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TECHWATCH

Imaging Self-Referral Associated With Higher Costs And Limited Impact On Duration Of Illness

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ABSTRACT Self-referral for imaging services occurs when a physician sends patients to receive an imaging procedure from a device that the physician owns or leases. Advocates argue that this shortens the duration of illness and lowers costs. For twenty common combinations of medical conditions and types of imaging, we evaluated the association between self-referral, duration of illness episode, and three measures of cost. Self-referral was associated with significantly and substantially higher episode costs for most of the combinations of medical conditions and imaging that we studied. There was no decrease in the length of illness, except when doctors self-referred patients to receive x-rays for a few common conditions. These findings indicate that except for x-rays, constraining the self-referral of imaging may be appropriate.

When a physician sends patients to receive an x-ray, computed tomography (CT) scan, or other imaging from equipment that the physician owns or leases, the practice is called self-referral. It is controversial. Supporters believe that self-referral usually leads to earlier imaging and sometimes may involve more extensive testing. This, they say, often leads to a faster and more accurate diagnosis, which in turn makes it possible to begin treatment more quickly.^{1–4} Supporters also contend that the total costs of an episode of care may be lower—or, at least, not higher—despite increased use of imaging. They argue that an earlier and more accurate diagnosis leads to better treatment and helps the patient recover faster.

For their part, critics say that self-referral increases the use of imaging.^{5–11} This, they say, elevates health costs and increases radiation exposure.^{12–15}

Empirical research on self-referred imaging has focused on utilization and has largely neglected self-referral's effects on illness duration and costs.^{5–8,10}

The Affordable Care Act of 2010 requires physicians who self-refer for imaging to inform their patients that they can obtain imaging services elsewhere. The law also authorizes the US Department of Health and Human Services (HHS) to study the impact of varying payments to physicians who order high-tech imaging such as CT or magnetic resonance imaging (MRI).

However, such payment reforms might not be as effective as proponents of the law anticipate. The Deficit Reduction Act of 2005 instituted major Medicare payment reductions for much of the high-tech imaging performed in doctors' offices. One preliminary analysis of the act's impact found that the payment cuts did not curtail the rapid growth of self-referred, in-office MRI and CT scans.¹⁶

Our objective was to study some of the possible benefits of self-referral. We measured the duration and costs of episodes of care for a wide range of nonchronic medical conditions. We then compared the results that pertained to care delivered by self-referring physicians to results that pertained to care delivered by non-self-referring physicians. Specifically, for each episode of care, we compared the duration of care, and also total

costs, imaging costs, and non-imaging costs.

To our knowledge, this is the first study to examine the effects of self-referral on episode duration and cost. Our analyses included controls for patients' demographic characteristics, patients' general health status and illness severity, and physicians' specialty. We used multiple years of patient data.

Study Data And Methods

We tested the hypothesis that patients treated by self-referring physicians, on average, have shorter care episodes than those treated by physicians who do not self-refer. We also tested the hypothesis that costs incurred by patients treated by self-referring doctors are no higher than costs incurred by other patients.

DATA SOURCE We obtained data from Medicare's Research Identifiable Files for all claims from a 5 percent random sample of Medicare fee-for-service beneficiaries for services during the period 2004–7. These files contain a Unique Physician Identification Number that identifies each physician and an encrypted identification number for each beneficiary.

We grouped claims of all types (not merely physician claims) into care episodes using the Symmetry Episode Treatment Grouper, version 7.5. We confined our study to care episodes in which all of the "evaluation and management" claims—principally claims for visits—for the care of a medical condition were in nonhospital settings. We did this because hospital privileges delineate what each physician is permitted to do in the hospital. This often substantially restricts opportunities for self-referral.

In contrast to evaluation and management services, imaging in the episodes studied might take place in any setting. We defined the *treating physician* for an episode of care as the physician listed on the first evaluation and management claim associated with the episode.

