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BUSINESS AND ADVOCACY

The Use of a Learning Community and Online Evaluation of Utilization for SPECT Myocardial Perfusion Imaging

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Resource-sensitive and quality-centered imaging begins with the selection of the appropriate patient and test. Appropriate use criteria have been developed to aid clinicians but are often not available in an easily accessible format. FOCUS (Formation of Optimal Cardiovascular Utilization Strategies), a Web-based community and quality improvement instrument, was developed to increase the feasibility of measuring and improving practice patterns based on the appropriate use criteria. The FOCUS instrument proposed to reduce inappropriate imaging by 15% in 1 year and by 50% within 3 years. Between April 2010 and December 2011, data were voluntarily collected through the FOCUS radionuclide imaging performance improvement module (PIM). Appropriateness rates were compared between phases of the PIM. For the 55 participating sites that had completed the PIM by December 2011, the proportion of inappropriate cases decreased from 10% to 5% ($p < 0.0001$). These preliminary data from initial participating sites suggest that through the use of a self-directed, quality improvement software and an interactive community, physicians may be able to significantly decrease the proportion of tests not meeting appropriate use criteria.

Cardiovascular imaging provides a key component of clinical care for 10 million patients a year (1). There is unquestioned value for medical imaging, with abundant literature support for a variety of modalities and clinical indications. However, as the technology adoption curve of advanced cardiac imaging went through its natural cycle, cardiac imaging growth rates exceeded other medical services. When combined with unexplained geographic variation, questions regarding appropriate use and overall quality of care were raised. Yet, since 2005, discretionary use of advanced diagnostic imaging in Medicare patients has largely stabilized and displayed a marked deceleration in growth. In 2009, the volume of advanced imaging services delivered to Medicare recipients actually decreased for the first time in 11 years. A variety of measures implemented to curb these costs may have contributed to shifting this growth curve. These have included the leveling off of technology adoption curves, the Deficit Reduction Act of 2005, the development of appropriate use criteria (AUC), reimbursement restrictions, and radiology benefit management (RBM) programs (2). Although payment cuts and third-party review reimbursement strategies may reduce costs, they may not all lead to optimal use of resources in which the appropriate test occurs in the appropriate patient.

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Resource sensitive and quality-centered imaging begins with the selection of the appropriate patient and test according to objective, clinically based criteria. Through the development and application of AUC, a potential partnership has been forged among clinicians, educators, and payers for rational and fair cardiovascular imaging practices. The goals of the AUC initiative include helping educate clinicians on their practice habits, emphasizing the clinical indications and risk factors that drive testing, and improving the cost effectiveness of cardiovascular imaging.

The FOCUS (Formation of Optimal Cardiovascular Utilization Strategies) program of the American College of Cardiology (ACC) aims to implement the criteria, while simultaneously providing information regarding practice performance to the clinician. The AUC form the basis for the program in which the quality improvement material and practice feedback are provided to physicians. FOCUS is as a Web-based community and quality improvement project with the stated intention of reducing inappropriate imaging by 15% in 1 year and by 50% within 3 years. FOCUS provides a structured format for physicians to document their cases and track the appropriateness of their utilization. The purpose of the FOCUS tool was to aid physicians in improving the appropriate use of radionuclide imaging (RNI) and reduce the number of studies designated as "inappropriate." This study examines cardiac imaging use among participating physicians and whether the proportion of studies designated as inappropriate improve, decrease, or stay the same over the course of their participation in the performance improvement module (PIM) for RNI, the first modality within the program.

The American College of Cardiology Foundation (ACCF) partnered with a technology vendor to create the FOCUS RNI PIM. This tool was created in response to questions about appropriate use to help physicians track their own practice patterns and implement positive changes. Availability of the FOCUS program was made known through various listservs, print, and Internet sources. The program was launched officially in January 2010 through a webcast; however, data collection did not begin until April 2010 after a second webinar. The FOCUS webinars contained information on the history and background of the AUC and FOCUS program, as well as more specific information about how to implement and use FOCUS in one's practice. Participation in the FOCUS listserv is a required component of the PIM. As participants gain a greater familiarity with the criteria and form their own action plans, the listserv can be used by a physician to e-mail a question or comment and receive responses from fellow participants and peers. The FOCUS community Web page was launched to provide another medium for questions, comments, and experiences to be shared and documented for a longer term. The page allows participants a space in which to create discussion groups and post questions and answers that can be viewed by future FOCUS participants. Both of these platforms encourage participant interaction and allow for exchange of ideas and the development of best practices.

