CHAPTER 4

Impact of physician self-referral on use of imaging services within an episode

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Chapter summary

There has been rapid technological progress in diagnostic imaging over the past several years, which has enabled physicians to diagnose and treat illness with greater speed and precision. Between 2002 and 2007, the volume per beneficiary of imaging services paid under Medicare's physician fee schedule grew nearly twice as fast as all physician services. Although the rate of growth slowed between 2006 and 2007, there are reasons to be concerned that some of the increased use in recent years may not be appropriate, which contributes to Medicare's growing financial burden on taxpayers and beneficiaries. First, the Government Accountability Office found an almost eightfold variation in per beneficiary spending on in-office imaging services across the states. Second, there is evidence that costly imaging services are mispriced under the physician fee schedule, thereby creating financial incentives to provide more imaging. Rapid growth in imaging may also be driven by technological innovation, defensive medicine, inconsistent adherence to clinical guidelines, an increase in imaging performed in physician offices, and other factors.

In this chapter

Although the rise of in-office imaging may improve access and convenience for patients, it might also lead to higher volume through additional capacity and financial incentives for physicians to refer patients for more tests. Several studies have found that physicians who furnish imaging services in their offices refer patients for more tests than other physicians. However, only two studies controlled for differences in patients' clinical conditions and only one examined whether physicians were referring patients to other members of their practices for imaging.

Given the limitations of prior research, we investigated whether physician self-referral is related to higher use of imaging, adjusting for differences in patients' clinical conditions and severity of illness, physician specialty, and market area. We used Medicare claims data to identify whether physicians referred patients to their practices for several types of imaging services, including computed tomography (CT), MRI, nuclear medicine, echocardiography, and standard imaging. In addition, we used Symmetry Episode Treatment Groups® (ETGs®) to classify beneficiaries by type of episode and patient severity; using ETGs allowed us to compare the observed imaging cost of a given episode with the average imaging cost of similar episodes (expected cost).

Our descriptive analyses of 2005 data revealed two key findings. First, a higher proportion of episodes with a self-referring physician received at least one imaging service than episodes with no self-referring physician. These differences were statistically significant for all but 1 of the 22 ETG-imaging types we examined. Second, episodes with a self-referring physician have higher ratios of observed-to-expected imaging spending than episodes with no self-referring physician. The ratios control for variations in beneficiaries' clinical condition and disease severity, market area, and physician specialty. The differences between the ratios ranged from 5 percent to 104 percent, depending on the ETG and type of imaging. These differences were statistically significant for all ETG-imaging types. Across all the ETGs and

imaging types we analyzed, the mean difference between the ratios was 68 percent.

We also used ETGs to investigate whether greater use of imaging within an episode is associated with higher or lower total episode spending. Some studies have found that the use of imaging in specific clinical circumstances saves money by preventing expensive interventions and hospital admissions or by reducing hospital length of stay. On the other hand, results from imaging may initiate a cascade of diagnostic tests and interventions, thereby increasing total episode costs. For each of the 13 ETGs we analyzed with 2005 data, we found that the ratio of observed-to-expected imaging spending was positively correlated with the ratio of observed-to-expected total episode spending. Although in specific cases an imaging study may substitute for other services, our finding suggests that greater use of imaging is associated with greater overall resource use for the types of episodes we examined, adjusting for patient severity and other factors. In addition, for the types of episodes we studied, greater use of specific types of imaging (e.g., nuclear medicine for ischemic heart disease) is associated with higher overall resource use during an episode. We also found that higher imaging use was positively correlated with higher procedure use, indicating that, on average, more spending on imaging is associated with slightly more spending on procedures during an episode.

In future work, we plan to analyze multiple years of data. We will use multivariate analyses to estimate the relative impact of various factors on the use of imaging during an episode, such as the self-referral status and specialty of physicians involved in the episode, the beneficiary's geographic location, and the number of physicians involved in the episode. Further, we will examine whether physicians order more imaging per episode after their practices begin performing in-office imaging and whether measures of appropriate imaging use can be linked to our data on self-referring physicians. In addition, we intend to explore policies to encourage more

prudent use of imaging services. One such option is to encourage greater adherence by physicians to appropriateness criteria developed by specialty societies; another option is to increase the size of the unit of payment in the physician fee schedule to include bundles of services that physicians often furnish together or during the same episode of care. ■

Background

The Commission recognizes that there has been rapid technological progress in diagnostic imaging over the past several years, which has enabled physicians to diagnose and treat illness with greater speed and precision. Between 2002 and 2007, the volume of imaging services paid under Medicare's physician fee schedule grew by 44 percent per fee-for-service (FFS) beneficiary, compared with 23 percent volume growth per beneficiary for all physician services (MedPAC 2009). Although the rate of growth slowed to 3.8 percent between 2006 and 2007 (compared with 2.9 percent growth for all physician services), there are reasons to be concerned that some of the increased use in recent years may not be appropriate. First, the Government Accountability Office (GAO) found an almost eightfold variation in per beneficiary spending on in-office imaging services across the states in 2006 (GAO 2008). According to GAO, the magnitude of this variation suggests that these differences are more likely related to variation in physician practice patterns than patients' health status. Second, there is evidence that costly imaging services are mispriced under the physician fee schedule, thereby creating financial incentives to provide more imaging (MedPAC 2009).

Increased use of imaging contributes to Medicare's growing financial burden on taxpayers and beneficiaries. In addition, certain types of imaging expose beneficiaries to ionizing radiation, which is associated with an increased risk of developing cancer. A recent report estimates that the U.S. population's per capita dose of radiation from medical imaging increased almost 600 percent from the early 1980s to 2006 (National Council on Radiation Protection and Measurements 2009). This increase was due mostly to higher use of computed tomography (CT) and nuclear medicine studies. Although an individual's risk of developing cancer from a single test is small, these risks are being applied to a growing number of patients.

Many factors appear to be driving imaging use, including:

- technological innovation and new clinical applications for imaging,
- incentives in Medicare's FFS payment systems,
- defensive medicine,
- consumer demand for diagnostic tests,
- lack of research on the impact of imaging on clinical decision making and patient outcomes,
- inconsistent adherence to clinical guidelines, and
- physician ownership of imaging equipment and opportunities to earn ancillary revenue (Douglas 2006, Douglas et al. 2006, GAO 2008, Gibbons et al. 2008, Hadley et al. 2006, Hendel 2009, Iglehart 2009, MedPAC 2009, MedPAC 2005a, NCQA 2006).