As noted, in order to observe the full effects of self-referral, it was necessary to limit our study to episodes that had evaluation and management claims only in nonhospital settings. However, in their initial phases, some of the medical conditions in our study are typically treated, at least partly, at a hospital. As a result, we were restricted to principally studying the postacute phase of these conditions.

To prevent possible misclassification from capturing a limited sample of a physician's behavior, we included a physician and the services he or she rendered in our analysis only if the physician had provided at least fifty evaluation and management services overall during the four-year study period (2004–7).

We identified and categorized imaging using the standard Berenson-Eggers Type of Service (BETOS) codes.¹⁷ We classified physicians as self-referring or not self-referring separately for CT, MRI, nuclear medicine procedures, ultrasound, and x-rays. We defined a *self-referrer* as a physician who appeared as both the referring and the performing physician on the same claim for a given type of imaging at least five times during a particular year.

We tested our results for robustness by using an alternative, "imager," definition of *self-referral*. *Imagers* were defined as physicians who billed for an imaging procedure in a modality (CT scan, x-ray, or other type of imaging) at least five times during a year. The "imager" definition does not require use of the referring physician information on a claim and recognizes the financially self-interested nature of situations in which, for example, one cardiologist in a cardiology group mostly provides office visits and refers patients for imaging to another cardiologist in the group who predominantly does imaging. If results are strongly similar with either definition of *self-referral*, that shows that our findings are not dependent on a particular definition of *self-referral*.

We determined episode duration by the number of days spanning the episode's start and end dates provided by the Episode Treatment Grouper. For each episode studied, total costs, imaging costs, and non-imaging costs were computed by summing all of the Medicare-allowed charges—including amounts that the patient or supplemental insurance had to pay—from all claims associated with the episode. We inflated all cost data to 2007 dollars using the Consumer Price Index and adjusted data for geographic price differences using Medicare's geographic price adjusters for each type of service.¹⁸

ANALYSIS Because episode duration and costs may be strongly affected by patients' characteristics, we used multivariate regression to estimate the relationship between self-referral in specific types of imaging and the duration and costs of episodes of care. We estimated this separately for ten broad nonchronic medical conditions, which consist of all episodes in forty-six narrower nonchronic Episode Treatment Groups; these groups are the direct product of the Episode Grouper.

The regressions controlled for patients' age, race, sex, and prospective risk score prior to the episode. The risk score measures patients' general health status. The regressions also controlled for the severity of the condition being studied, the treating physician's specialty, and episode calendar year. To control for geographic variation, the regressions also controlled for the

patients' state of residence.

We performed an analysis for each of the types of imaging commonly used for each of the ten conditions. In total, we studied twenty condition-imaging combinations. We conducted analyses separately for each. For each of the twenty combinations, we performed an analysis separately for episode duration and for each of the cost measures studied.

We included all episodes of a studied condition regardless of whether or not a physician self-referred. We used an indicator (dummy) variable to note episodes in which the treating physician was identified as a self-referrer in the imaging category of interest.

The episode duration and cost data were transformed into natural logarithms. This allows the estimates to be interpreted directly as percentages rather than as days or dollars.

We calculated a weighted mean to examine mean outcome differences associated with self-referral for an imaging type across the multiple medical conditions for which that imaging procedure was used. We weighted each condition for which the imaging type was studied by the number of episodes of that condition in our data.

A more extensive discussion of our methods, as well as tables detailing both the specific Episode Treatment Groups examined and descriptive statistics, is available in the online Appendix.¹⁹

LIMITATIONS Our study had a number of limitations. Our analyses identified associations, not causes. We did not investigate all of the possible benefits of self-referral for imaging. For example, we did not consider the convenience of having imaging at the same time and in the same place as the initial visit to a treating physician's office.

Self-referrers may deal differently with a younger population than with the elderly population of our Medicare sample. It is also possible that the Episode Treatment Grouper's computed severity scores do not fully capture subtle differences between episodes of the same condition. We did not investigate the possibility that self-referral serves as a signal. For example, physicians may feel that they provide better-quality care if their practice has high-tech imaging equipment as well as more traditional equipment, or may feel that patients will judge such equipment to be a sign of quality. Patients may take it to be evidence of particularly high quality.

