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Evaluation of a Program for Improving Advanced Imaging Interpretation

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Objectives: Self-referred imaging has grown rapidly, raising concerns about increased costs and compromised quality of care. A quality improvement program using imaging interpretation criteria was designed by a national payer to ensure that noninvasive diagnostic images are interpreted by appropriately trained physicians. The objective of this program evaluation was to compare self-referral rates before and after institution of the imaging interpretation criteria program.

Methods: The imaging interpretation criteria program allocated privileges to bill for advanced imaging interpretation according to physician specialty. Nonradiologist physicians could obtain exemptions by appeal. Some physicians were not restricted in their billing because of successful appeals of the restrictions or the timing of their contract renewals. Self-referral rates were compared between the period 12 months before and 25 months after the program was initiated using *t* tests. The preprogram and postprogram self-referral rate for computed tomography and magnetic resonance imaging in aggregate was calculated both for the physicians that came into contact with the program and nationally, and then was stratified based on physician appeal status and reimbursement restrictions.

Results: The program was associated with significantly less frequent self-referrals by physicians whose appeals were denied (17.4%–8.2%; $P = 0.0011$) and by physicians notified of the program but not subject to it (24.8%–18.5%; $P = 0.026$). Self-referrals in the program states declined from 19.9% to 13.7% ($P < 0.01$).

Conclusions: A significant reduction in image interpretations billed by physicians working outside of the scope of their training occurred after the implementation of the imaging interpretation criteria program.

Key Words: imaging, self-referral, privileges, nonradiologist physicians, credentialing

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Diagnostic imaging self-referral occurs when a physician orders an exam to be performed on equipment that he or she owns. Self-referral for advanced diagnostic imaging by non-radiologist physicians has been justified on the grounds that it enhances patient convenience, improves continuity of care, and reduces the time required to diagnose and treat some conditions.¹ However, some physicians have been concerned that the conflict of interest inherent in self-referral leads to potential clinical and financial harms resulting from higher volumes of imaging and a greater proportion of images being interpreted by inadequately trained physicians.^{2–4} Articles debating the merits of self-referral have been published for more than 40 years,^{5–8} and there is some evidence that there has been a recent increase in self-referral,⁹ amplifying the importance of examining the issue.

Although some imaging interpretation by nonradiologist physicians may be appropriate, the potentially unnecessary utilization resulting from self-referral is a particular concern with high-tech imaging modalities, such as computed tomography (CT) and magnetic resonance imaging (MRI). As computed tomographic scans expose patients to amounts of radiation that are orders of magnitude larger than plain film radiographs, their excessive use increases patients' risk of cancer.^{10,11} Furthermore, the contrast agents used to conduct CTs and MRIs have the potential to cause harm; patients with inadequate renal function are at an elevated risk of developing contrast-induced nephropathy and nephrogenic systemic fibrosis.¹² In comparison, low-tech imaging modalities, such as ultrasound and plain film radiography, pose fewer potential health hazards to patients. Neither the danger of contrast exposure nor radiation exposure exists when a patient receives an ultrasound. Although plain film radiographs involve radiation, the quantity is substantially lower than that used in a CT.¹³

In addition to having the potential to expose patients to contrast and radiation, unnecessary high-tech imaging utilization resulting from self-referral has a financial cost. Because some non-radiologist physicians directly profit from their decisions to pursue self-referred imaging studies, self-referrals can create an inherent conflict of interest. Conflicts of interest can bias physicians toward both overutilization and underutilization of care.⁴ Multiple studies and literature reviews have shown that self-referral is associated with higher diagnostic imaging utilization and higher costs.^{2,6,7,14–16} The Government Accountability Office estimated that in 2010, additional CT and MRI studies resulting from self-referral caused in an additional \$109 million in Medicare spending.¹⁶

Even when a study itself may be justified, interpretation of sophisticated studies by physicians with little formal training may compromise patient safety. Radiologists have been found to provide higher quality medical imaging reports than nonradiologist physicians and to order studies with less frequency than nonradiologist physicians.^{6,7,17} Some have postulated that the radiologist's role goes beyond image interpretation to also involve overseeing patient safety and quality of care.^{18,19} The manner in which radiologists choose to frame findings impacts downstream care, as radiologists can play a conscious role in encouraging or

discouraging further testing by varying the degree of certainty that they ascribe to their findings.²⁰

In response to the quality issues posed by rising self-referral, a national health insurer and a quality improvement-focused radiology benefits management company codeveloped an “imaging interpretation criteria program” (described in the “Methods” section) to ensure that noninvasive diagnostic images are interpreted by appropriately trained physicians. The program was designed to increase the likelihood of desired health outcomes by limiting improper use of imaging.