Data collection began in April 2010 and continued through December 2011. The PIM consisted of 3 stages. In the first stage, participants entered consecutive patient cases (prospective or retrospective) to establish a baseline sample. Appropriate use was measured based on the 2009 RNI Appropriate Use Criteria using a computer based algorithm (Fig. 1). A few short questions based on the main reason for the patient visit were required. These categories were preoperative assessment, active or current ACS, evaluation after percutaneous coronary intervention or coronary artery bypass graft surgery, follow-up after prior testing, evaluation of ischemic equivalent, and evaluation of an asymptomatic patient. No protected health information or patient identifiers were required. Participants used the FOCUS PIM for a variety of different reasons (Intersocietal Commission for the Accreditation of Nuclear Medicine Laboratories laboratory accreditation, physician level maintenance of certification part IV, and general quality improvement); therefore, it was not possible to monitor whether each registered "participant" was entering data for 1 physician or for multiple physicians. However, each user was required to register for the PIM with a unique e-mail address and Cardiosource account. Therefore, we will refer to each registered user as 1 site or participant. Participants sorted patients into 1 of 6 categories on the basis of their reason for visit and then responded to a few short questions necessary to determine the appropriateness of the case (Fig. 2). A minimum of 10 consecutive patient cases were required before participants could move to the next stage. However, participants were encouraged to enter at least 30 cases and the Intersocietal Commission for the Accreditation of Nuclear Medicine Laboratories required at least 5% of their cases be reviewed. Stage 2 featured the development of an action plan and incorporated quality improvement activities to support appropriate use of imaging. Participants were asked to list 3 goals they had in regard to improving their appropriateness rate, and 3 actions that they would implement to achieve these goals. Participants were also asked to view a FOCUS webinar, contribute at least twice to the FOCUS listserv and join the online FOCUS Innovation Community. At least 30 days after they had created and begun to implement their action plan, participants entered additional consecutive patient cases and reviewed appropriateness rates for a second time to gauge their progress. Participants then continued to implement their action plan for at least 30 to 60 days, after which they once again entered consecutive patient cases in stage 3 to re-evaluate their performance and see the final impact of their changes.

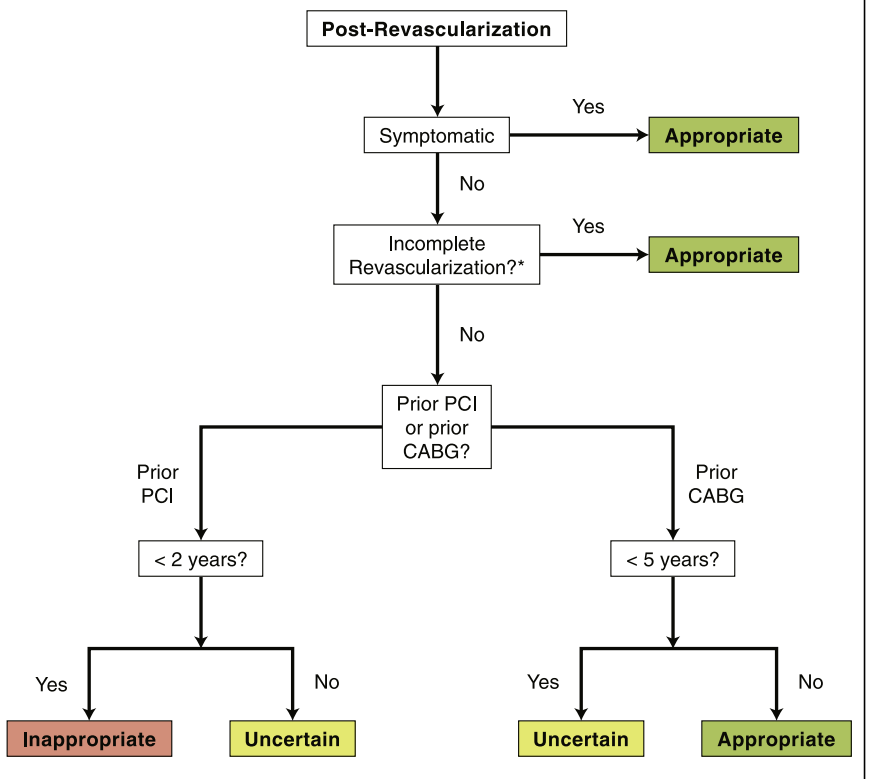

Figure 1. Post-Revascularization Decision Tree

An algorithm from the American College of Cardiology radionuclide imaging appropriate use criteria. The FOCUS (Formation of Optimal Cardiovascular Utilization Strategies) tool uses similar algorithms to sort cases into the appropriate, inappropriate, and uncertain categories. *Assumes that additional revascularization is feasible. CABG = coronary artery bypass graft surgery; PCI = percutaneous coronary intervention.

