Evidence-Based Reporting: A Method to Optimize Prostate MRI Communications With Referring Physicians

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OBJECTIVE. The purpose of this study was to develop an evidence-based method to optimize prostate MRI reports that would improve communication between urologists and radiologists.

MATERIALS AND METHODS. This quality improvement initiative was approved by the institutional Quality Improvement Review Committee. A structured report was developed containing essential components defined by local practice norms and Prostate Imaging Reporting and Data System (PI-RADS) lexicon version 2. Two hundred preintervention and 100 postintervention reports were retrospectively reviewed for essential components. Additionally, a sample of 40 reports generated before the intervention and 40 reports generated after the intervention that made use of the structured report were evaluated by a urologist and were scored on a 5-point scale for consistency, completeness, conciseness, clarity, likelihood to contact radiologist, and clinical impact. Variables were compared with ANOVA, chi-square, or Fisher exact test.

RESULTS. Essential components of the report were utilization of the PI-RADSv2 lexicon, findings listed by lesion, reporting of pertinent positive and negative findings (extraprostatic extension, seminal vesicle, and neurovascular bundle invasion), and low word count. In postintervention reports, all essential measures were statistically improved except for mean report word count. The urologist indicated statistically improved consistency (before intervention, 2.7; after intervention, 3.5; $\chi^2 < 0.001$), completeness (before intervention, 2.8; after intervention, 3.3; $\chi^2 < 0.001$), clarity (before intervention, 2.9; after intervention, 3.3; $\chi^2 < 0.05$), and clinical impact (before intervention, 2.8; after intervention, 3.8; $\chi^2 < 0.001$) of the report with reduced perceived need to contact (before intervention, 3.2; after intervention, 2.1; $\chi^2 < 0.001$) the interpreting radiologist for explanation.

CONCLUSION. The structured prostate MRI report resulted in improved communication with referring urologists as indicated by the increased perceived clinical impact of the report.

Keywords: evidence-based reporting, prostate MRI, structured reporting

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Communication errors in medicine have been linked to incorrect diagnoses, delayed treatments, and adverse patient outcomes including increased mortality rates [1]. The primary mechanism by which an interpreting radiologist communicates with patients, other radiologists, referring providers, and downstream providers is the radiology report. To improve communication in cancer screening examinations, standardized lexicons and risk stratification scores have been developed. The first, BI-RADS, was developed by the American College of Radiology (ACR) and was adopted by radiologists in the late 1980s [2].

Because of the success of BI-RADS, radiologists interpreting other cancer screening examinations began to develop standard lexicons and risk stratification scores in conjunction with clinicians to reduce ambiguity in radiology reports. One such examination is prostate MRI, for which the Prostate Imaging Reporting and Data System (PI-RADS) was initially developed by the European Society of Uroradiology (ESUR) in 2011 [3]. The second version was developed through collaboration of ESUR, the ACR, and the AdMetech Foundation in 2015 [4]. Although PI-RADS provides a standardized report lexicon and assessment category to assign risk of clinically significant prostate carcinoma, interobserver agreement has been shown to be moderate at best, and no recommendation has yet been developed for the findings that must be included in the final report to appropriately guide management [5]. These deficiencies may lead to reduced clarity of findings, increase the likelihood of urologists to contact the interpreting radiologist for clarification, and degrade the clinical impact of the radiology report.

Quality improvement frameworks have been developed to conceptualize the continuing process of quality improvement. One of these, the knowledge-to-action (KTA) framework, has been used by radiologists to successfully improve the clinical impact of reports [6, 7]. The KTA framework is a conceptual method for taking research theory to clinical practice and is similar to other iterative quality improvement frameworks such as Plan-Do-Study-Act and the Define, Measure, Analyze, Improve, Control approach used in conjunction with Six Sigma.

The aim of this investigation was to improve and quantify improvement in communication between urologists and radiologists by developing an evidence-based method to optimize prostate MRI reports using local practice norms, the KTA framework, and PI-RADSv2 guidelines.