METHODS

Study Design

This program evaluation aimed to compare self-referral rates for CT and MRI before and after the institution of the imaging interpretation criteria program. To provide context for the findings, an analysis of the contemporaneous changes in self-referral nationally was also conducted. Self-referral rates were determined during the preprogram period (February 1, 2012, to January 31, 2013) and the postprogram period (February 1, 2013, to February 28, 2015).

Program

HealthHelp, LLC, a company providing radiology benefits management services, and Humana, Inc., a company providing medical and pharmacy benefit plans, have worked together since 2005 on improving the quality of care received by plan members.²¹ The companies’ previous radiology quality improvement efforts largely focused on ensuring that physicians were appropriately ordering imaging and that facilities had the proper equipment to conduct imaging. As proper diagnoses require a combination of the right test, conducted on the right equipment, interpreted by the right physician, the organizations resolved to develop a program for increasing the quality of imaging interpretation by carefully allocating billing privileges.

To enhance the quality of imaging interpretation, the organizations jointly developed an “imaging interpretation criteria program,” which allocates privileges to bill for interpretation of advanced imaging according to physician specialty. Nonradiologist physician specialties were organized into groups allowed to bill for all image interpretation, some image interpretation, or no image interpretation, depending on their training. Nonradiologist physicians could obtain an exemption and be allowed to provide the technical component of imaging studies if they had a valid contract with a radiologist for the interpretations or had an approved appeal justifying their competency in interpretation. Appeals would be granted if a physician documented hospital privileges for diagnostic imaging interpretation or formal training in image interpretation.

In building the program, specialty reimbursement determinations were made through consultation with an advisory board composed of 9 physicians with expertise in multiple specialties. More than 60 scientific studies and medical residency program requirement documents were cited in the specifications for the program. The program’s criteria consist of a comprehensive set of policy recommendations for CT, MRI, PET, nuclear medical studies, ultrasound, fluoroscopy, and bone densitometry. Bone densitometry using CT, nuclear radiography, and ultrasound are on the permissible code list for primary care (family medicine, geriatric medicine, internal medicine, etc.). Plain film radiography services could be billed by all types of physicians.

The imaging interpretation criteria program mailed letters about the program to select physicians in 6 states without any willing

provider laws (Arizona, Florida, Michigan, Ohio, Tennessee, and Wisconsin). The states in the program had higher levels of self-referral than the health plan’s national average. Physicians were identified based on their specialties and the Current Procedural Terminology (CPT) codes they had previously billed. Physicians received letters if they belonged to a specialty managed by the program (Table 1) and had billed for any imaging CPTs managed by the program—regardless of whether their specialty was allowed to bill for the CPT.

The letters that the physicians received described the program, stated whether the physician was to be impacted by it, and characterized the CPTs for which reimbursement would not be allowed. The imaging studies included in the allowed list ranged from plain film radiographs to a specialty-specific list containing multiple studies. Physicians whose contracts could not or would not be impacted by the program were sent letters informing them of the reimbursement limitations being placed on other physicians within their specialties. Those who did not meet the criteria of the program were notified that their imaging reimbursement privileges would be fully or partially rescinded. Physicians could appeal the decisions and subsequently had their appeals approved or denied. As a result, the physicians who received the letters can be divided into 4 groups: those whose appeals were denied and payments terminated, those whose appeals were granted and payments continued, those who did not appeal and had payments terminated, and those who did not appeal and had payments continued.

Sample Selection

Claims for fully insured patients with commercial or Medicare Advantage health plan coverage at the time of the imaging request, who received a complete consult with the radiology benefits manager (RBM), were included in the analysis. The unit of analysis in the study was the imaging claim processed by the RBM.