Recent research points to an expansion of in-office imaging as many physicians purchase machines for their offices. The Stark self-referral law contains an exception that allows group practices to provide imaging services to patients in their offices (see text box, p. 86). According to a survey sponsored by the Commission in 2006, almost 20 percent of physicians reported that they had expanded their use of in-office imaging in the past year (MedPAC 2007a). GAO found that physician offices accounted for 64 percent of imaging spending under the physician fee schedule in 2006, compared with 58 percent in 2000 (GAO 2008). Physicians in several specialties that provide in-office imaging—other than radiology—have obtained an increasing share of their Medicare revenue from imaging; for example, between 2000 and 2006, the share of cardiologists' revenue related to in-office imaging grew from 23 percent to 36 percent (GAO 2008).

Although the rise in physician ownership of imaging equipment may improve access and convenience for patients, it may also lead to higher volume through additional capacity and financial incentives for physicians to refer patients for more tests. Proponents claim that in-office imaging improves quality of care and patient convenience (Casalino 2008, Kouri et al. 2002). According to one study, patients are more likely to receive imaging on the same day as their office visit for seven clinical conditions if their physician self-refers for imaging services (Gazelle et al. 2007). However, the rate of same-day imaging for patients of self-referring physicians ranged from 11.5 percent (nuclear medicine studies for patients with cardiac or coronary disease) to 91.5 percent (radiography for knee pain), indicating that many imaging studies are scheduled in advance. The ability to provide tests on the day of an office visit may enable physicians to develop treatment plans more quickly. Supporters of in-office imaging also contend that physicians can better supervise the quality of imaging performed in their office.

The Stark law allows physician practices to provide in-office imaging

The Ethics in Patient Referrals Act, also known as the Stark law, prohibits physicians from referring Medicare or Medicaid patients for "designated health services" (DHS)—such as imaging, hospital services, radiation therapy, home health, and physical therapy—to entities with which they have a financial relationship, unless the relationship fits within an exception. For example, physicians are prohibited from referring patients to an imaging center or clinical lab that they own. However, a provision in the law—called the in-office ancillary exception—allows group practices to provide most DHS, including imaging, in their own offices (42 CFR § 411.355). When the law was enacted, this exception was expected to apply mostly to in-office laboratory tests or X-rays, recognizing that a need often exists for a quick turnaround time on crucial tests (Congressional Record 1989). However, the exception protects all imaging services, as long as they are provided and billed under certain conditions.[1]

The in-office ancillary exception prohibits group practices from compensating their physicians in a manner that directly or indirectly reflects their referrals for imaging or other DHS (42 CFR § 411.352) (Johnson and Walker Keegan 2006). However, the Stark rules allow practices to allocate profits from imaging to physicians in the practice using certain indirect methods, such as on a per capita basis or based on the practice's distribution of revenue from non-DHS services. In addition, practices may create separate pools of profits from imaging and other DHS services for separate subgroups of physicians, as long as each subgroup has five or more physicians. Physician subgroups may be based on specialty, practice location, level of referrals for ancillary services, or other factors (Johnson and Walker Keegan 2006). The pool of profits may be distributed to each physician in the subgroup on a per capita basis or by another indirect method.

In addition to practices providing imaging services in their own offices, arrangements exist in which a physician practice leases a block of time from an imaging provider or agrees to pay the provider a per service (per click) fee to use its equipment. The practice then refers its patients to the imaging provider for imaging studies and bills the insurer for the services, profiting from the difference between the insurer's payment rate and the fee paid by the practice to the imaging provider. According to data from a California health plan, more than 60 percent of the physicians who billed the insurer for MRI or CT scans engaged in such arrangements (Mitchell 2007). These arrangements may comply with the Stark law's in-office ancillary exception if certain conditions are met—for example, if the provider that performs the imaging study is located in the same building where the referring physician furnishes non-DHS services (42 CFR § 411.355).[2] Under a new CMS rule, however, imaging providers that are enrolled in Medicare as independent diagnostic testing facilities (IDTFs) may not lease their operations to or share testing equipment with other organizations (42 CFR § 410.33). Although this rule prohibits leasing arrangements between group practices and IDTFs, group practices may still engage in block of time or per click leases with other practices. ■

On the other hand, physician acquisition of imaging equipment could lead to greater overall capacity, and evidence suggests that additional machines in a market are associated with higher volume. A recent article estimated that each additional MRI scanner in a market is associated with 733 additional MRI studies among Medicare beneficiaries, and each additional CT machine is associated with 2,224 additional CT scans (Baker et al. 2008). The study also estimated that, between 1995 and 2004, the number of MRI scanners in the United States more than doubled and the number of CT scanners increased by more than 50 percent.

Physicians who purchase machines for their offices have a financial incentive to refer patients for additional services, as long as those services are profitable. Although physicians are usually motivated by professional ethics and concern for their patients' best interests, physician ownership could influence the clinical judgment of some physicians, particularly when there is not strong evidence to guide their decisions. Some physicians have noted the

TABLE 4–1 **Methodologies of selected studies of physician self-referral and use of imaging**

	Hillman et al. 1992	GAO 1994	Gazelle et al. 2007	MedPAC analysis
Physician is defined as self-referring if…	Same physician orders and performs at least one imaging study	More than 50 percent of studies ordered by physician are performed by his/her practice	All imaging ordered by physician is interpreted by himself/herself or providers in the same specialty	More than 50 percent of studies ordered by physician are performed by his/her practice
Unit of analysis	Percent of episodes with imaging, charges per episode	Number of tests ordered per 1,000 office visits	Percent of episodes with imaging	Percent of episodes with imaging, ratio of observed-to-expected imaging spending per episode
Data source	United Mine Workers' claims,1988–1989	Medicare claims from Florida, 1989–1991	Claims from large national health plan, 1999–2003	Medicare claims from six markets, 2005 (100 percent)
Adjustment for clinical episode?	Yes (10 types of episodes)	No	Yes (6 types of episodes)	Yes (13 types of episodes)
Adjustment for patient severity within episode?	No	No	Adjustment for patient's age and number of comorbidities	Adjustment for comorbidities, complications, treatment, and patient severity*
Adjustment for physician specialty?	Yes	Yes	No	Yes*

Note: GAO (Government Accountability Office).
*The analysis of the ratios of observed-to-expected imaging spending adjusted for these factors; the analysis of the percent of episodes with imaging did not.