Study Results

The Episode Treatment Grouper produced 1,056,883 episodes of the medical conditions we examined after selecting episodes that had

only nonhospital evaluation and management claims. Of these, 918,058 met our criterion of at least fifty evaluation and management claims for the treating physician. After we excluded patients younger than age sixty-five, 733,459 episodes remained that were free of missing data and suitable for analysis. They involved 470,530 unique patients and 146,623 unique physicians.

ASSOCIATION WITH ILLNESS LENGTH AND COSTS Self-referral was significantly ($p < 0.01$) associated with shorter illnesses only for x-rays for chest pain, respiratory illness, and sinusitis (Exhibit 1).

Self-referral was associated with a statistically significant difference in mean total costs in fourteen of the twenty medical condition and imaging-type pairs studied (Exhibit 1). Of those fourteen, mean total episode costs were higher for self-referring physicians in all but one of the pairs. The largest excess, in percentage terms, was for ultrasound (echocardiography) for the diagnosis of heart disease. The single finding of lower cost was for self-referred x-rays in the diagnosis of extremity dislocations and fractures.

Mean imaging costs were significantly higher for self-referring physicians in fifteen of twenty pairs (Exhibit 1). The largest cost excess was for episodes of heart disease in which the treating physician self-referred ultrasounds.

Mean non-imaging costs differed significantly in nine of the twenty combinations of medical condition and imaging type. Higher non-imaging costs were found for self-referral in seven condition-imaging combinations, and lower non-imaging costs were found in two combinations (Exhibit 1).

Results using the alternative "imager" definition of self-referral were very similar. For example, two of the medical condition-imaging type combinations—x-rays for respiratory illness and for sinusitis—showed a significantly shorter duration when treated by physicians identified as imagers. Using the "imager" definition, thirteen of the twenty medical condition-imaging-type combinations studied were associated with statistically significant differences in mean total episode cost; this cost was higher for imagers in all but one of these combinations.

AVERAGE EFFECT BY TYPE OF IMAGING On average, self-referral for conventional x-rays was associated with substantially (5 percent) shortened duration (Exhibit 2). Self-referral was associated with higher mean costs across essentially all of the imaging types and cost outcomes (Exhibits 3–5). Mean total episode cost was in the range of 4–10 percent higher with self-referral than without, depending on the type of imaging studied, and mean imaging cost per episode was 27–40 percent higher. Mean total

EXHIBIT 1

Effect Of Self-Referral For Imaging On Selected Patient Outcomes, By Condition And Modality

Type of imaging	Episode duration (%)	Episode cost (%)	Episode imaging cost (%)	Episode non-imaging cost (%)
BACK, PAIN AND MINOR TRAUMA				
MRI	12.6*	19.6****	61.5****	7.7**
X-ray	-0.6	6.2****	30.7****	4.5****
CHEST, PAIN AND OTHER SYMPTOMS				
CT	2.4	14.4****	55.4****	0.7
Nuclear medicine	-0.6	10.3****	28.6****	1.9
Ultrasound	-0.7	2.4	1.7	0.3
X-ray	-6.3****	-0.9	17.3****	-1.6*
HEADACHE				
CT	12.2	13.4***	13.1	9.4**
MRI	-8.1	0.4	11.0	-2.1
BENIGN DIGESTIVE SYSTEM NEOPLASMS				
CT	-3.1	-7.2*	16.9**	-9.7**
EXTREMITY FRACTURE AND DISLOCATION				
X-ray	-4.0*	-6.0****	10.7****	-6.2****
HEART DISEASE				
Nuclear medicine	0.9	10.6****	37.1****	2.3*
Ultrasound	-0.2	22.3****	69.0****	9.0****
THIGH, HIP, AND PELVIS TRAUMA AND FRACTURE				
X-ray	2.4	4.4	30.2****	1.9
KNEE AND LOWER LEG INJURY, INFLAMMATION				
MRI	0.5	2.0	34.1****	-7.3***
X-ray	0.3	3.6***	29.8****	1.1
RESPIRATORY DISEASE				
CT	-1.1	11.3***	34.0****	7.2****
Ultrasound	-0.8	3.9****	19.7****	2.0****
X-ray	-5.9****	6.2****	38.1*	3.4****
SINUSITIS				
CT	-1.0	11.6****	38.8****	4.8****
X-ray	-7.8****	3.6****	18.4****	2.0****