A flow chart showing the sample selection process is depicted in Figure 1. The initial pool of claims consisted of claims from the 6 states in which the program was introduced, pertaining to people who had commercial and Medicare Advantage insurance (860,796 claims) spanning February 1, 2012, to February 28, 2015. Exclusions were made for claims pertaining to physicians in the market who were not intended to be in the imaging interpretation criteria program and physicians whose letters about the imaging interpretation criteria program were not successfully delivered. Additional claims were excluded if they related to Medicare Risk or Administrative Services Only contracts, were not marked as complete by the RBM (likely because they were opened in clerical error), or pertained to procedure codes not managed by the program. These claims were reduced to a pool only containing CT and MRI claims (2786 claims)—2 modalities managed by the RBM. Within the pool, there were 1695 CT claims and 1091 MRI claims. The same criteria (except for program participation) were used to identify CT and MRI claims for physicians in states not participating in the program, which were used in the national comparison group.

Measurement and Analysis

Self-referrals were defined as referrals in which the RBM’s identification number for the referring and image-performing physician was the same. Self-referral rates were calculated by dividing the total number of self-referred claims by the total number of referrals which occurred. In cases where physicians self-referred for a modality that the imaging interpretation criteria had deemed them adequately trained to bill, the resulting imaging units were not counted in the numerator or denominator of the

TABLE 1. Specialties Impacted by the Imaging Interpretation Criteria Program*

Exempt From the Imaging Interpretation Criteria Program	Allowed to Do All Types of Bone Densitometry, Plain Film Radiography, and Certain Other Studies (But Not Other CT or MRI Studies)	Allowed to Do Plain Film Radiography and Certain Other Studies (But Not CT or MRI Studies)	Allowed to Do Plain Film Radiography But No Other Types of Studies
Cardiac electrophysiology	Allergy/immunology	Anesthesiology	Addiction medicine
Cardiac surgery	Family practice	Endocrinology	Critical care
Cardiology	Gastroenterology	General surgery	Dermatology
Diagnostic radiology	General practice	Ophthalmology	Emergency medicine
Gynecological/oncology	Geriatric medicine	Pain management	Hand surgery
Hematology/oncology	Hematology	Urology	Maxillofacial surgery
Hospice and palliative care	Infectious disease	Vascular surgery	Otolaryngology
Interventional cardiology	Internal medicine		Pathology
Interventional radiology	Nephrology		Plastic surgery
Medical oncology	Pulmonary disease		Psychiatry
Neurology	Rheumatology		Rehabilitation
Neurosurgery			Sleep medicine
Nuclear medicine			
Obstetrics/gynecology			
Orthopedic surgery			
Radiation oncology			

*The program defines more than 400 specialty classifications, many of which are quite granular. Table 1 represents a stylized summary.

self-referral rate. Two-sided *t* tests assuming unequal variances were used to examine whether the rate of self-referral significantly changed after the imaging interpretation criteria program was implemented. Self-referral rates were also calculated nationally to contextualize the findings.

Self-referral rates for claims from states participating in the program were explored further. Claims were divided into the 4 groups mentioned previously. The preprogram and postprogram self-referral rates for each of the 4 groups of claims were compared. The comparisons were performed both in aggregate and in a stratified analysis by modality (CT and MRI).

RESULTS

The sample used in the analysis consisted of 1695 CT claims and 1091 MRI claims, for a total of 2786 claims. (See Fig. 1 and the “Sample Selection” section.) The claims came from 165 physicians in the preprogram period and 243 physicians in the postprogram period. These numbers differed as the program involved additional modalities beyond CT and MRI, and some of the physicians did not have a CT or MRI claim in both periods. Because the postprogram period was more than twice as long as the preprogram period, a number of the physicians who had claims in the postprogram period did not have them in the preprogram period. Table 2 depicts the number of claims and physicians impacted by the program, stratified by whether the physicians appealed and by whether the physicians had payments terminated. Internal medicine and family physicians accounted for 72% of physicians during the preprogram period and 77% during the postprogram period. The states outside of the program had a total of 1,116,271 claims meeting the sample selection criteria during the period, with 67,417 physicians represented in the preprogram period and 97,941 in the postprogram period.

