

Attitudes and experience of urology trainees in interpreting prostate magnetic resonance imaging

Craig Rodrigues, MD¹; Kash Visram, MD¹; Alireza Sedghi²; Parvin Mousavi²; D. Robert Siemens, MD¹

¹Department of Urology, Queen's University, Kingston, ON, Canada; ²School of Computing, Queen's University, Kingston, ON, Canada

Cite as: Rodrigues C, Visram K, Sedghi A, et al. Attitudes and experience of urology trainees in interpreting prostate magnetic resonance imaging *Can Urol Assoc J* 2021;15(5):E293-8. <http://dx.doi.org/10.5489/auaj.6614>

Published online October 27, 2020

Abstract

Introduction: Multiparametric magnetic resonance imaging (mpMRI) has resulted in accurate prostate cancer localization and image-guided targeted sampling for biopsy. Despite its more recent uptake, knowledge gaps in interpretation and reporting exist. Our objective was to determine the need for an educational intervention among urology residents working with mpMRIs.

Methods: We administered an anonymous, cross-sectional, self-report questionnaire to a convenience sample of urology residents in U.S. and Canadian training programs. The survey included both open- and closed-ended questions employing a five-point Likert scale. It was designed to assess familiarity, exposure, experience, and comfort with interpretation of mpMRI.

Results: Fifty-three surveys were completed by residents in post-graduate years (PGY) 1–5 and of these, only 12 (23%) reported any formal training in mpMRI interpretation. Most residents' responses demonstrated significant experience with prostate biopsies, as well as familiarity with reviewing mpMRI for these patients. However, mean (\pm standard deviation [SD]) Likert responses suggested a relatively poor understanding of the components of Prostate Imaging-Reporting and Data System (PI-RADS) v2 scoring for T2-weighted films (2.45 ± 1.01), diffusion-weighted imaging (DWI) films (2.26 ± 0.90), and dynamic contrast-enhanced (DCE) films (2.21 ± 0.99). Similar disagreement scores were observed for questions around interpretation of the different functional techniques of MRI images. Residents reported strong interest (4.21 ± 0.91) in learning opportunities to enhance their ability to interpret mpMRI.

Conclusions: While mpMRI of the prostate is a tool frequently used by care teams in teaching centers to identify suspicious prostate cancer lesions, there remain knowledge gaps in the ability of trainees to interpret images and understand PI-RADS v2 scoring. Online modules were suggested to balance the needs of trainee education with the residency workflow.

Introduction

The evolution of our health system has been accompanied by an increasing demand for healthcare services and administration, which may limit instruction focus and time for learners. As medical training across Canada moves toward competency-based curricula, it has become clear that expertise is developed by exposure to high-quality teaching followed by ample opportunity to practice and incrementally develop knowledge and skills. A key issue lies in a relative lack of resources and support necessary to facilitate deliberate attainment of these competencies.¹ The limitations have resulted in a call for institutions to develop innovative ways to train residents more efficiently. Self-directed learning via online platforms has been shown to improve trainee outcomes, including effective development of new diagnostic skills.^{2,3} As a simulated environment allows for no risk to actual patients, trainees can feel comfortable increasing skills through trial and error.⁴

Owing to its high soft-tissue contrast, high resolution, and ability to simultaneously image functional parameters, magnetic resonance imaging (MRI) provides the best visualization of the prostate compared to other imaging methods. Over the past few years, using MRI has led to a frame-shift for early prostate cancer detection. Functional imaging techniques, such as diffusion-weighted MRI (DW-MRI) and dynamic contrast-enhanced MRI (DCE), in addition to conventional T2-weighted anatomical sequences (i.e., multiparametric MRI [mpMRI]), have resulted in accurate prostate cancer localization and allowed image-guided targeted sampling to overcome the limitations of traditional blind prostate biopsy. Large, randomized trials have now confirmed the importance of optimal imaging with mpMRI in the early diagnosis — and subsequent management — of prostate cancer.^{5,6} Unfortunately, use of mpMRI has become story of “haves” and “have nots.”^{7,8} Democratizing access to optimal prostate imaging, as well as enhancing the ability for clinicians to interpret mpMRI images, has real potential to enhance the care of all men being investigated for this

common cancer, regardless of economical and geographical barriers.

