Teaching Urologists "How to Read Multi-Parametric Prostate MRIs Using PIRADSv2": Results of an iBook Pilot Study

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OBJECTIVE To create an online resource that teaches urologists how to interpret prostate multiparametric magnetic resonance imaging (mpMRI). As prostate mpMRI becomes widely adopted for cancer diagnosis and targeted biopsy, it is increasingly important that urologists are comfortable and experienced in assessing the images. The purpose of this study was to create an online mpMRI ibook and measure its effect on instilling proficiency among urology residents.

METHODS We created a case-based ibook aimed at teaching clinicians how to identify and score prostate lesions on mpMRI using the Prostate Imaging-Reporting and Data System (PIRADS) v2. Residents completed a 43-question pretest before gaining access to the ibook for 1 month. The test asks participants to identify and score visible lesions using interactive mpMRI images. After a formal review of the material, they completed a post-test. Participants also rated their diagnostic confidence on a scale of 1-10 before and after reviewing the ibook. The change in performance and confidence scores for each resident was compared using Wilcoxon signed-rank test.

RESULTS Eleven urology residents completed the pretest, review session and post-test. The mean test score rose from 37% (median 40%) to 57% (median 58%) after reviewing the ibook. Improvement was significant (P= .0039). Confidence scores also improved (P = .001).

CONCLUSION We created an interactive ibook that teaches urologists how to evaluate prostate mpMRIs and demonstrated improved performance in interpretation among urology residents. This effective module can be incorporated into resident education on a national level and offered as a self-teaching resource for practicing urologists. UROLOGY 131: 40–45, 2019. © 2019 Elsevier Inc.

The use of multiparametric MRI (mpMRI) in prostate cancer diagnosis and management is becoming widely adopted in the United States. One study reported a 486% increase over 26 months at a single institution.[1] MpMRI has become a valuable noninvasive diagnostic tool that not only helps clinicians decide who to biopsy, but also where to biopsy when used for targeted-fusion biopsies. Several landmark trials have demonstrated mpMRI's increased sensitivity for diagnosing high-grade prostate cancer when compared to standard systematic transrectal ultrasound-guided biopsies.[2,3] However, significant variability in mpMRI interpretation has contributed to recommendations against routine mpMRI use in screening biopsy naïve men by the American Urologic Association (AUA),[4] European Association of Urology (EAU),[5] and National Comprehensive Cancer Network.[6] Additionally, both the AUA and EAU currently recommend combining systematic biopsies with targeted-fusion biopsies due to the large heterogeneity in diagnostic performance of targeted sampling that is reported in the literature.[7]

While several scoring systems have been created to help standardize interpretation of prostate mpMRIs, including the Prostate Imaging and Reporting Data System (PIRADS), variability in interpretation remains an ongoing problem. Several studies have reported significant variability in scoring among radiology experts and novices,[8] between experts at the same center,[9,10] and between experts at different centers.[11] As mpMRI use grows for biopsy decision-making, fusion targeted biopsy, focal therapy, and in prostatectomy planning, it is increasingly important for urologists to develop independent proficiency of mpMRI evaluation. Just as urologists routinely review computed tomography scans themselves for presurgical planning and evaluation, an understanding of prostate mpMRIs will become similarly important for urologists involved in prostate cancer diagnosis and treatment.

Proficiency in mpMRI interpretation requires an understanding of different MRI sequences, how to manipulate

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the images, and how to assign suspicion scores. Several online MRI teaching modules using interactive simulations and case-based practice have been created[12] and shown to have durable success in increasing diagnostic accuracy of mpMRI among radiology residents.[13] Training courses have also been developed for practicing urologists. Recently, a 2-day course offered by Dr Kasivisvanathan et al[14] was shown to successfully increase accuracy of detection of clinically significant cancer by urologists of varying experience and exposure to mpMRI.

As the importance of urology involvement in mpMRI interpretation grows, additional accessible education tools are needed. We set out to develop an online case-based, interactive mpMRI teaching tool in the form of an ibook created for practicing urologists. We then tested and evaluated the impact of the ibook on diagnostic accuracy and confidence among a group of urology residents.

