Title: Shared decision making model improves biparametric prostate magnetic resonance imaging protocols by reducing patient unpleasant experiences while maximizing cost savings and throughput

Authors: Andrew Gusev[1], Michelle Shabo[1], Alan J. Goldstein[1], Jennifer Yates[1], Evan Ruppell[1], Scott Greenberg[1], Ahmed Sobieh[1], Mitchell H. Sokoloff[1], Khashayar Rafatzand[1]
[1]UMASS Medical School, Worcester, MA | Contact author email: andrew.gusev@umassmed.edu

Introduction and objective: Biparametric MRI (bpMRI) of the prostate includes T2-weighted imaging and diffusion-weighted imaging. Its diagnostic accuracy and tumor detection rates are comparable with those of multiparametric MRI (mpMRI), despite not requiring venipuncture nor administration of gadolinium-based contrast agents (GBCA). Per the Prostate Imaging Reporting and Data System Version 2 (PIRADS v2), the diagnostic value of dynamic contrast-enhanced imaging (DCE) is in the ability to upgrade peripheral zone (PZ) lesions from PR-3 (PIRADS-3) (indeterminate) to PR-4 (suspicious) in the presence of asymmetric enhancement. Despite this, if PZ PR-3 lesions are routinely biopsied similarly to PZ PR-4 and PR-5 lesions, lesion characteristics on DCE do not have management implications.However, if PZ PR-3 lesions are observed, while PZ PR-4 and PR-5 lesions are biopsied, bpMRI cannot solely guide management and DCE is necessary. Similarly, if an individual patient is very biopsy-averse or conversely biopsy-keen [for example due to anxiety about his risk of prostate cancer (PCa)] bpMRI without DCE is sufficient to guide management even if a PZ PR-3 lesion is found. Patients who are biopsy-neutral, or defer to the physician, may benefit from DCE.

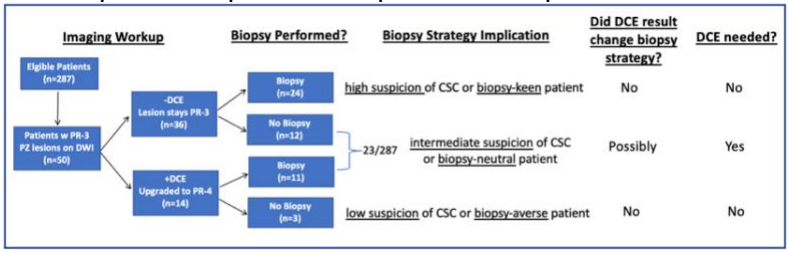
Specific aims: (1) Retrospectively investigate the value of bpMRI in comparison to that of mpMRI with regard to cost, patient experience and MRI throughput. (2) Create a shared decision making workflow that acknowledges physician clinical practice and patient preference and utilize it to investigate value of optimal bpMRI protocol.

Rationale and background: While cost effectiveness of bpMRI has been previously reported, this is the first study to emphasize the patient's perspective in an assessment of bpMRI value. Complications of venipuncture and GBCA, albeit respectively minor and uncommon, can adversely affect patient experience. Despite the purported benefits and evidence supporting the diagnostic non-inferiority of bpMRI, adoption remains limited.

Methods: IRB approved retrospective study with population of 287 treatment-naïve men undergoing mpMRI. For specific aim (1) Compared bpMRI and mpMRI on primary outcomes of system cost, patient cost, MRI throughput, and patient perspective. For specific aim (2) Created three hypothetical workflows: scenario 1 (S1), scenario 2 (S2), scenario (S3) and retrospectively sorted patients into them based on their DCE results and decision to biopsy or not. S1: standard of care, mpMRI. S2: initial bpMRI with decision to observe PR-3, but biopsy PR-4+; all patients with PZ PR-3 must be called back for DCE to complete study. S3: initial bpMRI with shared decision protocol; only subset of patients with PZ PR-3 determined to directly benefit from DCE are called back to complete study. Evaluated primary outcomes for each scenario to determine optimal workflow.

Results: Of 287 men, 50 were found to have PZ PR-3 lesions. Of these 50, negative DCE for 36 (24 still biopsy, 12 no biopsy), positive DCE with upgrade to PZ PR-4 for 14 (3 no biopsy, 11 biopsy). Combined we retrospectively deduced that only 23 out of 287 (12 no biopsy when negative DCE plus 11 biopsy when positive DCE) may have had management altered by DCE result. Thus for S2, 50 callbacks were required to complete workup if PZ PR-3 found, but for S3 only 23 callbacks were required using the shared decision model. We compared both S2 and S3 outcomes with those for standard of care S1. System cost was reduced by both: S2 [$32,646.75 (20%)] and S3 [$36,366 (22.4%)]. Per patient cost was increased by both: S2 [$18 (17%)] and S3 [$8 (8%)]. Time to complete MRI workup was reduced by both: S2 [1.3 days (8.02%)] and S3 [4.2 days (25.9%)]. Number of unpleasant patient experiences was increased by S2 [59.1 (13%)], but decreased by S3 [25.2 (48.18%)]. Using S3 as a control due to its lowest number of unpleasant experiences, we calculated number needed to harm (NNH) for S1 to be 5.98 patients and S2 to be 58.82 patients.

Conclusion: By combining bpMRI with a shared decision on how to proceed should a PZ PR-3 lesion be identified (S3), it is possible to greatly minimize system cost, maximize MRI throughput, and significantly reduce patient unpleasant experiences in prostate MRI, while having only a minor increase in per patient cost.



N = 287	Scenario 1	Scenario 2	Scenario 3
Intervention Type	Current Practice	Proposed	Proposed
MRI type + Biopsy Strategy	mpMRI	bpMRI + biopsy ≥PR-4	bpMRI + SD Model
System Cost ($)	163,816.73	131,169.98	127,450.73
Difference from S1	0	-32,646.75 (↓20.0%)	-36,366 (↓22.4%)
Per Patient Cost ($)	103	121	111
Difference from S1	0	+18 (↑17%)	+8 (↑8%)
Time to complete MRI Eval (days)	16.2	14.9	12
Difference from S1	0	-1.3 (↓8.02%)	-4.2 (↓25.9%)
Number of unpleasant experiences	52.3	59.1	27.1
Difference from S1	0	+6.8 (↑13%)	-25.2 (↓48.18%)
Number needed to harm (NNH)	5.98	58.82	N/A: Control