When the CT and MRI claims in the program states were pooled, the overall self-referral rate declined from 19.9% to

13.7% between the preprogram and postprogram periods ($P < 0.001$). Overall self-referral nationally (program and nonprogram states) dropped from 11.5% to 10.6% after the program was initiated. The decrease was statistically significant ($P < 0.01$), but was small in comparison with the decline observed in the program states.

When the pooled claims were examined separately for the 4 groups (Fig. 2), self-referral declined in all cases. Reductions were significant for claims from physicians whose appeals were denied and payments terminated (17.4%–8.2%; $P = 0.0011$) and from physicians who did not appeal and continued to receive payments (24.8%–18.5%; $P = 0.026$). Although there was a decline in self-referral for claims from physicians who did not appeal and had payments terminated, it was not significant (19.6%–10.1%; $P = 0.099$). Unsurprisingly, self-referrals among physicians with successful appeals also did not experience a significant decrease (14.6%–13.7%, $P = 0.77$). These findings suggest that there was an overall reduction in self-referral both by physicians whose payments were terminated and by physicians informed of the program but not immediately subject to it.

Similar patterns held when CT claims were viewed in isolation, as is shown in Figure 3. All claims groups were characterized by lower self-referral rates in the postprogram period. However, the reduction was only significant for claims from physicians who filed an unsuccessful appeal and had their payments terminated (23.3%–12.4; $P = 0.013$). This claims group was likewise the only group to show a significant decrease in MRI self-referral, as is shown in Figure 4 (11.1%–3.9%; $P = 0.03$).

DISCUSSION

After the imaging interpretation criteria program was implemented, there were significant reductions in self-referrals both among physicians impacted by the program (17.4%–8.2%) and among physicians merely informed of its presence (24.8%–18.5%). The