Source: GAO 1994, Gazelle et al. 2007, Hillman et al. 1992.

paucity of research on the impact of imaging on physician decision making and patient outcomes (Douglas et al. 2006, Redberg and Walsh 2008).

Several studies have found that physicians who own imaging facilities or furnish imaging services in their offices refer patients for more imaging than other physicians (see text box, pp. 88–89). The studies did not ascertain whether the additional services improved quality of care or outcomes. Only two of the studies grouped patients by clinical condition and only one examined whether physicians were referring patients to other members of their practices for imaging (Table 4-1).

Given the limitations of prior research, we investigated whether physician self-referral for imaging services is related to higher use of imaging, adjusting for differences in patients' clinical conditions and severity of illness, physician specialty, and market area. We used Medicare claims data to identify whether physicians referred patients to their practices for imaging services, and we used Symmetry Episode Treatment Groups® (ETGs®), an Ingenix, Inc., product, to classify beneficiaries by condition and illness severity. As in previous studies, we did not evaluate whether more imaging led to improved outcomes. Table 4-1 compares the methodology used for our study with that of other studies.

We also used ETGs to investigate whether greater use of imaging within an episode is associated with higher or lower total episode spending. Some studies have found that the use of imaging in specific clinical circumstances saves money by preventing expensive interventions and hospital admissions or by reducing hospital length of stay (Rao et al. 1998, Ross et al. 2007, Wardlaw et al. 2004). On the other hand, results from imaging studies may initiate a cascade of diagnostic tests and interventions, thereby increasing total episode costs (Deyo 2002).

Literature on the relationship between physician self-referral and imaging use

Several studies have found that physician investment in imaging facilities or equipment is associated with higher volume (Baker 2008, GAO 1994, Gazelle et al. 2007, Hillman et al. 1992, Hillman et al. 1990, Kouri et al. 2002, Litt et al. 2005). A study by the Government Accountability Office (GAO) found that physicians in Florida who were investors in diagnostic imaging centers referred their Medicare patients more frequently for MRI, computed tomography (CT), nuclear medicine, and ultrasound studies than nonowners (GAO 1994). Some of the differences were dramatic: Imaging center owners ordered twice as many MRI scans and 29 percent more CT scans for their patients than nonowners. GAO also found that physicians who were members of practices that performed in-office imaging ordered studies more frequently than physicians who referred patients to outside facilities. For example, physicians with MRI machines in their offices ordered about three times as many MRI scans per 1,000 office visits as other physicians. Cardiologists who performed echocardiography in their offices ordered 2.6 times as many echocardiograms as other cardiologists. The GAO report adjusted for physician specialty but did not control for the health status of patients treated by each physician or address whether the additional services were appropriate.

A study by Hillman and colleagues examined the use of imaging for patients with 10 common clinical episodes (e.g., chest pain, congestive heart failure, and knee pain) (Hillman et al. 1992). This analysis, which was based on claims for primarily elderly patients covered by the United Mine Workers of America Health and Retirement Funds, found that physicians who performed imaging services in their offices were more likely to use imaging than physicians who referred their patients to a radiologist for imaging. Depending on the type of episode, self-referring physicians were 1.7 to 7.7 times more likely to order at least one imaging study during an episode than other physicians. The results were similar when the researchers adjusted for physician specialty. The study also found that self-referring physicians had higher mean imaging charges per episode than non-self-referring physicians.[3] Although the authors controlled for type of clinical condition, they did not adjust for patients' comorbidities or complications within a condition. The study did not attempt to determine whether the additional tests ordered by self-referring physicians were inappropriate.

(continued next page)

Is physician self-referral associated with additional use of imaging in an episode?

Following earlier studies examining the effect of physician self-referral on the use of imaging services, we analyzed whether physician self-referral might affect the use of imaging within an episode of care. Our methodology allowed us to compare the observed cost of a given episode with the average cost of similar types of episodes in the same market area (the expected cost). Two key results emerged: (1) compared with episodes with no self-referring physician, a higher proportion of episodes with a self-referring physician received at least one imaging service, and (2) episodes with a self-referring physician had higher-than-expected spending on imaging, while episodes with no self-referring physician had lower-than-expected spending on imaging.

Defining self-referring physicians

To identify whether physicians self-referred for different imaging modalities, we used 100 percent of Medicare claims from 2005 for beneficiaries in six markets (Boston, MA; Miami, FL; Orange County, CA; Greenville, SC; Minneapolis, MN; and Phoenix, AZ). These markets, which are located in different parts of the United States and have different levels of per capita Medicare spending, have been used in prior Commission research

Literature on the relationship between physician self-referral and imaging use (cont.)

Likewise, a more recent study found that self-referring physicians used imaging more frequently than physicians who referred patients to radiologists (Gazelle et al. 2007). This study, which used data from a large national health plan, examined patients in six clinical episodes based on Symmetry Episode Treatment Groups® (ETGs®).[4] Physicians were classified as self-referring if they referred patients to themselves or to other physicians in the same specialty for imaging services (physicians in the same specialty could represent partners in the same practice). The study found that patients of self-referring physicians were 10 percent to 130 percent more likely to receive an imaging study during the episode than patients of radiologist-referring physicians, depending on the ETG. Similarly, when the researchers adjusted for each patient's age and number of comorbidities, most of the ETGs demonstrated higher use of imaging by self-referring physicians.[5] A weakness of the study is that physicians in the same specialty may not be members of the same practice, in which case the referring physician probably would not benefit financially from the referral.[6]

In a study presented at a public Commission meeting, Laurence Baker found that patients of neurologists and orthopedic surgeons who owned MRI machines were more likely to receive an MRI scan within seven days of an office visit than patients of neurologists and orthopedic surgeons who did not own MRI machines (Baker 2008). For example, 14.5 percent of patients who saw a neurologist who owned a machine received an MRI scan within seven days of their visit, compared with 9.3 percent of patients who saw other neurologists. This analysis used Medicare claims data from 1999 through 2005. Baker also used a regression model to examine the impact of acquiring an MRI machine on a physician's likelihood of ordering MRI studies, controlling for physician and patient characteristics. Acquiring an MRI scanner led to a 22 percent increase in the probability of ordering MRI scans by orthopedic surgeons and a 28 percent increase in the probability of ordering MRI scans by neurologists.

