bladder and urethra, affecting urinary flow dynamics.
- Dr. Wells said that MRE can visually display and quantify prostate tissue stiffness.
- He presented an example of patient imaging that included: axial T2-weighted MRI for an anatomical assessment, an elastogram measuring tissue stiffness, a color map to better visualize the elastogram data, and a wave image to assess the quality of the MRE.
 - The imaging identified that an increase in prostate stiffness related to BPH elongates and narrows the prostatic urethra, reducing urethral compliance and causing an increased urethral opening pressure and early urethral closure, altering flow dynamics.
- Dr. Wells said he believed that prostate segmentation from MRI/MRE can be used to co-register imaging data and create a 3D stiffness map of the prostate to quantify the tissue stiffness.

Jesse Hamilton, PhD

MR Fingerprinting for Quantitative Bladder Wall Tissue Characterization

Bladder Remodeling in BPH:

- **Dr. Jesse Hamilton** began by reviewing how BPH increases bladder workload and can lead to BOO and progressive bladder remodeling. As bladder dysfunction increases, the bladder undergoes the following stages of remodeling: normal, hypertrophy, compensation, and decomposition.

Magnetic Resonance Fingerprinting (MRF):

- Dr. Hamilton said that while conventional MRI is largely qualitative, **quantitative mapping offers more insight on bladder tissue traits**. Researchers can use MRF, he said, as a framework for mapping multiple tissue properties in a single rapid scan.
- Based on changes in MRI data over time, MRF generates “fingerprints” to be compared with simulated fingerprints in a dictionary to identify the best match and generate co-registered quantitative maps.

FEATURED SPEAKERS

SHANE WELLS, MD

JESSE HAMILTON,
PHD



- He noted, however, that there is not currently a standardized MRF approach for bladder wall segmentation.

In BPH Preliminary Results:

- Dr. Hamilton said that Isotropic imaging allows different views, sagittal, coronal, axial, and oblique planes, to be generated from the same acquisition.
- Using data from an initial volunteer study, Dr. Hamilton was able to find that older patients had increasing T_2 values and that men had higher T_1 and bladder wall thickness compared to women, establishing age- and sex-adjusted normative values for future studies.
- Further preliminary work that used 3T MRF in BPH patients to map T_1 and T_2 values showed elevated T_1 and T_2 levels in symptomatic patients compared with healthy volunteers.
- Dr. Hamilton concluded by suggesting that fibrotic tissues may be able to be identified with MRF $T_{1\rho}$, which is sensitive to macromolecular environment (especially collagen). While $T_{1\rho}$ is still in preliminary data stages, he said, literature in both cardiac and liver imaging supporting its use for identifying fibrosis.

Shane Wells, MD is an Associate Professor of Radiology and Associate Professor of Urology at the University of Michigan Medical School. His translational research program is highly collaborative and focuses on the development of non-invasive image-based biomarkers – such as magnetic resonance imaging and ultrasound – to improve diagnostics and treatment of the prostate and bladder problems associated with lower urinary tract symptoms.

Jesse Hamilton, PhD is an Assistant Professor of Radiology at the University of Michigan Medical School. He has a degree in Biomedical Engineering and collaborates closely with clinicians and clinician-scientists, such as Dr. Wells, to improve early detection and monitoring of diseases using new quantitative magnetic resonance imaging methods. A particular method of interest is MRI “fingerprinting,” which allows for the measurement of multiple biological properties from one rapid scan. Dr. Hamilton’s lab focuses on the development of new data acquisition methods and reconstruction algorithms; validation in simulations, phantom experiments, and human subjects scanning; and clinical translation. His prior work has been largely among cardiac patient groups.

Drs. Wells and Hamilton are co-PIs (along with Giulia Ippolito, MD, MS, also at University of Michigan) on an NIDDK-funded R01 grant, “Non-Invasive Risk Stratification of Neurogenic Lower Urinary Tract Dysfunction with Magnetic Resonance Fingerprinting.”