Our center has developed an online platform for residents to learn more about interpreting mpMRI as a diagnostic tool in prostate cancer. This system known as *prostatecancer.ai*, available online and through a browser, employs artificial intelligence (AI) to identify lesions on mpMRI images and annotate findings with a thought process comparable to an experienced radiologist (Fig. 1).⁹ These scans are then presented as practice exercises to trainees with an accessible answer key. Urology residents can test their skills with hundreds of de-identified scans and ultimately practice reporting using Prostate Imaging-Reporting and Data System (PI-RADS) v2 — a standard reporting methodology intended to optimize detection, localization, characterization, and risk stratification in patients with suspected prostate cancer.

While in theory, self-directed learning may be beneficial, there is limited consensus on current urology residents' attitudes towards use of online teaching platforms to learn about the role of MRI in prostate cancer. This study aimed to quantify the need for an educational intervention among urology residents working with mpMRIs and PI-RADS v2.

Methods

Based on previously published methods for the creation of quantitative surveys, a needs assessment approach was used to determine the comfort level of urology residents working with mpMRI images and PI-RADS v2 reporting.¹⁰⁻¹³ Questions were drafted based on the following themes: 1) experience and comfort with reading and interpretation of mpMRI images; 2) confidence with the use and components

of PI-RADS v2; and 3) interest in educational opportunities in mpMRI and PI-RADS v2.

The survey contained questions about respondent demographics, as well as their experience with the use of mpMRI in their center, with answers graded between “never” and “always.” Finally, there were a series of questions on their comfort with interpreting mpMRI, as well as their educational experiences focused on prostate imaging ranked on a Likert agreement scale, ranging from 1 (not at all) to 5 (strongly agree). The survey was developed by a team of staff and trainees and tested for readability and face validity by staff urologists and residents in both the U.S. and Canada. The survey concluded with one free-form, open-ended question inviting trainees to share their thoughts on how best to deliver educational method(s).

The survey was delivered to both U.S. and Canadian urology trainees as a convenience sample, including residents ranging from postgraduate year (PGY) 1–5. The survey was delivered opportunistically in hard copy at resident research and educational meetings between April 2019 and December 2019.

Ethics approval was attained from the Queen's University Institutional Review Board, and an information package describing the motives, objectives, and confidentiality of the study were distributed with the surveys. Data was analyzed using descriptive statistics. Frequencies were tabulated and means with standard deviations used, as appropriate, to describe responses on the Likert scale. In cases where a participant responded with a range rather than a single value, the midpoint was used for analysis. For the purposes of reporting on questions using the five-point Likert scale, the agreement responses 4 and 5 were grouped together, as were the disagreement responses 1 and 2, unless otherwise stated. All other quantitative statistics used the full five-point Likert scale. The non-parametric Mann-Whitney U test was used to compare responses between different cohorts.

Results

Demographic data of respondents are found in Table 1. Of the 53 surveys that were completed by PGY1 to PGY5 residents, 32 (61%) were in their fifth year of the program. There were five fourth-year residents, five third-year residents, seven second-year residents, and two first-year residents in the survey sample. Thirty-two residents were from Canada and 21 were from the U.S. Most of the residents (91%) documented that they had previously performed prostate biopsies, with 31 residents performing 1–20 and 19 residents performing 21 or more biopsies in the past. When asked how many prostate mpMRI they had personally thoroughly reviewed, most (n=43, 81%) responded some experience, although only 10% documented they had read more than 30 scans. Despite this, only 12 (23%) residents, responded that they had received training in mpMRI interpretation through a formal course or lecture.



Fig. 1. Sample photo of prostatecancer.ai: an online tool, built on Open Health Imaging Foundation Viewer that uses artificial intelligence (AI) to identify lesions on multiparametric magnetic resonance images and annotate findings with a thought-process comparable to an experienced radiologist.