MATERIALS AND METHODS

Description of the iBook

We created a case-based ibook titled "How to Read Multi-Parametric Prostate MRIs Using PIRADSv2." The ibook provides a structured overview of MRI sequences, prostate cancer imaging characteristics, and a detailed explanation of the PIRADS scoring system. The ibook also includes a high-yield and clinically focused review of all the different MRI naming conventions as well as a video demonstrating how to interact with different features of MRI programs such as windowing, zooming, and stacking images to allow for simultaneous evaluation of multiple sequences.

The ibook features case examples for each PIRADS score that includes clinical histories, annotated images, as well as embedded videos of the MRI sequences (Fig. 1). Though other mpMRI scoring systems are available, we focused on the most commonly used scoring system, PIRADS version 2. The case examples were curated from over 500 men who underwent fusion targeted

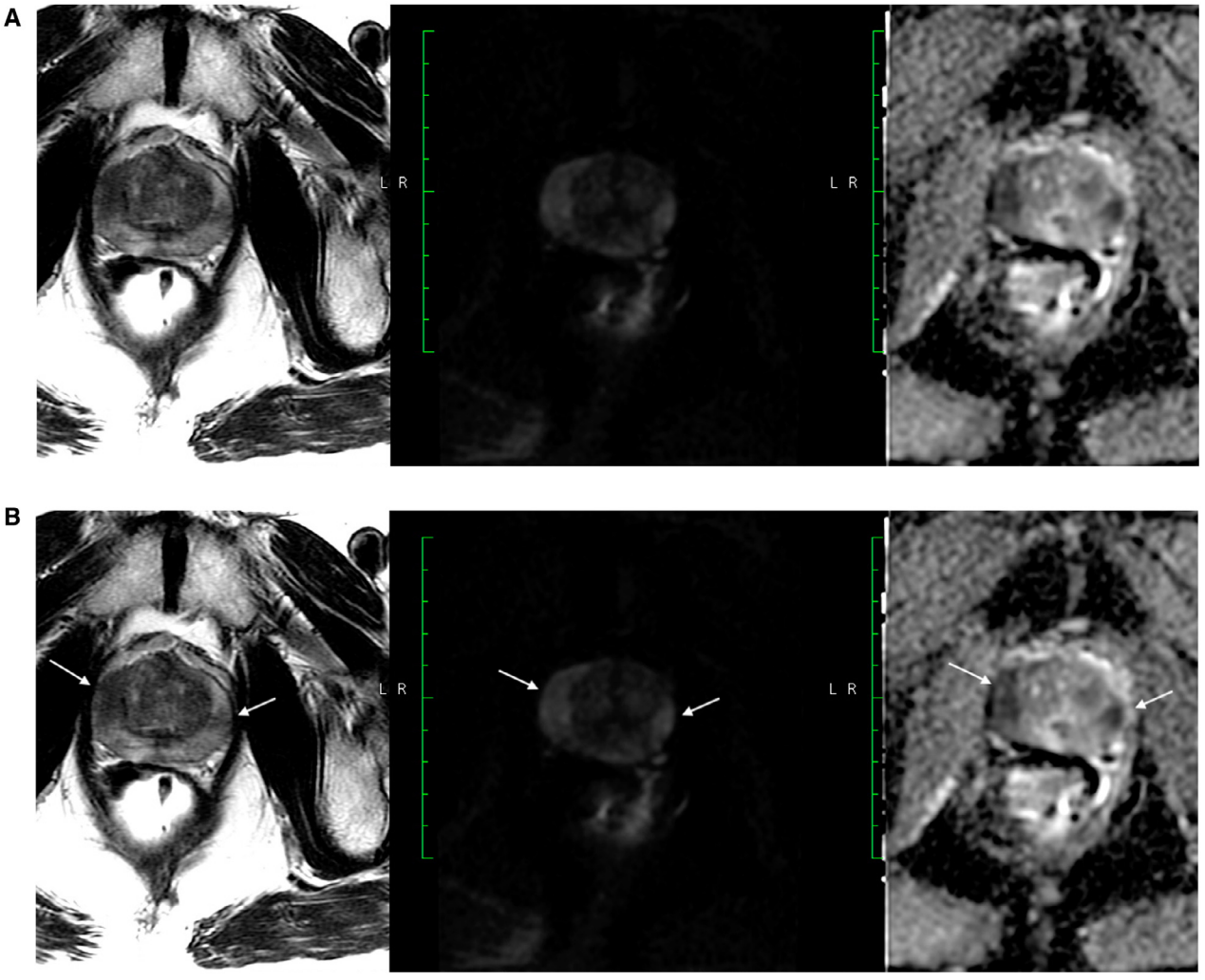

Figure 1. Example of one of the teaching cases in the ibook. This patient was a 71-year-old male with PSA of 13.6 with normal DRE and a history of ASAP on a previous transrectal prostate biopsy. His prostate MR images are shown below in the T2, DWI, and ADC sequences. This case highlights 2 lesions that both are homogenously hypointense in the T2 sequence, hyperintense on DWI, and hypointense on ADC. The lesions are also fairly circumscribe which classifies them at least as a PIRADS 4 lesion. However, based on the size criteria (≥1.5 cm), the right peripheral zone lesion qualifies as a PIRADS 5 lesion as it measures 2.3 cm in length. Targeted fusion biopsy of these 2 lesions yielded Gleason 3 + 4 in the right peripheral zone and Gleason 3 + 3 in the left lesion. DRE, digital rectal examination. (Color version available online.)

prostate biopsy and/or prostatectomy with whole-mount pathology processing. The images, clinical data, and information in the database were all prospectively collected with patient consent and under an institutional review board-approved protocol. All of the information included in the ibook has been deidentified and complies with Health Insurance Portability and Accountability Act (HIPAA) regulations.