Materials and Methods

This quality improvement initiative was approved by the quality improvement review committee at a single large academic institution. At this institution, prostate MRI had been regularly performed since 2008 with a substantial increase in volume in August 2015 after acquisition of an ultrasound/MRI fusion biopsy system, similar to other institutional experiences [8]. The institution adopted the PI-RADSv2 lexicon and assessment category after its online release in December 2014 and implemented it after internal review and discussion in early 2015. At the time of the initiative, the volume of prostate MRI cases was approximately 30 cases per month. The most common indications for prostate MRI were abnormal screening, cancer surveillance, and staging.

The initiative was designed in accordance with the KTA method [6]. The KTA method provided the framework to synthesize information gained from both literature and stakeholders and apply that information to a quality improvement initiative. Seven radiologists who were fellowship-trained in abdominal imaging with 3–10 years of postfellowship experience and two referring urologists at a single center were the stakeholders for this study.

Need for Quality Improvement

A survey was distributed to two referring urologists in March 2016 to assess whether there was a need for improving the quality of prostate MRI reports. Urologists were surveyed regarding report format and content, including preferred descriptions of the prostate gland, prostatic lesions, seminal vesicles, neurovascular bundle, and metastasis. The survey also elicited the specific report components considered to be most essential for clinical management and sought to determine appropriate language for radiologically uncertain findings.

The Structured Report (Intervention)

A structured report (SR) was developed and implanted into the dictation software. The SR was based on one described by Silveira et al. [9] and modified using the KTA method to include the PI-RADSv2 lexicon and assessment category in addition to local practice norms as defined by referring urologists and interpreting radiologists [4]. The initial version of the SR was implemented in June 2016, and feedback was subsequently obtained from the original stakeholder groups. Radiologists were educated and trained in the proper use of the structured report. Emphasis was placed on referring urologists' desire for improved report quality. Iterative improvement in the SR was then performed on the basis of radiologist feedback from surveyed responses.

Objective Quality Analysis of Reports

Two hundred random preintervention and 100 sequential postintervention reports were selected for analysis and reviewed by a single investigator. Only reports mentioning at least one prostatic lesion, nodule, or mass were included. One hundred of the preintervention reports were randomly selected from a period extending from August 2012 and August 2015 using a Text Information Extraction System, a clinical document search engine available at our institution. The other 100 preintervention reports were selected from a period extending from August 2015 to June 2016. Postintervention reports were obtained sequentially from July 2016 to October 2016. Again, only reports mentioning at least one prostatic lesion, nodule, or mass were included. The reports were reviewed for overall word count, use of a technical qualifier as a limitation of the examination, report format (narrative vs structured), structure of the findings section (findings listed by lesion), prostate size reported as volume (present or absent), prostate-specific antigen density (reported or not reported), and PI-RADSv2 assessment category reported (present vs absent). In addition, reports were reviewed for reporting of pertinent positive or negative findings including extraprostatic extension, seminal vesicle invasion, neurovascular bundle invasion, lesion size reported as volume, and lymph node and bony metastasis. In the postintervention period, compliance with use of the SR was also recorded. Results were stratified and compared among three groups of reports: those generated before the intervention, those generated after the intervention that used the SR, and those generated after the intervention that did not use the SR.

Subjective Quality Analysis of Reports

Forty preintervention and 40 postintervention reports were randomly selected from the pool of reports in the objective analysis and sent to a urologist for review by survey to determine report quality. This urologist was one of the two originally surveyed regarding report content. A survey was developed utilizing a 5-point scale that assessed six categories to measure clinical value and effective communication in radiology reports: consistency of the report format between radiologists, completeness of the report to satisfy the clinical question, clarity of the wording and structure of the report, conciseness of the language in the report, likelihood of need to contact the interpreting radiologist or a trusted radiology colleague to clarify report findings, and the overall perceived clinical impact of the report. They were based on categories originally proposed by Armas [10] in 1998 but were modified to ensure the approach would center on concerns of patients and referring providers. The 5-point scale in the survey to the urologist was 1, completely disagree; 2, moderately disagree; 3, neutral; 4, moderately agree; and 5, completely agree.