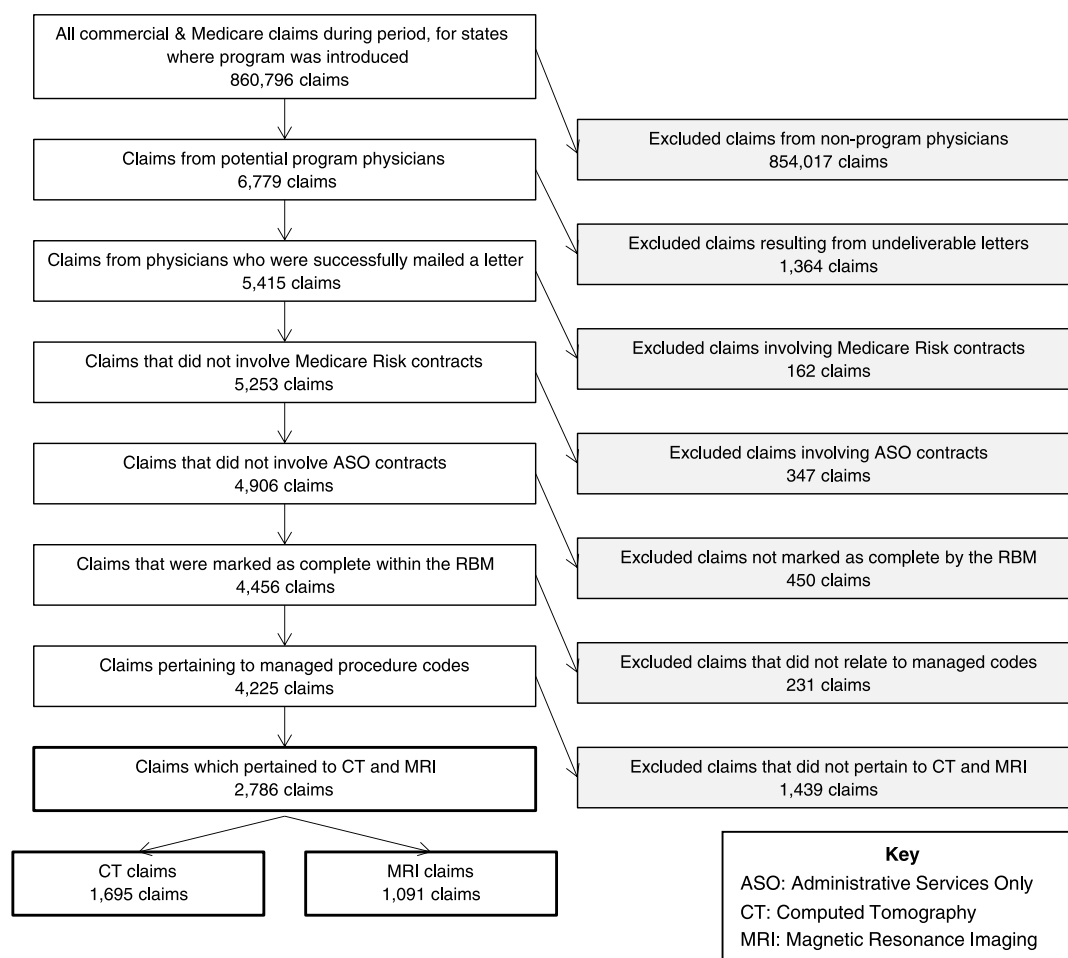


FIGURE 1. Sample selection flow chart.

drop in self-referral represented by claims from physicians who did not appeal and had payments terminated was not significant; however, the reduction was large, and the number of claims in the category was smaller than the number of claims in the other categories (Table 2), suggesting that statistical power may have been an issue.

Self-referral reduction was greatest for claims from physicians who had their payments terminated. The persistence of a nonzero level of self-referral was anticipated, as there are a number of factors which may lead physicians to continue receiving reimbursement for self-referred services no longer permitted by the payer. The program may have also had an indirect impact on physicians

whose payments were not terminated. The self-referral rates exhibited a statistically significant reduction for claims from the physicians who did not appeal their letters and continued to receive payments and from the physicians who contracted with the payer nationally (most of whom were not subject to the program). These physicians may have been aware that the program was impacting their colleagues and proactively curbed their self-referrals. The finding that physicians with denied appeals had the greatest drop in self-referrals supports the hypothesis that the physicians most conscious of the program reacted the most strongly to it. Nonetheless, it is also possible that the self-referrals declined for other reasons.

TABLE 2. Sample Size, Physicians, and Claims

Postprogram Status of Physicians		Physicians*		Claims	
		Pre	Post	Pre	Post
Appeal	Appeal denied, payments terminated	38	57	224	570
	Appeal granted, payments continued	44	56	178	417
No appeal	Payments terminated	21	39	56	228
	Payments continued	62	91	302	811
Total		165	243	760	2026

*There was an overlap between the physicians represented by preprogram and postprogram claims.

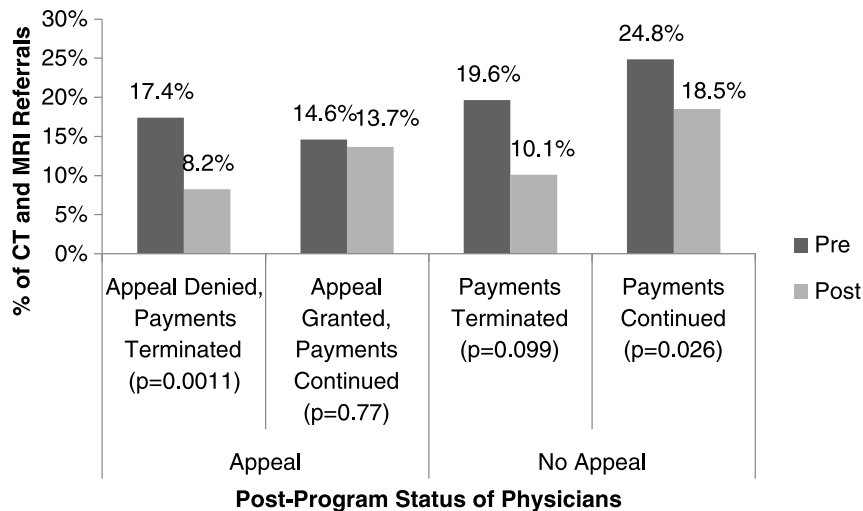


FIGURE 2. Combined MRI and CT self-referral rates before and after the implementation of the imaging interpretation criteria program (preclaims n = 760, postclaims n = 2026).