Description of the Test

To assess the effects of the ibook intervention, we created a test comprised of didactic questions as well as 13 interactive clinical cases. The didactic questions focused on PIRADS scoring guidelines and cancer characteristics on MRI sequences. The 13 cases each included a brief clinical description as well as interactive MRI images presented on Box DICOM viewer (Fig. 2). The Box DICOM interface mimics web-based PACS viewers that are widely used in hospitals and clinics.

For each case question, residents are asked to identify the relevant MRI sequences, window them, and scroll through the images in order to identify suspicious lesions. Residents were then asked to assign a PIRADS score, state how many lesions were present (0-3+) and identify the location of the index lesion, if present. All cases were drawn from our targeted biopsy and prostatectomy database and were chosen by urologists. However, all questions were reviewed by radiologists specializing in prostate MRIs. The answers for each case question were based on the final biopsy histopathology or annotated whole-mount histopathology results when available.

Participants

Study participants were urology residents who were not involved in the creation of this ibook and test. All 14 residents consented to the study and completed the pretest. Eleven residents attended the formal ibook review session and completed the post-test assessment. None of the residents had any previous formal radiology or mpMRI training, though all residents have rotated through a prostate oncology clinic providing some exposure to prostate mpMRIs. The teaching and testing took place between March and April 2018.

Testing and Analysis

All data collection and testing was done according to an institutional review board-approved protocol. Prior to gaining access to the ibook, the residents completed a 43 question pretest and assigned themselves a confidence score from 1 to 10 with 10 indicating strong confidence in their ability to interpret prostate mpMRIs. Residents were not given the correct answers following the pretest and were blinded to their score.

After completing the test, all residents were given unlimited access to the online ibook for 1 month. At the end of the month,