After the completion of each phase, participants were asked to complete a short evaluation survey about their participation in the PIM. They were also presented with a report detailing their AUC rates. The AUC rates were shown for cases considered to be appropriate, inappropriate, uncertain, and not covered. Additionally, the inappropriate rates were further broken down by common inappropriate clinical scenarios as well as comparisons of their individual rates to those within their practice and/or specialty. Upon completion of the PIM, participants were presented with a report comparing their AUC rates through the different stages of the PIM.

Demographic information on the participants and the proportion of imaging tests within categories of appropriate, uncertain, and inappropriate are reported. A chi-square test was used to evaluate the proportion of cases within appropriateness categories. A chi-square test was also used to test the significance between baseline rates of participants. Participant level data was measured by determining if an individual practice's rates showed a significant increase or decrease. Qualitative data from participant action plans was also analyzed to establish best practices. These were analyzed by creating several broad categories based on the data and sorting each answer item into the appropriate category. Physician responses to the evaluation questions after each phase of the PIM were also analyzed to better understand how physicians felt about the format, clinical relevance, and benefit of the PIM.

A total of 521 sites registered for FOCUS as of December 2011: 362 participating sites were working on stage 1, 104 on stage 2, and 55 on stage 3. Because the PIM is self-directed, participants progress through the stages at their own pace, spending differing amounts of time collecting data in each stage. Sites are located in 49 states and consist of a variety of practice sizes (Fig. 3). The baseline utilization rates for the 221 participants who had completed stage 1 found 80% of studies were appropriate, 9% uncertain, and 11% inappropriate (n = 11,845). For the 55 participating sites that had completed the PIM, the proportion of inappropriate cases decreased from 10% to 5% ($p < 0.0001$) between stages 1 and 3. A concomitant increase in appropriate cases was noted, from 82% to 89% (Fig. 4).

The baseline (stage 1) rates between participants who had completed the PIM were compared with those who had not completed the PIM. Participants who had completed the PIM had slightly better appropriateness rates (82% appropriate, 9% uncertain, 10% inappropriate) than those who had not yet completed (80% appropriate, 9% uncertain, 11% inappropriate; $p = 0.025$).

A participant level analysis was also conducted on sites that had completed the PIM. Between stages 1 and 3, 87% of sites had improved or unchanged (62% improved, 25% unchanged) appropriateness rates. Of those whose rates remained unchanged, 86% had started and ended with a 0% inappropriate rate. Thirteen percent (7 of 55) of the sites experienced an increase in their rate of inappropriate testing. For these 7 sites, the increases ranged from 2 to 24 percentage points.

Table 1 outlines the most common specific inappropriate indications: low risk asymptomatic, low risk symptomatic, perioperative, post–percutaneous coronary intervention within 2 years, and other. The "other" category consisted of inappropriate indications that did not fall into the above groups. Although the actual numbers in each category declined, the proportions in