A survey was administered to all radiologists who interpret prostate MRI studies in our department 1 month after release of the first iteration of the SR. The survey questions focused on whether the SR was comprehensive and easy to use in clinical practice.

Statistical Analysis

The presence of essential report components among the three groups of reports were compared using a chi-square test or Fisher exact test for categoric variables and ANOVA for continuous variables. The subjective report quality scores of the pre- and postintervention reports were compared using a chi-square test.

Statistical analysis was performed using SPSS Statistics for Mac software (2013 release, IBM). Statistical significance was set at p or $\chi^2 < 0.05$.

Results

Need for Quality Improvement

On the basis of survey findings, urologists deemed the following report components to be essential: risk of cancer reported using PI-RADSv2 assessment category, findings section organized by lesion, descriptions of pertinent positive and negative findings for staging (e.g., extraprostatic extension and invasion of seminal vesicles and neurovascular bundles), and low word count. Radiologist communication of degree of certainty of findings was also an important component of the report. Lesion signal intensity, imaging parameters such as sequence and slice thickness, and the reporting of any incidental cysts or calcifications were determined to be less important. Appendix S1 presents detailed survey results (Appendix S1 can be viewed in the *AJR* electronic supplement to this article, available at www.ajronline.org).

The Structured Report (Intervention)

Appendix S2, which can be viewed in the *AJR* electronic supplement to this article, available at www.ajronline.org, contains a sample of the SR used in this study.

Objective Quality Analysis of Reports

Of the 100 prostate MRI reports generated after the intervention, 36 (36%) used the SR. These reports showed a significant improvement in inclusion of urologists' essential components compared with the two other groups of reports (Table 1). All 36 contained PI-RADSv2 assessment category and descriptions of any extraprostatic extension or local invasion. Additionally, 35 of the 36 (97.2%) reports had a findings section organized by lesion. Mean word count did not vary (321 before intervention, 317.5 in reports using the SR after intervention, 339.7 in reports not using the SR after intervention, $p = 0.55$).

The 36 reports using the SR also had significant improvement in the reporting of data necessary for cancer staging (Table 1). Lesion volume was included in 24 of 36 (66.7%) postintervention reports using the SR, 1 of 64 (1.6%) postintervention reports not using the SR, and 1 of 200 (0.5%) preintervention reports ($p < 0.001$). All postintervention reports using the SR described the extent of bone metastasis, compared with 58 of 64 (90.6%) postintervention reports not using the SR and 150 of 200 (75%) preintervention reports ($p < 0.001$).

Subjective Quality Analysis of Reports

Urologist assessment improved in all cases in five of the six studied categories; the exception was conciseness of language contained in the report. The urologist-perceived clinical impact of the radiology report was increased (mean score of reports before intervention, 2.8 of 5; mean score of reports using the SR after intervention, 3.8 of 5; $\chi^2 < 0.001$). Figure 1 presents detailed findings.

A sample of the postimplementation radiologist survey can be found in Appendix S3, which can be viewed in the *AJR* electronic supplement to this article, available at www.ajronline.org. The radiologists surveyed regarding satisfaction were involved in the development of the SR. Seven radiologists responded to the postintervention survey, none of whom identified significant barriers to use of the SR. Five reported having tried the SR and using it more than once. Five found the SR to be comprehensive. Three did not perceive a change in reporting speed; two reported an increase in speed. Six were receptive to using an evidence-based reporting tool.