Although it remains a question for exploration in further research, the decrease in the self-referral rates may have resulted from more of the imaging interpretations having been performed by radiologists. While referrals to radiologists decrease the numerator of the self-referral rate, they may decrease the denominator as well. Previous research has found that radiologists may be more conservative in their ordering and use of imaging than nonradiologist physicians.^{3,6,7,22,23} Referrals which did not result in imaging utilization were not included in the study. Thus, the absolute decrease in self-referrals may have been even larger than the self-referral rates suggest.

Although the program described in this study has never been previously researched, it was expected that physicians would rationally respond to financial incentives, as economic considerations have been shown to impact both the purchase of imaging equipment and its utilization.^{20,24} Furthermore, other managed care organizations have successfully implemented physician privileging

programs to reduce self-referral.^{25–27} Other RBMs have also reported success in reducing self-referral through privileging.²⁸ However, the training-based approach of the imaging interpretation criteria program is not the only one that has been used. One commercial insurer has successfully restricted reimbursement for self-referral by nonradiologist physicians by requiring facilities providing CT and MRI to possess the equipment necessary to perform at least 5 different imaging modalities and to be available for imaging exams at least 40 hours per week—capital and labor requirements which are accessible to radiologists but onerous to nonradiologist physicians.²⁹

Although the majority of the literature shows restricting privileges or reimbursement to be an effective method of curbing self-referral among nonradiologist physicians, success has not been universal.^{25–30} There is one report of a program which was unsuccessful in reducing self-referral claims by nonradiologist physicians. As the program in question only restricted physicians'

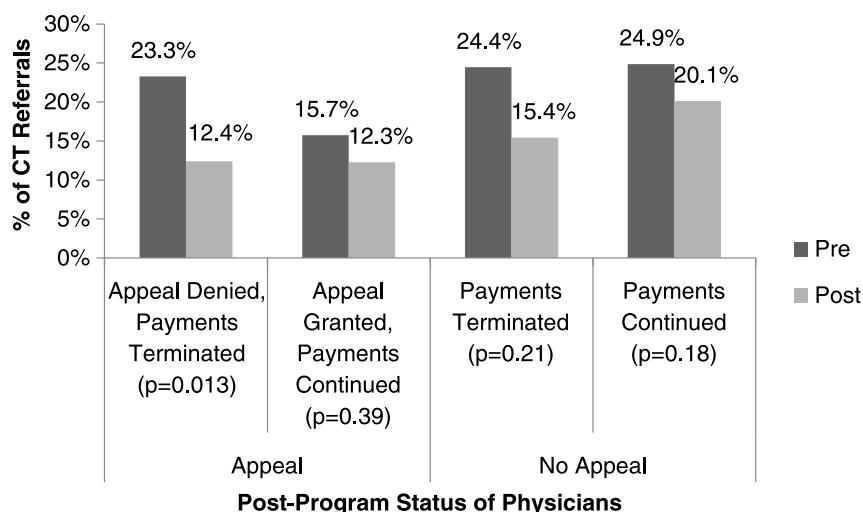


FIGURE 3. CT self-referral rates before and after the implementation of the imaging interpretation criteria program (preclaims n = 463, postclaims n = 1232).