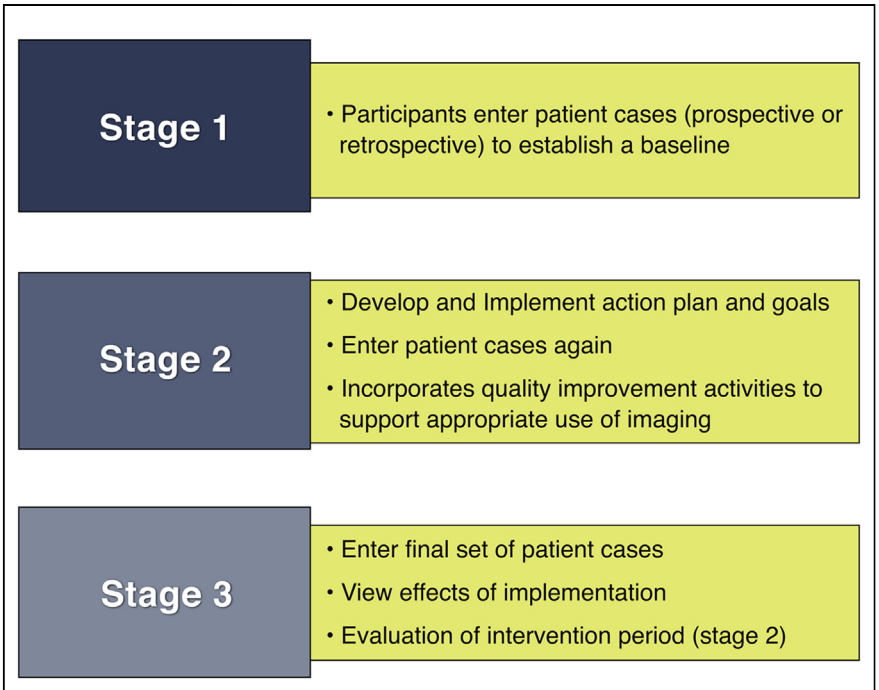

Figure 2. FOCUS RNI PIM Overview

The 3 stages of the performance improvement module (PIM) and the tasks that participants accomplish in each. FOCUS = Formation of Optimal Cardiovascular Utilization Strategies; RNI = radionuclide imaging.

some of the categories changed. The greatest differences were the decrease in the "other" category and the increase in the "symptomatic" category.

Many common themes and ideas for improvement emerged from the physician responses in the action plan and implementation phase. The FOCUS participants shared a wide array of educational approaches and quality techniques that they used to impact change in their practices. The majority of participant's goals were to decrease inappropriate use (71%), increase education and awareness about AUC (37%), and to identify current ordering patterns (29%). Physicians also wanted to improve communication with primary care physicians and simplify referrals (22%). Most participants hoped to accomplish these goals through actions such as increasing the use of AUC (36%), providing physicians with regular feedback regarding their practice patterns (33%), and discussing these data at staff meetings (30%). Physicians also wanted to inform referring physicians (28%) and make better use of tools such (i.e., order sheets) to help collect more detailed patient histories (26%) (Table 2).

Participants were asked to complete an evaluation survey at several points during PIM completion. After the second stage of the PIM, many participants (48%) thought that they had been very successful in implementing their action plan; an additional 49% thought they had been somewhat successful; 93% of participants thought that they had been successful in impacting change in the appropriate use of RNI; and 66% thought they had learned something new during the implementation of their action plan.

The results of this study provide a preliminary proof of concept for potential ways to reduce inappropriate use of cardiac imaging. By decreasing the rate of inappropriate tests from 10% to 5% in 1 year among a self-selected and motivated sample of physician practices conducting RNI, the FOCUS program has begun to make progress toward its objectives. This change arose within the multifaceted approach of FOCUS that combines an immediate feedback tool, required review of data, interaction with peers, and education of physicians.

Some previous studies attempting to improve imaging appropriateness have had limited success. These have shown that feedback and education alone are not sufficient to impact physician ordering patterns. More recent studies of AUC implementation have shown improvement only with a combination of decision support and physician activation in quality improvement (3). These studies also showed similar residual rates of inappropriate use after

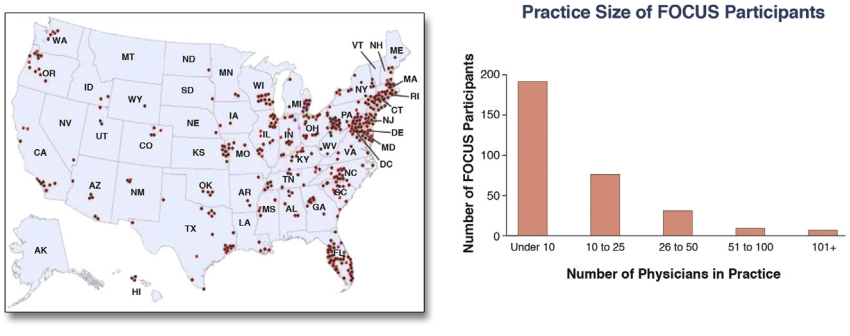

Figure 3. FOCUS Participant Demographics

Participating sites represent areas from 48 states across the nation. A variety of practice sizes are also represented. FOCUS = Formation of Optimal Cardiovascular Utilization Strategies.