TABLE 1: Results of Review of the Prostate MRI Structured Report

Report Component	Before Intervention	After Intervention		χ^2
		Noncompliant[a]	Compliant[b]	
Report				
Sample size (*n*)	200	64	36	
Mean no. of words ± SD[c,d]	321.0 ± 109.7	317.5 ± 91.7	339.7 ± 90.9	
Technical limitation qualifier	23 (11.5)	3 (4.7)	4 (11.1)	0.27
Report in narrative format	169 (84.5)	23 (35.9)	0 (0)	< 0.001
Findings listed by lesion[c]	113 (56.5)	40 (62.5)	35 (97.2)	< 0.001
Lesion characteristic reported				
PI-RADSv2 assessment category[c]	108 (54.0)	48 (75.0)	36 (100)	< 0.001
Extraprostatic extension (positive or negative finding)[c]	151 (75.5)	48 (75.0)	36 (100)	0.003
SV invasion (positive or negative finding)[c]	164 (82.0)	56 (87.5)	36 (100)	0.017
NVB invasion (positive or negative finding)[c]	99 (49.5)	51 (79.7)	36 (100)	< 0.001
Lesion size reported as volume	1 (0.5)	1 (1.6)	24 (66.7)	< 0.001
Prostate characteristic reported				
Size (as volume)	138 (69.0)	63 (98.4)	36 (100)	< 0.001
PSA density	99 (49.5)	53 (82.8)	34 (94.4)	< 0.001
Metastasis reported				
Lymph node (positive or negative finding)	187 (93.5)	64 (100)	36 (100)	0.032
Bone (positive or negative finding)	150 (75.0)	58 (90.6)	36 (100)	< 0.001

Note—Except for sample size, mean number of words, and χ^2 value, data are numbers of reports with percentages in parentheses. For statistical significance, ANOVA was used to compare groups with regard to number of words, whereas the Fisher exact test was used for technical limitation qualifier and lymph node metastasis. The remaining categories were compared using a chi-square test. PI-RADSv2 = Prostate Imaging Reporting and Data System version 2, SV = seminal vesicle, NVB = neurovascular bundle.

[a]Reports that did not use the structured template.

[b]Reports that used the structured template.

[c]Essential report component as defined by local practice norms.

[d]$p = 0.55$.

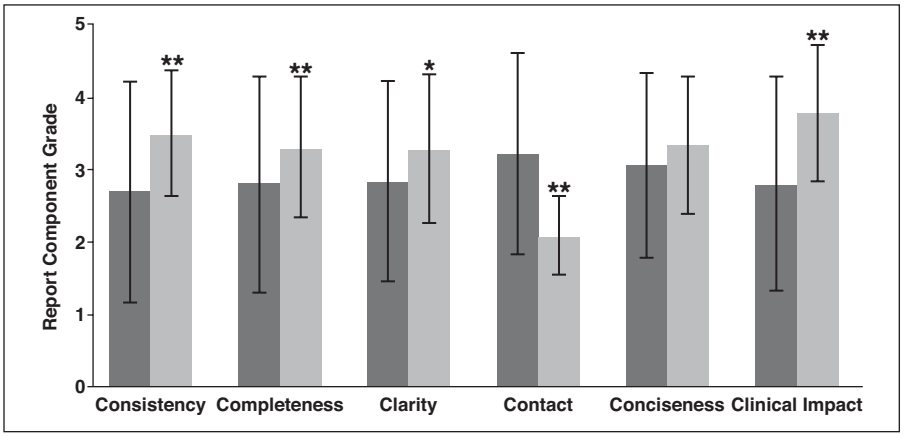

Fig. 1—Mean report quality scores in reports before intervention ($n = 200$, *dark gray bars*) and those using structured report after intervention ($n = 36$, *light gray bars*). Double asterisk denotes $\chi^2 < 0.001$; single asterisk, $\chi^2 < 0.05$.