A study of California workers' compensation cases concluded that self-referring physicians were more likely than other physicians to order medically inappropriate MRI scans (Swedlow et al. 1992). The researchers, who examined about 500 MRI scans, found that 38 percent of the scans ordered by physicians with an ownership interest in an MRI facility were determined to be inappropriate during a precertification review. By contrast, 28 percent of the scans ordered by physicians without such an ownership interest were found to be inappropriate. ■

(MedPAC 2007b, MedPAC 2006). We examined seven different types of imaging, or modalities: CT (head), CT (other), MRI (brain), MRI (other), nuclear medicine, echocardiography, and standard imaging. Although we explored various definitions of a self-referring physician, our primary definition is one who refers more than 50 percent of the imaging studies that he or she orders to his or her practice.[7] For one of our analyses, we tested a less restrictive definition based on whether a physician refers at least 1 percent of the imaging services that he or she orders to his or her practice. We examined physicians' referral patterns for each imaging modality to determine modality-specific self-referral categories.

Consistent with previous Commission work, we assume that physicians who share the same tax number are in the same practice (MedPAC 2007b). However, a physician affiliated with multiple practices may bill under multiple tax numbers. In these cases, we have assigned physicians the tax number that appears on the plurality of their Medicare claims.

Because our definition of self-referral is based on Medicare claims data, which do not indicate where a test was performed, we are unable to determine whether the imaging study was performed in the practice's office or by another provider with whom the practice has a leasing arrangement. According to an analysis of data from a California insurer, more than 60 percent of the physicians

who billed the insurer for MRI or CT scans did not own the equipment; rather, they leased time from an imaging provider or paid the provider a set fee to perform the scan (Mitchell 2007). As described in the text box on p. 86, such arrangements may be structured to comply with the in-office ancillary exception to the Stark law.

Regardless of whether the study is performed on equipment owned by the practice or through a leasing arrangement with another provider, we assume that most physicians who refer patients to their practice for imaging services benefit indirectly from their referrals, as long as they are profitable for the practice. As described in the text box on p. 86, the Stark self-referral rules allow a group practice to use indirect methods to allocate profits from imaging to physicians in the practice, such as on a per capita basis or based on the distribution of nonancillary revenue. However, the rules allow a practice to allocate profits from imaging to a subset of five or more physicians, meaning that some physicians in the practice may not receive profits from imaging. In addition, the Stark law prohibits physicians who have a direct employment relationship with a hospital from being compensated based on their imaging referrals to the hospital, either directly or indirectly (Johnson and Walker Keegan 2006). Because we do not have data on the compensation methods of individual practices, we are not able to fully distinguish between physicians who benefit financially from referrals and those who do not. Therefore, our analysis may include some physicians who refer patients to their practices for imaging services but do not receive a share of the imaging profits. Including these physicians in the self-referral category reduces the likelihood of finding a significant difference between self-referring and non-self-referring physicians.

Although we can tell if a physician's practice bills Medicare for performing imaging studies, we are unable to detect other financial relationships that might influence physician referrals. For example, if a physician invests in a hospital, we would not know about his or her financial interest in the hospital's imaging equipment. Thus, our comparison group of non-self-referring physicians may include some who have a financial interest in imaging, which might bias our study toward finding no difference between self-referring and non-self-referring physicians.

Grouping claims into episodes and selecting episodes for analysis

Medicare claims from 2005 for beneficiaries in the six markets were grouped by Ingenix into clinical episodes using the ETGs episode grouper (version 7.0). The Commission has used ETGs and other groupers in prior work, and Chapter 3 in this report describes additional work using episode groupers (MedPAC 2007b, MedPAC 2006). Episode groupers are software packages that use clinical logic to assign claims to distinct episodes of care—a series of clinically related health care services over a defined time period, such as all claims related to a patient's diabetes. Episode groupers use all types of health care claims: inpatient admissions, physician visits, other outpatient services, and prescription drugs.[8] The ETGs software groups claims into episodes based on the patient's underlying condition, complications, comorbidities, treatment, and severity level.[9] In March 2009, Ingenix released its ETGs grouper methodology for public review and comment (Ingenix 2009).

For our analysis, we selected 13 ETGs that represent a broad range of conditions and imaging modalities and are treated by a variety of specialties (Table 4-2). For 10 of the ETGs, imaging accounted for at least 10 percent of overall resource use, on average. For each ETG, we selected one or two modalities that accounted for the largest share of imaging dollars within the episode type, for a total of 22 ETG-imaging categories.

Assigning physicians to episodes and categorizing episodes

We assigned physicians to an episode of care if they provided an evaluation and management (E&M) office visit that was part of the episode.[10] Almost two-thirds of the episodes (across all 13 ETGs) had only one physician who provided an office visit; one-quarter had two physicians and 11 percent had three or more. If an episode had multiple office visits provided by different physicians, each physician would be assigned to the episode. We used this method because each of the physicians who provided an office visit during the episode could have decided to order an imaging test.