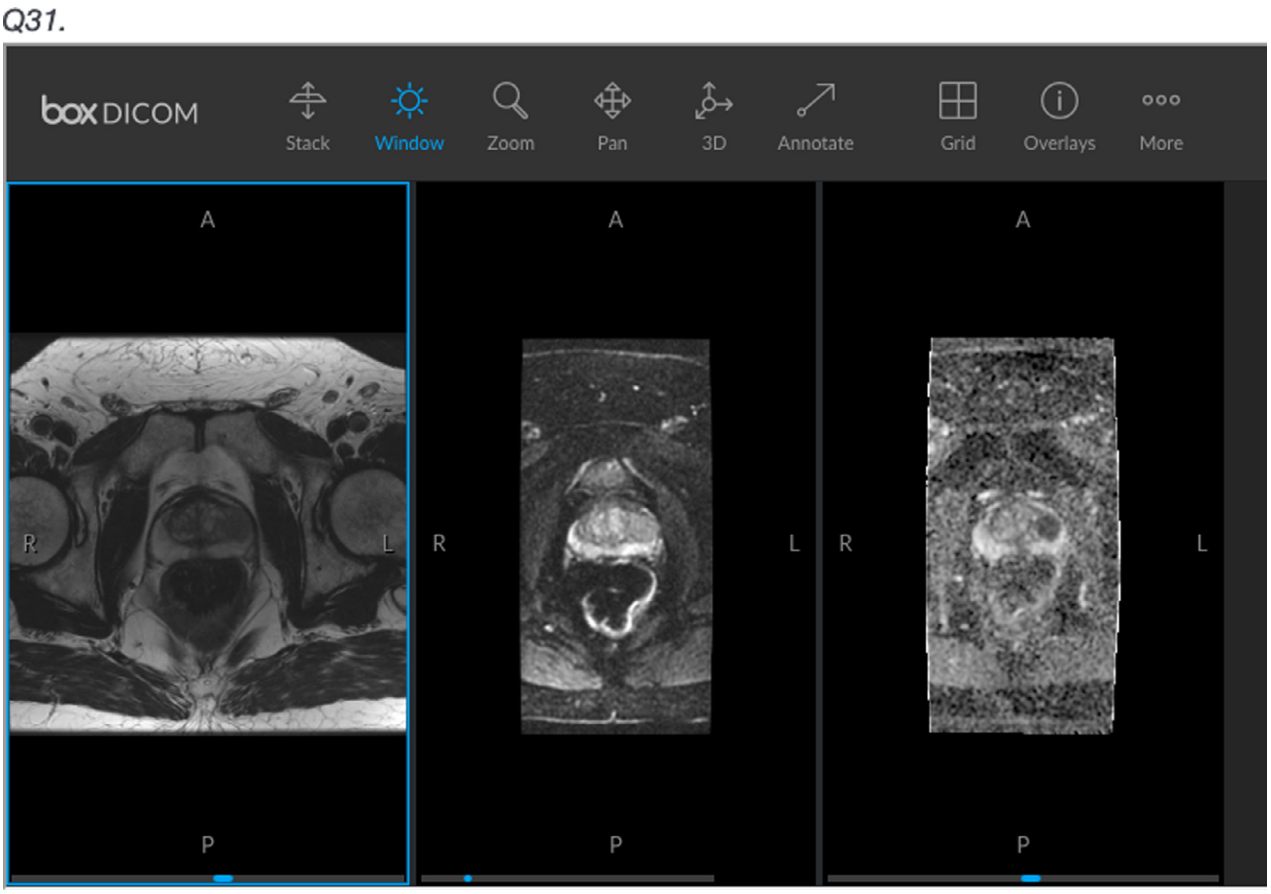

Figure 2. Example of one of the interactive case questions presented in the test. Each case question included information on the patient's age, PSA, DRE, and any previous biopsy results. The interactive DICOM viewer then allowed the test-takers to zoom, window, and coregister the images as they see fit in order to identify the presence and locations of any lesions. DRE, digital rectal examination. (Color version available online.)

the residents were then taken through a formal review of the ibook during a teaching session that lasted approximately 1 hour. The residents then took the post-test, which was a scrambled version of the pretest. Afterwards, they again provided an overall diagnostic confidence score.

The scores from each resident's pre- and post-test were compared using Wilcoxon signed-rank test to evaluate for significant differences. Each resident's pre- and postconfidence scores were also compared using Wilcoxon signed-rank test. Multivariable logistic regression using STATA 14 (StataCorp, College Station, TX) was conducted to evaluate if Post-graduate year (PGY) level was associated with improvement in their test score.

RESULTS

Fourteen urology residents completed the initial pretest and 11 of 14 attended the ibook review session and completed the post-test. Of the 11 residents who completed the study, there were 3 PGY 1s, 3 PGY 2s, 2 PGY 3s, and 3 PGY 4s. The 3 chief residents (PGY 5) were unable to attend the formal review session due to operative obligations. As such, they were not included in the analysis.