Discussion

The results of this quality improvement initiative suggest that the development of standardized prostate MRI reports results in improved clinical impact of the primary radiologist contribution to patient care: the radiology report as assessed by referring urologists (mean score before intervention, 2.8 of 5; mean score for reports using the SR after intervention, 3.8 of 5; $\chi^2 < 0.001$). The collaboration with urologists to include pertinent positive and negative information and structure of the report resulted in lower perceived need to contact the interpreting radiologist (score before intervention, 3.2 of 5; score for reports using the SR after intervention, 2.1 of 5; $\chi^2 < 0.001$) to clarify findings. This improvement was achieved with no significant barriers identified by radiologists in using the report. These results are important because they suggest that evidence-based collaborative reporting contributes to improved communication between radiologists and referring providers, solidifying the clinical practice and quantitative value of radiology. This outcome was accomplished by adhering to the PI-RADSv2 lexicon and developing a structured report in conjunction with both referring urologists and interpreting radiologists. The report was built using the KTA model, a method that has been used to optimize rectal MRI reporting [7]. The process included soliciting and then adhering to local practice norms and national guidelines with iterative improvement of the report based on feedback provided by interpreting radiologists and referring urologists.

As highlighted in a recent bulletin of the American College of Radiology, "Radiologists are indisputably the best-trained and most experienced physicians at interpreting imaging studies.and part of the value of the interpretation is consultation with referring physicians about the findings" [11]. The effective communication of findings through conventional and structured reporting continues to be debated. The development and implementation of structured reports in radiology has sought to balance theoretic systemic consistency and physician autonomy [12, 13]. The Radiological Society of North America (RSNA) has made various modality and organ-specific report templates available to standardize reporting and encourage best practices [14]. As the RSNA acknowledges, these templates are a useful starting point to develop site-specific, evidence-based reporting templates, but referring physician and radiologist preference and patient care ultimately should result in modification to meet the needs of local practice patterns. Kahn et al. [15] identified several quality metrics that should be derived from the radiology report including assessed quality of examination, technical limitations, completeness of report, discrepancy from preliminary interpretation, errors in interpretation, and complications. Wibmer et al. [16] found that the implementation of a standardized lexicon improved diagnostic certainty in prostate MRI reports, possibly avoiding miscommunication and allowing radiologist assessments to aid in patient management. Rosenkrantz et al. [17] used a quality improvement initiative to consistently report level of suspicion for tumor in prostate MRI using a template reporting macro, radiologist training session, ordering physician input, ongoing weekly review, and radiologist feedback with modification to their method as national reporting guidelines changed.

In this investigation, six measures of quality reporting were developed and implemented to judge the clinical impact and quality of prostate MRI reports. The six measures were based on those suggested by Armas [10] but modified using RSNA best practices as well as information published by Kahn et al. [15], Wibmer et al. [16], and Rosenkrantz et al. [17]. The modification was done to ensure the approach was updated but still focused on patient and referring provider priorities. Only elements that added to report clarity and increased clinical utility were included. Because prostate MRI is a low acuity examination, preliminary interpretations were not submitted, so documentation and communication of findings that deviated in final reports were not necessary.

The main strength of this quality improvement initiative is the analysis of both objective and subjective measures of report quality to determine value in evidence-based radiology reports. However, several limitations need to be acknowledged. First, the pre- and postintervention groups contained small numbers of reports. This drawback was compounded by a low level of compliance with the structured report, which likely resulted from an environment where structured reporting was uncommon and a lack of automatic population of the structured report template into dictation software, which has been shown to improve compliance [18]. Additionally, the urologists who helped design the contents of the structured reports were also responsible for grading postintervention results, which may have led to sample biases, especially in the postintervention period when reports were selected sequentially. To maintain anonymity in the blinded review of report contents, the name of the interpreting radiologist for each report was not recorded. Thus, it is possible that only a few radiologists used the structured report, which may have led to a sample bias that affected the results. In addition, a single reviewer determined the objective properties of the report. Finally, neither the six categories Armas proposed [10] nor his method to improve communication in radiology reports has been verified as an effective tool to judge clinical utility of radiology reports.

In summary, the structured prostate MRI report resulted in improved communication with referring urologists as indicated by the increased perceived clinical impact of the report.

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