Next, we divided all the episodes within an ETG into three categories:

- episodes in which at least one physician who met our primary definition of self-referral (more than 50 percent of the imaging studies ordered by the physician were performed by his or her practice) provided an E&M office visit;
- episodes in which no physician who met our primary definition of self-referral provided an office visit,

TABLE 4–2 **Type of episodes selected for analysis**

Type of episode (ETG®)	Primary imaging modalities	Primary specialties	Share of total dollars spent on imaging (all modalities), 2005
Cerebral vascular accident	MRI: brain, CT: head	Internal medicine, neurology, family practice	10.2%
Spinal trauma	MRI: other	Internal medicine, orthopedic surgery, family practice	6.0
Migraine headache	MRI: brain	Neurology, family practice, internal medicine	21.1
Ischemic heart disease	Echocardiography, nuclear medicine	Cardiology, internal medicine, family practice	9.8
Congestive heart failure	Echocardiography, nuclear medicine	Internal medicine, cardiology, family practice	3.8
Valvular disorder	Echocardiography, nuclear medicine	Cardiology, internal medicine, family practice	22.5
Malignant neoplasm of pulmonary system	CT: other	Internal medicine, hematology/ oncology, pulmonary disease	15.4
Kidney stones	CT: other	Urology, internal medicine, family practice	16.0
Joint degeneration, localized—back	Standard imaging, MRI: other	Internal medicine, family practice, orthopedic surgery	14.8
Joint degeneration, localized—neck	Standard imaging, MRI: other	Internal medicine, family practice, orthopedic surgery	15.7
Joint derangement—knee and lower leg	Standard imaging, MRI: other	Orthopedic surgery, family practice, internal medicine	16.4
Bursitis and tendonitis—shoulder	Standard imaging, MRI: other	Orthopedic surgery, internal medicine, family practice	13.8
Other minor orthopedic disorders—back	Standard imaging, MRI: other	Internal medicine, family practice	17.6

Note: ETG® (Symmetry Episode Treatment Groups®, an Ingenix, Inc., product), CT (computed tomography). Primary specialties are the specialties that account for at least 10 percent of the evaluation and management office visits for an ETG®.

Source: MedPAC analysis of 100 percent Medicare claims data from six markets (Boston, MA; Miami, FL; Orange County, CA; Greenville, SC; Minneapolis, MN; and Phoenix, AZ) using ETGs® version 7.0.

but at least one physician with a lower level of self-referral (referring between 1 percent and 50 percent of the imaging studies he or she ordered to his or her practice) furnished an office visit; and

- episodes in which no physician who met either definition of self-referral provided an E&M office visit.

To compare physicians with strong self-referral patterns with non-self-referring physicians, we dropped episodes in the middle category from our analyses. However, our risk-adjusted analysis (described below) tests the sensitivity of combining the first two categories into a single self-referral category.

Research suggests that radiologists can influence the ordering of imaging by making recommendations for

follow-up studies in their reports to the ordering physician (Lee et al. 2007).[11] Non-self-referring physicians are more likely to refer patients to radiologists for imaging studies; hence, any influence of radiologists on follow-up testing would be present in the comparison group of episodes with no self-referring physician (Gazelle et al. 2007, Hillman et al. 1992).

Methodology for basic and risk-adjusted analyses

We used the episode data to perform a basic descriptive analysis—with no adjustments for patient severity within the episode, geographic market, or physician specialty—and a risk-adjusted analysis that controlled for these factors. In the basic analysis, we calculated the proportion of episodes with and without a self-referring physician that received at least one imaging service for each ETG and modality (e.g., ischemic heart disease and nuclear medicine). This analysis included 493,000 episodes from 2005 across all 13 ETGs. On the basis of prior research, we expected to find that a higher proportion of episodes with a self-referring physician received an imaging study than episodes with no self-referring physician.

In our risk-adjusted analysis, we calculated the ratio of observed-to-expected spending for specific imaging modalities (e.g., CT (head)) for each ETG. The observed value equals the amount of spending for a particular episode. The expected value is based on average spending for episodes within a fairly narrow category: the same ETG (which varies depending on whether there are complications, comorbidities, or specific treatments), patient severity level, geographic market, and the specialty of the physician responsible for at least 35 percent of the E&M payments.[12] Thus, a ratio describes the costliness of an episode relative to similar episodes and patients. Imaging spending includes payments made by Medicare under the physician fee schedule and the hospital outpatient prospective payment system. The payment amounts for each claim within an episode have been standardized to remove the effects of geographic payment adjustments. The payments have been normalized to a base year (2001) because some of Medicare's payment systems are updated on a fiscal year, rather than a calendar year, basis. Thus, payment rates may change within a calendar year. Normalizing payments to a base year also facilitates comparisons across multiple years, which we plan to do in future work.

As part of our risk-adjusted analysis, we identified episodes that had a claim for an imaging interpretation (the professional component) but lacked an associated technical component claim for performing the imaging study. Such episodes might have had an imaging service provided during an inpatient stay, in which case there would be no technical component claim because Medicare's inpatient payment rate includes any facility services provided during the admission. Alternatively, the technical component claim associated with the professional component claim might have had a different diagnosis code, procedure code, or beneficiary identification number, in which case it could have been grouped with a different episode. In either case, the amount of imaging spending for the episode would be lower than for an episode in which a technical component claim is present. To avoid the possibility that such episodes (about 5 percent of the total) could bias our results, we did not include them in our ratio calculations.[13]

For the episodes in each self-referral category, we computed the mean ratio of observed-to-expected spending on imaging. This analysis included 443,000 episodes from 2005 across all 13 ETGs. On the basis of prior research, our hypothesis was that episodes linked to self-referring physicians would have higher ratios of observed-to-expected spending on imaging.

Results of analyses

We first present results from our basic analysis, which show that a greater proportion of episodes with a self-referring physician received at least one imaging service than episodes with no self-referring physician (Table 4-3). The magnitude of the variation ranges from 2 to 23 percentage points. In all but one case (malignant neoplasm of the pulmonary system and CT (other)), the differences are statistically significant using a univariate logistic regression. Although this analysis controls for the type of episode and imaging modality, it does not adjust for severity of illness within the episode, physician specialty, or the market area; our risk-adjusted analysis controls for these factors.