Table 1. Demographic information about survey respondents

Demographic (N=53)	n (%)
Year of training	
PGY5+	2 (3.8%)
PGY5	32 (60.4%)
PGY4	5 (9.4%)
PGY3	5 (9.4%)
PGY2	7 (13.2%)
PGY1	2 (3.8%)
Country of practice	
Canada	32 (60.5%)
U.S.	21 (39.5%)
Residents who received formal mpMRI training	12 (22.6%)
Residents who personally have reviewed (#) mpMRI scans	
0–10	39 (73.6%)
11–30	8 (15.1%)
>30	6 (11.3%)

mpMRI: multiparametric magnetic resonance imaging; PGY: postgraduate year.

Table 2 documents the respondent's experience of mpMRI in clinical practice at their institutions. When asked how often patients receive mpMRI scans prior to initial prostate biopsy, 11 (21%) residents responded "often" or "always" but 26% responded never in their experience. On the contrary, 38 (72%) of the residents responded "often" or "always" to how often patients receive prostate mpMRI scans prior to repeat biopsy. When asked about their experience on the use of mpMRI and the change in practice, half of the respondents felt that information from the mpMRI "often" or "always" led to changes in biopsy technique. Despite what appeared to be moderate experience with mpMRI in clinical practice within their institutions, only a small minority of residents (19%) responded they routinely read their own mpMRI prior to considering/planning a prostate biopsy, with 51% of residents indicating "never."

The rest of the survey questions focused on the residents understanding and comfort with interpretation of prostate MRI and, specifically, the components of the multiple parameters within PI-RADS v2 scoring (Table 3). With a mean Likert score of 2.45 (± 1.01 standard deviation [SD]), 34 (64%) residents "strongly disagreed" or "disagreed" with the statement suggesting they understand components/findings in PI-RADS

v2 scoring for T2W films. Similarly, 36 (68%) residents responded "strongly disagreed" or "disagreed" when asked a similar question around understanding of DWI components (mean Likert score 2.26 ± 0.90 SD) and DCE (2.92 ± 1.11 SD). Although still dichotomous, the residents responded slightly more positively when asked about their comfort in interpreting the different functional imaging techniques compared to their understanding of the components of PI-RADS v2 scoring. Residents' agreement in their ability to interpret T2W films was 23% (2.43 ± 1.06 SD) compared to 47% with DWI films (2.92 ± 1.11 SD) and 40% with DCE films (3.08 ± 1.30 SD).

Fifty-five percent of residents responded with survey answers to suggest they were not comfortable reviewing and subsequently confirming the radiologists' interpretation of mpMRI images. When questioned about the test characteristics of mpMRI use within their own institutions, the responses appeared generally negative, with only 34% agreement that the residents understand the likelihood of cancer between lesions graded between PI-RADS 3–5 and only 26% agreement in their confidence with the specificity of overall PI-RADS 4–5 lesions.

We compared differences in responses among the more junior and more senior trainees (\geq PGY3 and $<$ PGY3 residents) (Supplementary Table 1). There were a few differences found in some of the main attitudinal questions within the survey, particularly when asked about comfort in interpretation of DWI MRI parameters (3.14 ± 1.07 vs. 1.89 ± 0.60 , respectively, $p < 0.01$). Although this finding is consistent with more educational opportunities due to seniority, it was interesting that there were no significant differences in many of the other survey questions between more junior and more senior residents, including their understanding of the components/findings in PI-RADS v2 scoring.

Although there appeared to be similar differences between U.S. and Canadian respondents, these were confounded by different years of training between these two cohorts (less $<$ PGY3 in the Canadian trainees) (Supplementary Table 2).

On average, residents agreed they would be interested to learn about further opportunities to improve their ability to read mpMRI films (4.21 ± 0.91 SD), with the majority (80%) responding "agree" or "strongly agree." Some examples of residents' preferred methods for enhancing skills in mpMRI interpretation included "online courses, modules, and interactive presentations."

Table 2. Experience of mpMRI use during practice for urology residents

	Number of residents (n=53)			
	Never	Sometimes	Often	Always
At your institution, how often do patients receive mpMRI prior to initial biopsy?	14	28	10	1
At your institution, how often do patients receive mpMRI prior to repeat biopsy?	1	14	31	7
In your estimation, how often does a prior mpMRI change biopsy technique?	2	24	22	5
I read my own mpMRI prior to considering/planning prostate biopsy?	27	16	6	4

mpMRI: multiparametric magnetic resonance imaging.