The average time needed for test completion was 30 minutes. The mean pretest score was 37% (median 40%, range of 14%-58%). The mean post-test score was 57% (median 58%, range of 35%-79%). The improvement in test scores was significant (P= .0039). All but 1 resident improved their test score. This resident's 58% score was the same pre- and post-test (Fig. 3).

The residents also gave themselves a confidence score before and after the teaching intervention. The median pretest confidence score was 1 (range of 1-2), indicating little to no confidence in the ability to interpret prostate mpMRIs. The average post-test confidence score rose to 4 (range of 3-6), indicating a moderate amount of confidence in the ability to interpret prostate mpMRIs. The confidence scores also significantly improved (P = .001; Fig. 4). PGY level had no significant effect on test score or confidence scores on multivariable analysis.

DISCUSSION

The field of urology is an ever-evolving practice. From laparoscopic and robotic surgery to image-guided procedures,

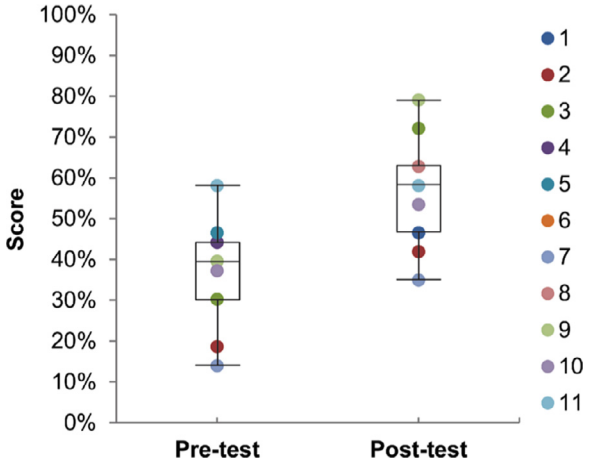

Figure 3. Changes in pre- and post-test scores for the 11 participating residents. The median pretest score was 40% and median post-test score was 58%. (Color version available online.)

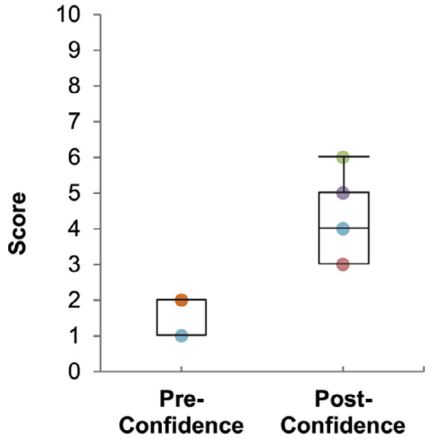

Figure 4. Differences in pre- and postconfidence scores for the 11 participating residents. The median pretest confidence score was 1 and median post-test confidence score was 4. (Color version available online.)

urologists have long demonstrated the ability to learn and adopt new skills. Independent interpretation of radiology images is an important skill for all urologists who use fluoroscopy for endourologic procedures and computed tomography scans for oncologic surgery. As the role of mpMRI in prostate cancer diagnosis and management continues to grow, and large variability persists among radiologists,[9,10] it is increasingly necessary for treating urologists to be proficient in interpreting prostate mpMRIs themselves. Urologists often cannot control for the skill and experience of the radiologist(s) reading the MRIs, but we can rely on our own abilities. In response to this need, we created an interactive, online ibook that provides a concise and clinically directed overview of prostate mpMRIs. We then tested the effects of this ibook among urology residents. We found significant improvement in mpMRI interpretation, diagnostic accuracy, and subjective confidence following the teaching intervention.