The results in Table 4-3 are comparable to previous research demonstrating that self-referring physicians are more likely to order imaging. The study by Gazelle and colleagues found that the proportion of episodes with self-referring physicians that received at least one imaging study was 1.5 to 14.0 percentage points higher than

TABLE 4–3

Episodes with a self-referring physician are more likely to receive at least one imaging service, 2005

ETG® and type of imaging	Percent of episodes with imaging: Episodes with self-referring physician	Percent of episodes with imaging: Episodes with no self-referring physician	Percentage point difference	Ratio	Number of episodes: With self-referring physician	Number of episodes: With no self-referring physician
Cerebral vascular accident—MRI: brain	37%	25%	12	1.5	1,774	43,822
Cerebral vascular accident—CT: head	36	29	7	1.3	1,483	43,892
Spinal trauma—MRI: other	37	22	15	1.7	505	6,570
Migraine headache—MRI: brain	14	8	6	1.5	311	7,393
Ischemic heart disease—nuclear medicine	38	19	19	2.0	72,361	94,956
Ischemic heart disease—echocardiography	50	27	23	1.8	74,397	69,284
Congestive heart failure—nuclear medicine	12	7	5	1.7	12,299	32,169
Congestive heart failure—echocardiography	36	26	10	1.4	13,561	25,422
Valvular disorder— nuclear medicine	16	8	8	2.1	10,123	12,323
Valvular disorder—echocardiography	67	46	21	1.5	11,451	8,397
Malignant neoplasm of pulmonary system—CT: other	75	73	2	1.0	459	5,807
Kidney stones—CT: other	58	50	8	1.2	718	7,919
Joint degeneration, localized, back—MRI: other	40	27	13	1.5	9,268	86,915
Joint degeneration, localized, back—standard imaging	60	38	22	1.6	39,913	39,880
Joint degeneration, localized, neck—MRI: other	35	22	13	1.6	2,608	29,521
Joint degeneration, localized, neck—standard imaging	58	35	23	1.6	13,315	13,400
Joint derangement, knee and lower leg—MRI: other	61	53	8	1.1	1,299	6,769
Joint derangement, knee and lower leg—standard imaging	72	58	15	1.3	5,513	1,820
Bursitis and tendonitis, shoulder—MRI: other	26	14	12	1.9	1,683	11,969
Bursitis and tendonitis, shoulder—standard imaging	59	38	21	1.6	7,645	4,033
Other minor orthopedic disorders, back—MRI: other	14	6	8	2.3	705	12,372
Other minor orthopedic disorders, back—standard imaging	38	24	14	1.6	3,546	6,525

Note: ETG® (Symmetry Episode Treatment Groups®, an Ingenix, Inc., product), CT (computed tomography). Episodes with imaging have at least one physician fee schedule or hospital outpatient department claim for a given type of imaging service. For each type of imaging, a self-referring physician is one who referred more than 50 percent of the imaging services he or she ordered during the year to his or her practice. Physicians were assigned to an episode if they provided an evaluation and management office visit during the episode. Except for malignant neoplasm of the pulmonary system, the difference between episodes with a self-referring physician and episodes with no self-referring physician is statistically significant ($p < 0.05$) using a univariate logistic regression for all comparisons. Percentage point differences reflect the effects of rounding.

Source: MedPAC analysis of 100 percent Medicare claims data from six markets (Boston, MA; Miami, FL; Orange County, CA; Greenville, SC; Minneapolis, MN; and Phoenix, AZ) using ETGs® version 7.0.

episodes with radiologist-referring physicians, depending on the ETG (Gazelle et al. 2007). Depending on the clinical condition, Hillman and colleagues found that the proportion of episodes with self-referring physicians that received at least one imaging study was 6 to 47 percentage points higher than episodes without self-referring physicians (Hillman et al. 1992).

For our risk-adjusted analysis, we compared imaging spending for episodes with and without a self-referring physician by computing the mean ratio of observed-to-expected spending on imaging for each ETG and modality. The expected spending level for each episode varies by its ETG, modality, patient severity level, geographic market, and physician specialty.

As shown in Table 4-4 (p. 94), episodes with a self-referring physician have a higher mean ratio of observed-to-expected spending for an imaging modality than episodes with no self-referring physician. The differences

TABLE 4–4

Episodes with a self-referring physician have higher ratios of observed-to-expected imaging spending, by ETG® and type of imaging, 2005

	Mean ratio of observed-to-expected imaging spending			Number of episodes	
ETG® and type of imaging	Episodes with self-referring physician	Episodes with no self-referring physician	Percent difference	With self-referring physician	With no self-referring physician
Cerebral vascular accident—MRI: brain	1.39	0.96	45%	1,470	31,606
Cerebral vascular accident—CT: head	1.49	0.97	55	1,142	29,553
Spinal trauma—MRI: other	1.43	0.94	53	393	3,111
Migraine headache—MRI: brain	1.76	0.95	85	267	4,383
Ischemic heart disease—nuclear medicine	1.37	0.69	100	69,225	89,462
Ischemic heart disease—echocardiography	1.35	0.69	96	67,808	60,414
Congestive heart failure—nuclear medicine	1.54	0.75	104	11,137	28,543
Congestive heart failure—echocardiography	1.44	0.74	96	11,335	20,104
Valvular disorder—nuclear medicine	1.31	0.72	83	9,504	10,911
Valvular disorder—echocardiography	1.15	0.81	42	10,804	7,081
Malignant neoplasm of pulmonary system—CT: other	1.12	0.97	15	392	3,306
Kidney stones—CT: other	1.32	0.95	39	633	4,747
Joint degeneration, localized, back—MRI: other	1.18	0.96	23	8,980	82,720
Joint degeneration, localized, back—standard imaging	1.20	0.82	47	38,260	36,687
Joint degeneration, localized, neck—MRI: other	1.27	0.95	34	2,481	27,140
Joint degeneration, localized, neck—standard imaging	1.20	0.81	49	12,461	12,170
Joint derangement, knee and lower leg—MRI: other	1.03	0.98	5	1,251	6,322
Joint derangement, knee and lower leg—standard imaging	1.02	0.96	6	5,312	1,625
Bursitis and tendonitis, shoulder—MRI: other	1.20	0.93	29	1,616	11,268
Bursitis and tendonitis, shoulder—standard imaging	1.10	0.90	22	7,352	3,642
Other minor orthopedic disorders, back—MRI: other	1.52	0.95	59	690	11,673
Other minor orthopedic disorders, back—standard imaging	1.14	0.93	23	3,443	5,931

Note: ETG® (Symmetry Episode Treatment Groups®, an Ingenix, Inc., product), CT (computed tomography). This analysis excludes episodes in which there is a claim for interpreting an imaging study but no claim for performing an imaging study; in these episodes, either the imaging study was provided during an inpatient stay or the claim for performing the study is missing from the episode. The expected value in the ratio equals average spending for episodes within the same ETG®, patient severity level, geographic market, and physician specialty. Thus, the ratios describe the costliness of an episode relative to similar types of episodes. The spending amounts have been standardized to remove the effects of geographic payment adjustments. For each type of imaging, a self-referring physician is one who referred more than 50 percent of the imaging services he or she ordered during the year to his or her practice. Physicians were assigned to an episode if they provided an evaluation and management office visit during the episode. The difference between episodes with a self-referring physician and episodes with no self-referring physician is statistically significant ($p < 0.05$) for all comparisons using a Wilcoxon rank order test. The statistical testing does not adjust for the clustering of episodes for the same patient or same physician.