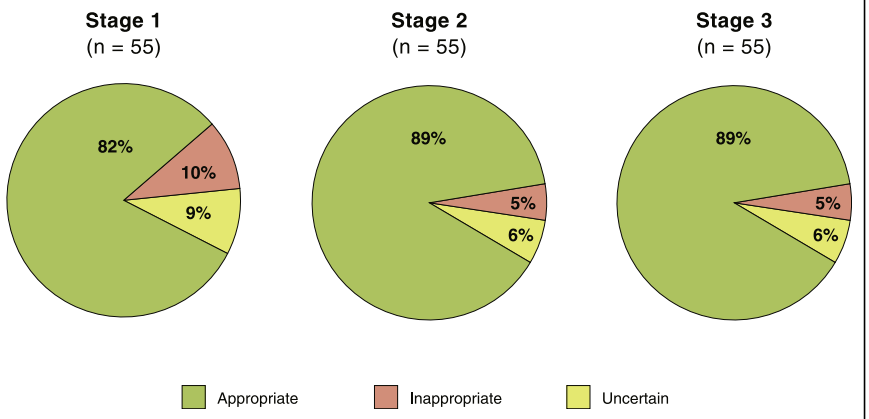

Figure 4. Change in Appropriateness Rates Across Stages

The change in the appropriateness rates is shown across the stages of the performance improvement module. **Green areas** indicate appropriate; **pink** indicates inappropriate; **yellow** represents uncertain. Only participants who had completed the performance improvement module were used in this analysis. The inappropriate rate decreased by 50% between stages 1 and 3.

improvement of <10%. The FOCUS unique performance improvement module combines data review and education with physician interaction. Physicians are required to share questions and experiences with the FOCUS listserv or on the FOCUS Web community page. This provides physicians with a platform to exchange best practices and share tips and ideas that have led to success. In addition, we also found that these avenues of communication were often heavily utilized by nurses, technicians, and other medical staff. These staff members were then able to take what they had learned and disperse it among their individual practices. The FOCUS tool also allows participants to receive feedback on the data they entered. Similarly, as they progress through the PIM participants receive feedback on prospective tests and can actually see their progress and improvement. All of these methods allow participants to first identify areas in which they need improvement, and then to develop and implement a plan to specifically target these issues. The FOCUS program provides participants with the correct educational and technological tools needed for successful self-directed quality improvement.

The relative increase in the proportion of inappropriate RNI in the low risk symptomatic group may reflect the greater challenge in changing physician ordering for this patient subset than other categories of inappropriate use. These patients are generally women under 60 years of age with atypical symptoms. Many providers perceive additional risk in these patients even if the actual models do not support it, and have cognitive dissonance about not ordering a test in light of public health efforts to address perceptions about women and heart disease. Further education and understanding is required to overcome these risk perceptions compared to other inappropriate indications.

There was no observed decrease between the average rate of the participants between stage 2 and stage 3. Therefore, most of the observed decrease in inappropriate ordering occurred in stage 2 after participants had written their action plan. Because the sites that improved decreased their inappropriate cases by a significant amount during stage 2, inappropriate rates were already <8% going into stage 3. It is expected that no site would have a 0% inappropriate rate as the clinical scenarios cannot account for every possible patient scenario. As such, further decrease in stage 3 was viewed as unlikely as the majority of the remaining inappropriate cases were likely patients who were exceptions. Additional improvement could have even been viewed as not allowing sufficient clinical judgment and overly strict adherence without consideration of specific patient clinical circumstances.

With the progress and the lessons learned from the PIM, the ACC has begun to expand the FOCUS program to include decision support software, through both an online portal and integrated with electronic health records. This extension will provide the AUC in an easily accessible format at the point of care and allow tracking practice patterns on an ongoing basis rather than a limited sample of cases in the current PIM. This program could be used by health plans in lieu of RBMs and would allow for more general adoption and testing of the FOCUS program and greater use and dissemination of the AUC.

Table 1. Rates of Individual Inappropriate Indications

	Stage 1 (n = 206)	Stage 3 (n = 70)	Percent Change
Other	25 (52)	14 (10)	−44
Low risk asymptomatic	1 (3)	0 (0)	−100
Low risk symptomatic	35 (72)	49 (34)	+40
Perioperative	31 (64)	30 (21)	−3
Post-PCI within 2 yrs	7 (14)	7 (5)	0

Values are % (n). Although the actual numbers in each category declined, the proportions in some of the categories changed. The greatest differences were the decrease in the "other" category and the increase in the "symptomatic" category.
PCI = percutaneous coronary intervention.