The use of online teaching in medical education has grown in recent decades, especially as surgical training becomes more compact. Interactive, web-based tools have been shown to provide both instruction and practice while offering ease of access and flexibility.[15] Several studies have shown how online education materials can improve diagnostic accuracy[16,17] and information retention.[18] Indeed, many surgical associations including the American Board of Surgery and AUA offer a growing number of online courses for CME credit. Online modules have also been used for other topics and incorporated into resident teaching in surgical subspecialties[19] including urology.[20]

We created the first online book aimed at teaching mpMRI interpretation to practicing urologists. Our study, which assessed its effectiveness, has several notable strengths. We demonstrated significant improvement in test scores among the residents after 1 month of access to the book and a 1-hour formal review session. The improvement not only reflects increased diagnostic

knowledge and accuracy, but it also captures the residents' ability to engage and manipulate the mpMR images in Box DICOM, a program that is very similar to those used in clinical settings. We also showed that the intervention increased participants' self-rated confidence scores, which is very important as confidence can have a significant impact on performance, skill attainment, and long-term engagement in a new topic. Additionally, these improvements were seen across PGY levels and for participants with varying baseline mpMRI understanding and pretest scores. Even residents with higher pretest scores improved after the educational intervention. Finally, it should be noted that these improvements were demonstrated in residents, many of who were not on a rotation where they regularly encountered prostate mpMRIs. As such, it is possible that our results underestimate the impact the teaching ibook could have on a clinician who routinely encounters prostate mpMRIs as part of their clinical practice.

Our pilot study has 3 notable limitations. As a single-site study, we had a small number of participants. We also limited the intervention and testing to residents for the pilot study, so we are unable to access the benefits if the ibook was offered to medical students or faculty members. Additionally, our results only capture short-term retention as the participants had access to the intervention for just 1 month prior to taking the post-test. These limitations notwithstanding, our results provide a strong justification for expanding the study. We are working on implementing the intervention and testing at other residencies and establishing a formal prostate MRI teaching curriculum that can be used nationwide. The ibook has also been published and is available for purchase on Apple iBook for any clinician who is interested in increasing their understanding and proficiency.

CONCLUSION

Prostate mpMRIs are increasingly being used for patient counseling, biopsy decision-making, and play a pivotal role in guiding target biopsies and focal therapies. Urologists who can evaluate prostate mpMRIs can be more confident in the planning and execution of these procedures, and offset variability in radiology interpretation. Our ibook provides an accessible complement and alternative to in-person training courses, and has been shown to improve diagnostic accuracy, understanding of the PIRADS scoring system, and confidence in interpreting prostate mpMRIs among urology residents. We hope to expand the use of this teaching tool to other residencies as well as offer it as a self-teaching resource for practicing urologists.

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EDITORIAL COMMENT

The accuracy of magnetic resonance imaging (MRI) for prostate cancer detection has been demonstrated in multiple studies, but the interpretation of prostate MRI can be quite challenging. In particular, changes caused by aging (ie, hyperplasia) or by pathologic conditions such as inflammation or cancer can lead to a nearly singular appearance on MRI for each prostate. Additionally, the lack of robust standardization across MRI scanners hampers the adoption of quantitative parameters for imaging analysis. Furthermore, the qualitative criteria used for interpretation of these images are subjective, leading to interobserver variability even among experienced readers.

In this pilot study, Wang et al compared diagnostic accuracy and confidence in interpretation of MRI for prostate cancer detection among a cohort of urology residents before and after they had access to an online case-based teaching tool in the form of an ibook. The residents had unlimited access to the ibook for a month and also attended a teaching session where they had the opportunity to review the ibook. The educational intervention led to an increase in both diagnostic accuracy and confidence.

The results of this pilot study are encouraging, and the authors should be lauded for this initiative. With the increasing use of MRI for prostate cancer detection and treatment planning, it is of paramount importance that urologists become well-versed with this imaging technique. To this end, urology residents and attending physicians can take advantage of a variety of online educational resources designed to teach physicians how to interpret prostate MRI; many of these resources are available for free. One such resource is the website learnprostatemri.com, which was created by Dr Andrew Rosenkrantz with support from the Radiological Society of North America's Research & Educational Foundation. The website contains more than 50 interactive cases with feedback, as well as links to an introductory lecture and to a curated list of review articles.

In summary, interpretation of prostate MRI can be challenging, but online resources such as the one described in this pilot study can help those interested in improving their knowledge base regarding this increasingly important topic.

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