Table 3. Likert scores assessing urology residents understanding and confidence of interpreting mpMRI films and PI-RADS v2 scoring

	Number of residents (n=53)				
	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I understand the components/findings in PI-RADS v2 scoring for T2W films?	7	27	8	10	1
I understand the components/findings in PI-RADS v2 scoring for DWI films?	9	27	12	4	1
I understand the components/findings in PI-RADS v2 scoring for DCE films?	14	21	11	2	0
I am comfortable in my ability to interpret a T2W MRI film?	11	20	10	12	0
I am comfortable in my ability to interpret a DWI MRI film?	7	14	7	18	7
I am comfortable in my ability to interpret a DCE MRI film?	5	17	10	19	2
I am comfortable in reviewing and subsequently confirming the interpretation of our radiologists read of a mpMRI	9	20	9	14	1
I understand the difference (likelihood of cancer) between lesions graded as overall PI-RADS score 3, 4, 5	8	15	10	13	5
I am confident with the specificity (few false positive reads) of overall PI-RADS 4-5 lesions at our institution	8	17	18	13	1
I am interested in learning opportunities that will develop my skills in mpMRI interpretation	0	3	8	17	25

DCE: dynamic contrast-enhanced; DWI: diffusion-weighted imaging; mpMRI: multiparametric magnetic resonance imaging; PI-RADS: Prostate Imaging-Reporting and Data System; T2W: T2-weighted image.

Discussion

This cross-sectional, self-report survey study suggests that although mpMRI of the prostate is a tool frequently used by care teams in teaching centers to identify suspicious prostate cancer lesions (particularly after a previous biopsy), there remain significant knowledge gaps in the ability of trainees to interpret images and understand PI-RADS v2 scoring. Although most respondents described some modest experience with personal review of mpMRI images of the prostate, only a small number (23%) suggested they had received any training in mpMRI interpretation through a formal course or lecture. Furthermore, only a minority of residents responded that they routinely personally review prostate mpMRI prior to clinical decision-making, which is, experientially, quite disparate from other genitourinary imaging techniques.

On average, residents described difficulty in understanding the components of PI-RADS v2 scoring regardless of the MRI imaging technique (i.e., T2W, DWI, DCE). The lowest trended score was demonstrated to be among DCE parameters, although few responded strong agreement that they had a fulsome understanding of any of the functional imaging techniques of mpMRI scoring. Interestingly, residents appeared to be more comfortable reviewing and interpreting mpMRI images relative to their understanding of the PI-RADS v2 scoring system, perhaps as they would be privy to a radiologist's reporting of suspicious lesions prior to reviewing specific cases. Indeed, most trainees confirmed they were not comfortable in reviewing and subsequently confirming a radiologist's interpretation of mpMRI images. Furthermore, residents did not acknowledge a strong level of comfort discerning the differences (i.e., likelihood of cancer) between

PI-RADS lesions scored as 3, 4, or 5. In contrast with what appears to be a relative lack of knowledge and comfort with using prostate mpMRI, the respondent trainees in this survey do appear to be highly engaged in learning opportunities that could help develop skills in mpMRI interpretation.

Although the results of this self-report survey did underscore a knowledge gap in prostate mpMRI interpretation, the survey content did not adequately address the specific teaching platforms that could best address this need. However, several comments from respondents did suggest that an online platform would be helpful to fill this gap. Previous studies have shown that a self-directed learning strategy may achieve trainee competence in specific imaging modalities.¹⁴

Furthermore, integration of online, modular learning has shown to benefit hospital staff and balance the needs of trainee education with the workflow of attending staff with pressing clinical duties.^{15,16} Future studies should assess the limitations of self-directed learning and its value of being a complementary — as opposed to supplementary — source of education for trainees. Beyond the need for self-discipline and accountability, the main tradeoff between online vs. in-person/on-site practice relates to the limited emotional and physical interaction a learner has with an educator, who may be able to tailor teaching and address concerns in real time.⁷ More research is needed to determine if an online tool, such as *prostatecancer.ai*, and its model of teaching is a sustainable, realistic approach that can significantly improve diagnostic accuracy for residents.