Source: MedPAC analysis of 100 percent Medicare claims data from six markets (Boston, MA; Miami, FL; Orange County, CA; Greenville, SC; Minneapolis, MN; and Phoenix, AZ) using ETGs® version 7.0.

between the ratios range from 5 percent to 104 percent, depending on the ETG and type of imaging. Across all the ETGs and imaging types, the mean difference between the ratios was 68 percent (weighted by the number of episodes in each ETG and imaging type). In all the comparisons, the differences are statistically significant using a Wilcoxon rank order test. The analysis includes episodes with and without spending on the imaging modality being examined.

Our results indicate that episodes with a self-referring physician are associated with greater imaging spending than episodes with no self-referring physician, controlling for differences in patient severity level, geographic market,

and physician specialty. For example, the mean spending ratio for nuclear medicine for ischemic heart disease was twice as high for episodes with a self-referring physician as for episodes with no self-referring physician. Although prior studies have not compared ratios of observed-to-expected spending on imaging for episodes with and without self-referring physicians, our results are consistent with previous research showing that self-referring physicians are more likely than other physicians to order imaging (see text box on pp. 88–89).

We tested a less restrictive definition of self-referral based on whether a physician's practice performed at least 1 percent of the imaging services ordered by that physician during the year. Similar to the results described above, episodes with a self-referring physician (based on the less restrictive definition) had ratios of observed-to-expected spending on imaging that were between 5 percent and 100 percent higher than episodes with no self-referring physician (the differences for all comparisons are statistically significant using a Wilcoxon rank order test). Across all the ETGs and imaging types, the mean difference between the ratios using the less restrictive definition of self-referral was 57 percent, compared with a 68 percent difference when using the more stringent definition of self-referral. As we would expect, the spending gap between episodes with and without a self-referring physician becomes smaller when we include physicians with weaker self-referral patterns in the self-referring group.

Do episodes with more imaging have higher or lower total spending?

We used the same 13 ETGs that we included in our self-referral analysis to investigate whether greater use of imaging is associated with higher or lower total spending in an episode. Some studies have found that the use of imaging in specific clinical circumstances saves money by preventing expensive interventions and hospital admissions or reducing hospital length of stay. For example, the use of CT scans for suspected appendicitis has been reported to prevent unnecessary appendectomies and hospital admissions and to result in net savings (Rao et al. 1998). A study from the United Kingdom estimated that the costs of immediately performing CT scans on patients with acute stroke are offset by savings in reduced length of stay (Wardlaw et al. 2004). Another study found that patients with transient ischemic attack who received a diagnostic protocol that involved more imaging tests had shorter lengths of stay and lower hospital costs than patients in the control group (Ross et al. 2007). On the other hand, results from imaging studies may initiate a cascade of diagnostic tests and interventions, thereby increasing total episode costs. In some cases, incidental findings or false-positive results from imaging tests can lead to follow-up testing and surgical interventions with uncertain benefits for patients (Deyo 2002). For example, CT scans sometimes reveal benign adrenal tumors that are followed up with multiple blood tests and repeat imaging.

As with our analysis of physician self-referral, we calculated ratios of observed-to-expected spending for each episode. The expected value is based on average spending for episodes within the same ETG, patient severity level, geographic market, and physician specialty. We calculated the correlation coefficient for the ratio of observed-to-expected imaging spending and the ratio of observed-to-expected total spending for the episodes in an ETG (the unit of observation was an individual episode). If higher-than-expected use of imaging is associated with lower-than-expected use of all services, we would find a negative correlation. If higher-than-expected use of imaging is associated with higher-than-expected use of all services, we would find a positive correlation. This analysis included 509,000 episodes from 2005 across all 13 ETGs.

For each ETG, observed-to-expected imaging use was positively correlated with observed-to-expected total resource use, suggesting that more imaging is associated with greater overall resource use during the episode (Table 4-5, p. 96). The correlations are different from 0 at a statistically significant level. In addition, we found that greater use of imaging within specific modalities (e.g., nuclear medicine or echocardiography for ischemic heart disease) is associated with higher overall resource use during an episode. The ratio of observed-to-expected imaging use was also positively correlated with the ratio of observed-to-expected procedure use, indicating that, on average, more spending on imaging is associated with slightly higher spending on procedures during an episode (Table 4-5, p. 96). For four of the five ETGs with substantial inpatient spending, there was a slightly positive correlation between the ratio of observed-to-expected imaging use and the ratio of observed-to-expected inpatient hospital use.[14]

These findings support the hypothesis that, on average, higher spending on imaging within an episode is

TABLE 4–5

Greater use of imaging is correlated with higher total resource use and higher use of procedures within an episode, 2005

ETG®	Correlation coefficient: Imaging and total resource use	Correlation coefficient: Imaging and procedure use	Number of episodes used in correlation of imaging and total resource use
Cerebral vascular accident	0.25	0.06	47,938
Spinal trauma	0.26	0.13	7,481
Migraine headache	0.59	0.09	7,536
Ischemic heart disease	0.33	0.12	182,578
Congestive heart failure	0.19	0.09	47,519
Valvular disorder	0.37	0.06	24,036
Malignant neoplasm of pulmonary system	0.60	0.20	7,003
Kidney stones	0.56	0.20	8,998
Joint degeneration, localized—back	0.38	0.14	104,319
Joint degeneration, localized—neck	0.42	0.12	34,223
Joint derangement—knee and lower leg	0.45	0.09	9,127
Bursitis and tendonitis—shoulder	0.44	0.08	14,912
Other minor orthopedic disorders—back	0.52	0.08	13,444

Note: ETG® (Symmetry Episode Treatment Groups®, an Ingenix, Inc., product). Pearson correlation coefficients were calculated by comparing ratios of observed- to-expected imaging use with ratios of observed-to-expected total resource use (or observed-to-expected procedure use) for episodes in the same ETG®. The expected value of each ratio equals average spending for episodes within the same ETG®, patient severity level, geographic market, and physician specialty. All of the correlations are different from 0 at a statistically significant level ($p < 0.0001$). The number of episodes used to calculate the correlation of imaging and procedure use (not shown) was slightly smaller than the number used in the correlation of imaging and total resource use due to missing values.