Table 2. Participant Action Planning Responses

	Goals—Educational Approaches	
1	Increase appropriate testing rates	71%
2	Increase education and awareness	37%
3	Document and determine current ordering patterns and identify areas to improve	29%
4	Acquire greater knowledge and implementation of guidelines and AUC	23%
5	Educate and simplify referrals	22%
6	Learn about FOCUS initiative	9%
7	Comply with ICANL	8%
8	Review data and compare with other measures, namely, outcomes	8%
9	Reduce RBM rejections and achieve better reimbursements	7%
10	Improve communication among physicians and staff	7%
11	Raise awareness about radiation safety and decrease patient exposure	4%
	Actions—Quality Techniques	
1	Increase education, awareness, and use of AUC	36%
2	Monitor, review, and report AUC rates (physician feedback)	33%
3	Physician meetings to review and discuss data	30%
4	Educate and inform referring physicians	28%
5	Use order sheets and/or AUC tools to get more comprehensive patient history	26%
6	Participate in webinars, listserv, and the FOCUS program	23%
7	Increase communication among physicians and staff	11%
8	Target improvements toward specific inappropriate indications	9%
9	Compare data with other measures (i.e., outcomes) to drive change	8%
10	Improve patient education and feedback	8%
11	Incorporate new technology into workflow	3%

These are the most common goals and actions that participants listed as part of their action plans.
AUC = appropriate use criteria; FOCUS = Formation of Optimal Cardiovascular Utilization Strategies; ICANL = Intersocietal Commission for the Accreditation of Nuclear Medicine Laboratories; RBM = radiology benefit manager.

Study limitations. Participants may have entered data as an individual or for a larger practice or group. Because of this, some "participants" may actually represent the combined data of several physicians. The FOCUS practice sites were concentrated heavily in the Northeast and in Florida; therefore, it is possible that certain geographic factors contributed to the observed decrease in inappropriate use, and more sites nationally would have to be studied before understanding the broader applicability and efficacy of the program. Of the 521 sites registered for the PIM, only 55 had completed the module (10.5%) as of December 2011. Most dropout/inactivity occurred before data collection during the initial registration phase of the PIM. These inactive practices may have been unable to obtain resources for the data collection requirements immediately and/or to obtain the data elements required to complete the PIM. Thus, the majority of inactive participants did not have appropriate use rates to bias their decision to proceed or not.

Participants were able to choose the time period for cases they entered and the quantity of cases entered; the program minimum was 10. Some participants entered hundreds of cases whereas others entered only 10 in each stage. Thus, some degree of self-selection bias could have influenced the results. However, because consecutive case entry for the time period chosen by the participant was required for all stages and because stage 2 and stage 3 were prospective, this bias should have been reduced. In addition, several participants were laboratory technicians and other staff who would not have had the clinical training to pre-judge whether a particular set of patients for a given time period were more likely to be appropriate or not. The baseline rates between participants who had completed and participants who had not completed the PIM were slightly different presenting another potential source for selection bias. Participants choosing to participate in a voluntary activity, especially early adopters, are likely to be more motivated and thus may be more likely to show improvement. However, the baseline inappropriate rate for those who had completed the PIM was lower than for those who had not. As such, these early adopters also had a more challenging task to demonstrate improvement because their appropriate use rates were better at the start.

Because this study was conducted with a "before-after" study design, various other changes in the fields of technology and health care may have contributed to the decrease in inappropriate use observed. Decreases in the use of advanced imaging studies were observed before the onset of this study. Although decreases in utilization may reflect broader adoption of appropriate use, several additional factors could also be impacting utilization such as payment rates. However, these secular trends of decreased utilization were seen before initiation of this study, and therefore, the ability of FOCUS to impact appropriate use beyond these trends should have been more limited if these broader trends were primarily due to appropriate use adoption. We were unable to track the exact duration of time participants spent on each activity within each stage; therefore, participants may have spent different amounts of time implementing their action plans before entering data in stage 2 in particular. Therefore, the duration of time between data collection in each stage could not be determined, potentially lessening the ability to judge the impact of the action

planning compared to other variables such as reporting the data alone.

This study finds that through the use of self-directed, quality improvement software and interactive community, such as the FOCUS PIM, it appears possible for physicians to decrease the proportion of their tests not meeting appropriate use. The potential for improvement has been documented by the practices who were early entrants in this study. The opportunity to improve through physician involvement in a community, sharing data among peers, and engaging in quality improvement appears substantial. Further study of the remaining participants and similar efforts outside of the FOCUS PIM will be needed to understand whether other sites can achieve gains similar to those accomplished by these early adopters.

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Key Words: appropriate use criteria ■ FOCUS ■ imaging ■ quality improvement ■ utilization.