Conclusions

Although, the results of this survey provide a quantitative assessment of the need and interest for learning opportuni-

ties for urology residents, there are several limitations inherent to a study design that need to be considered. First, the results are derived from a self-report survey on the experience and attitudes of contemporary residents towards mpMRI and independent verification of data was not possible. Secondly, this survey represents only a snapshot of self-reported attitudes and experience of residents from different years of training. However, most of the respondents were in their senior years of training, close to completion of their programs, and likely have had multiple opportunities and experiences of their educational curricula set out by their respective programs. Thirdly, this was a somewhat small sample size, with mixed resident population (U.S. and Canada) and variable methods to approach the residents. The overall response rate was not captured. Nonetheless, the generally high number of responses, especially from the senior Canadian residents, likely is a good representation of the experience and attitudes.

Competing interests: The authors report no competing personal or financial interests related to this work.

This paper has been peer-reviewed.

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Correspondence: Dr. D. Robert Siemens, Department of Urology, Queen's University, Kingston, ON, Canada; Siemens, Robert.Siemens@kingstonhsc.ca

Supplementary Table 1. Differences between \geq PGY3 and $<$ PGY3 residents' attitudes and experiences while interpreting prostate MRI

Question	Mean Likert score		Mann-Whitney U-test (p<0.05)
	\geq PGY3 n=44	$<$ PGY3 n=9	
I understand the components/findings in PI-RADS v2 scoring for T2W films?	2.52 \pm 1.05	2.11 \pm 0.78	0.23
I understand the components/findings in PI-RADS v2 scoring for DWI films?	2.32 \pm 0.91	2.00 \pm 0.87	0.30
I understand the components/findings in PI-RADS v2 scoring for DCE films?	2.25 \pm 1.01	2.00 \pm 0.87	0.52
I am comfortable in my ability to interpret a T2W MRI film?	2.55 \pm 1.11	1.89 \pm 0.60	0.12
I am comfortable in my ability to interpret a DWI MRI film?	3.32 \pm 1.27	1.89 \pm 0.60	0.004
I am comfortable in my ability to interpret a DCE MRI film?	3.14 \pm 1.07	1.89 \pm 0.60	0.003
I understand the difference (likelihood of cancer) between lesions graded as overall PI-RADS score 3, 4, 5	2.84 \pm 1.22	3.11 \pm 1.54	0.60

DCE: dynamic contrast-enhanced; DWI: diffusion-weighted imaging; mpMRI: multiparametric magnetic resonance imaging; PGY: postgraduate year; PI-RADS: Prostate Imaging-Reporting and Data System; T2W: T2-weighted image.

Supplementary Table 2. Differences between Canadian and U.S. residents' attitudes and experiences while interpreting prostate MRI

Question	Mean Likert score		Mann-Whitney U-test (p<0.05)
	Canada n=32	U.S. n=21	
I understand the components/findings in PI-RADS v2 scoring for T2W films?	2.47 \pm 1.04	2.43 \pm 0.98	0.80
I understand the components/findings in PI-RADS v2 scoring for DWI films?	2.19 \pm 0.86	2.38 \pm 0.97	0.67
I understand the components/findings in PI-RADS v2 scoring for DCE films?	2.03 \pm 0.97	2.48 \pm 0.98	0.15
I am comfortable in my ability to interpret a T2W MRI film?	2.69 \pm 1.12	2.05 \pm 0.86	0.04
I am comfortable in my ability to interpret a DWI MRI film?	3.81 \pm 1.03	1.95 \pm 0.74	<0.00001
I am comfortable in my ability to interpret a DCE MRI film?	3.53 \pm 0.84	2.00 \pm 0.77	<0.00001
I understand the difference (likelihood of cancer) between lesions graded as overall PI-RADS score 3, 4, 5	2.44 \pm 1.01	3.57 \pm 1.33	0.00244

DCE: dynamic contrast-enhanced; DWI: diffusion-weighted imaging; mpMRI: multiparametric magnetic resonance imaging; PI-RADS: Prostate Imaging-Reporting and Data System; T2W: T2-weighted image.