Source: MedPAC analysis of 100 percent Medicare claims data from six markets (Boston, MA; Miami, FL; Orange County, CA; Greenville, SC; Minneapolis, MN; and Phoenix, AZ) using ETGs® version 7.0.

associated with higher total episode spending, at least for the 13 conditions in our study. There are three possible reasons why our findings differ from studies indicating that the use of certain imaging tests in specific circumstances reduces the use of other services, such as surgical procedures and hospital days:

- Our analysis examined the relationship between the use of imaging services (in aggregate or within specific modalities) and total resource use within an episode, whereas the studies cited above evaluated the impact of specific tests performed within a limited time frame on the use of a specific type of service; for example, whether immediately performing CT scans on patients with acute stroke reduces the length of a hospital stay (Wardlaw et al. 2004).
- Our analysis defined resource use as standardized Medicare payments, whereas two of the studies cited above examined costs incurred by hospitals during an admission (Ross et al. 2007, Wardlaw et al. 2004). Under the Medicare acute hospital inpatient prospective payment system, payments do not generally vary even if the length of stay and other hospital costs decline for an admission.
- We examined 13 ETGs, and the relationship between imaging use and the use of other services may vary for other clinical conditions (e.g., suspected appendicitis).

Future work

Because this chapter presents descriptive statistics from a single year of data (2005), we plan to conduct multivariate analyses with data from multiple years to help determine the relative impact of various factors on the use of imaging during an episode, such as the specialty and self-referral status of physicians involved

with the episode, the beneficiary's geographic location, and the number of physicians involved in the episode. Further, we will examine whether physicians order more imaging after their practices begin performing in-office imaging. We also plan to evaluate whether measures of appropriate imaging use can be linked to our data on self-referring physicians.

Moreover, we intend to explore policies to encourage more prudent use of imaging services. One option is to encourage greater adherence by physicians to appropriateness criteria developed by specialty societies. Another option is to increase the size of the unit of payment in the physician fee schedule to include bundles of services that physicians often furnish together or during the same episode of care. The Commission has expressed concern that the relatively small units of payment for many physician services could give physicians a financial incentive to increase volume (MedPAC 2005b). ■

Endnotes

1 For example, the services must be personally furnished by the referring physician, a physician who is a member of the group, or an individual who is supervised by the referring physician or another physician in the group. The services must be furnished in the same building where the referring physician provides non-DHS services or in a centralized building that the group uses to provide DHS services. Further, the services must be billed by the physician performing or supervising the service, the group practice, a wholly owned entity, or a third-party billing company acting as an agent of the physician or group (42 CFR § 411.355).

2 Such arrangements would have to comply with at least two other federal requirements: (1) the anti-kickback statute, which prohibits the offer, payment, or receipt of anything of value to induce the referral of patients for services reimbursed by federal health programs, and (2) the anti-markup rules, which apply to a physician who bills Medicare for diagnostic tests that are performed (or supervised) by a physician who does not share a practice with the billing physician. In such cases, Medicare will not pay more than the performing provider's net charge to the billing physician. CMS recently clarified that the anti-markup rules do not apply to tests performed or supervised by a physician in the same building where the billing physician regularly furnishes patient care (42 CFR § 414.50).

3 The comparison of charges was not based on relative value units and did not adjust for geographic differences in input prices.

4 The six episodes included cardiopulmonary disease, cardiac or coronary artery disease, extremity fracture, knee pain or injury, known or suspected abdominal malignancy, and known or suspected stroke.

5 For all but one of the comparisons, patients of self-referring physicians were 1.2 to 3.2 times more likely to have an imaging study than patients of radiologist-referring physicians.

6 The inclusion of physicians without a financial interest in imaging in the self-referral group likely reduced the overall use of imaging by that group, thereby reducing the size of the difference in imaging use between the self-referring and radiologist-referring groups.

7 To determine a physician's self-referral percentage for a specific modality, we first calculated the number of technical component and global claims billed by each physician's practice in which that physician was listed as the ordering physician. We then divided that number by the total number of professional component and global claims within the modality ordered by that physician during the year, whether they were provided in an inpatient hospital setting, hospital outpatient department, physician office, or freestanding imaging center. Most physicians did not refer any imaging services to their practice. Of those who did, about half referred more than 90 percent of the studies they ordered to their practice.

8 Because our data precede implementation of Medicare Part D, our episodes lack data on spending on outpatient prescription drugs.

9 The software uses evaluation and management, procedure, and facility claims (but not claims for imaging services) to classify patients into episodes, to determine whether patients have complications or comorbidities, and to identify patient severity levels. However, an imaging service may produce a diagnosis that leads to evaluation and management, procedure, or facility services.

10 We did not assign episodes to radiologists because, under Medicare's rules, they are generally not allowed to order imaging studies. In any event, radiologists are unlikely to bill for E&M services.

11 According to one article, 8 percent of high-cost imaging studies are repeat studies recommended by radiologists in their reports on the preceding examination (Lee et al. 2007).

12 The software assigns episodes a severity score based on the age and gender of the patient, complications and comorbidities associated with the episode, and the interaction of multiple complications and comorbidities. Episodes are classified into as many as four severity levels based on the severity score. The distribution of episodes by patient severity was similar for episodes with and without a self-referring physician.

13 However, our analysis of the percent of episodes in each self-referral category with at least one imaging service includes episodes that had a claim for an imaging interpretation but lacked an associated technical component claim for performing the study. Including these episodes does not bias the results of this analysis because we are counting episodes that received at least one imaging service rather than calculating imaging dollars per episode.

14 The correlation coefficients for the ratio of imaging use and the ratio of inpatient hospital use for four ETGs (cerebral vascular accident, spinal trauma, ischemic heart disease, and congestive heart failure) ranged from 0.07 to 0.08 and were different from 0 at the statistically significant level of $p < 0.0001$. The correlation for these variables for malignant neoplasm of the pulmonary system was not statistically different from 0.

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