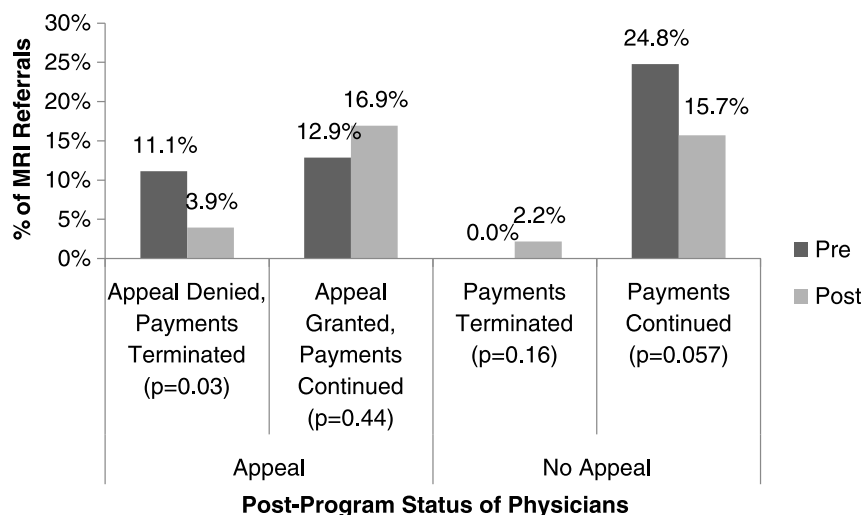


FIGURE 4. MRI self-referral rates before and after the implementation of the imaging interpretation criteria program (preclaims n = 297, postclaims n = 794).

abilities to bill for the professional component of their services, they were able to compensate by increasing their technical component charges.³⁰ This loophole did not exist in the program that was examined in this study, as reimbursement restrictions were concurrently placed on the technical and professional components of imaging.

Based on the success of the program to date, the imaging interpretation criteria are being gradually introduced in additional states. Physicians in contracts not currently subject to the criteria are being introduced to the criteria as contracts are renegotiated. Similar programs can be developed by additional health insurers, further reducing the prevalence of self-referrals by decreasing the economic viability of imaging equipment acquisition.

Self-referrals can benefit patients by enhancing the convenience and continuity of care¹ but can simultaneously increase patients' exposure to radiation and contrast agents by driving utilization.^{3,14–16} Under the program, physicians could appeal their reimbursement restrictions if they had hospital privileges for imaging interpretation, had contracted with a radiologist for imaging interpretation, or could document formal training in imaging interpretation for the types of exams being interpreted. Because the program reduces the potentially poor quality imaging interpretation by inadequately trained physicians¹⁷ while allowing adequately trained physicians to maintain continuity of care, it offers a balance which may enhance quality.

Limitations

There are a number of limitations which may have impacted the findings. Although the same set of physicians were eligible for inclusion in the study in the pre and post-implementation periods, not all of the physicians included in the study submitted claims in both periods. Some of the postprogram claims were from physicians who did not submit preprogram claims, although their claims would have been considered in the analysis had they done so. This may have created a bias of unknown magnitude and direction in the before-and-after comparisons. Given the relatively higher preprogram self-referral rate in the program states compared with other states, it is possible that the change in self-referral in those states simply reflected a regression to the mean. Additionally, the program's impact was only examined at one point in time, and any measured effect could change over time. It is possible that some physicians self-referred but did not bill

for imaging interpretation if they anticipated that they would not be compensated for doing so. Referrals which did not result in utilization were not measured.

Finally, only a 6-state population of physicians subject to the program during one 25-month period was examined. A number of these physicians were excluded from the program for contractual reasons, and as a result, the sample may not be representative of the physician population in the network. As the analysis suggests that the states included in the program had higher self-referral rates than the states not included, the results may not be generalizable to other physician populations or time frames, as confounding temporal changes or aspects of state-specific practice environments may have affected these results. However, the difference between changes in the states in which the program was introduced and changes nationally suggests that the temporal bias would have been very small. Once the program is introduced into additional states and observed over a longer period, it may be possible to better characterize how these limitations have impacted the findings.

CONCLUSIONS

These results suggest that an imaging interpretation criteria program may be an effective way to reduce inappropriate self-referral by nonradiologist physicians. Furthermore, the impact of an imaging interpretation criteria program may be both direct and indirect. Qualification-based limitations on reimbursement for the interpretation of self-referred imaging studies were associated with lower self-referral rates, indicating that the program may have had a direct impact. Even the physicians who did not ultimately face reimbursement limitations had a lower self-referral rate after implementation of the program, suggesting that these physicians may have been indirectly impacted as well. Because of the quality issues caused by self-referral behavior that have been suggested by some studies, the implementation of an imaging interpretation criteria program by an RBM may increase the likelihood that patients receive higher quality image interpretation.

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