SOURCE Authors' analyses of Medicare data from Medicare 5 percent Research Identifiable Files for 2004-7. **NOTES** Asterisks are significance indicators for the difference in sample means for self-referral versus non-self-referral. Percentages shown are estimates of the relative difference between self-referral and non-self-referral for each variable/condition pair, calculated as differences between natural logarithms of the sample means. CT is computed tomography. MRI is magnetic resonance imaging. **p* < 0.10 ***p* < 0.05 ****p* < 0.01 *****p* < 0.001

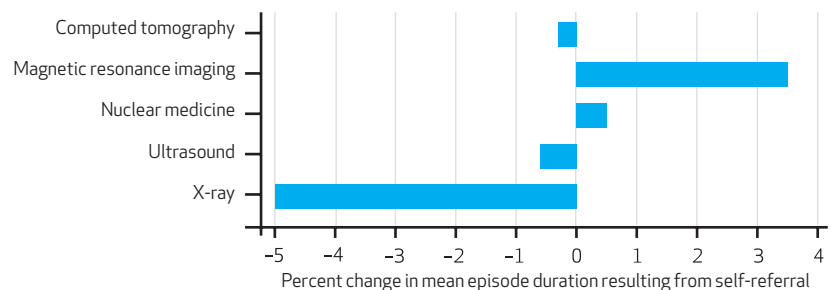
non-imaging cost per episode was not lower with self-referral than without for any type of imaging. Indeed, for CT, the total non-imaging cost per episode averaged 5 percent higher with self-referral than without. For most other types of imaging, it was somewhat higher with self-referral than without, although by lesser amounts.

Discussion

PRINCIPAL FINDINGS Based on our findings, for types of imaging other than x-rays, we reject the hypothesis that self-referral for imaging in non-hospital settings is associated with shorter episodes of illness than occur in the absence of self-referral. Separate analyses of thirteen medical condition-imaging combinations for these

EXHIBIT 2

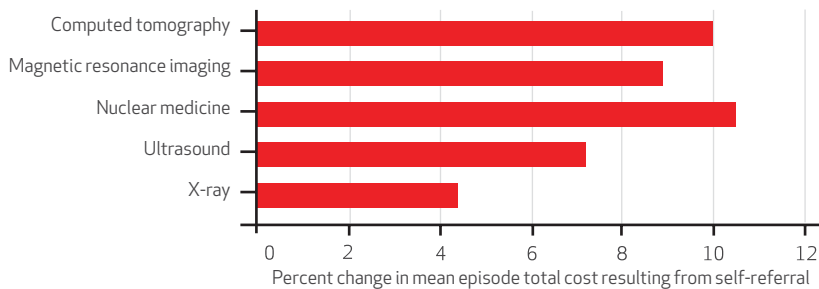
Average Effect Of Self-Referral For Imaging On Mean Episode Duration



SOURCE Authors' analyses of Medicare data from 5 percent Research Identifiable Files for 2004-7.

EXHIBIT 3

Average Effect Of Self-Referral For Imaging On Mean Episode Total Cost



SOURCE Authors' analyses of Medicare data from 5 percent Research Identifiable Files for 2004–7.

modalities showed none with shorter duration.

In contrast, three of seven analyses showed that the use of x-ray associated with self-referral was associated with shorter duration of illness—a reduction of 5 percent, on average, across all analyses.

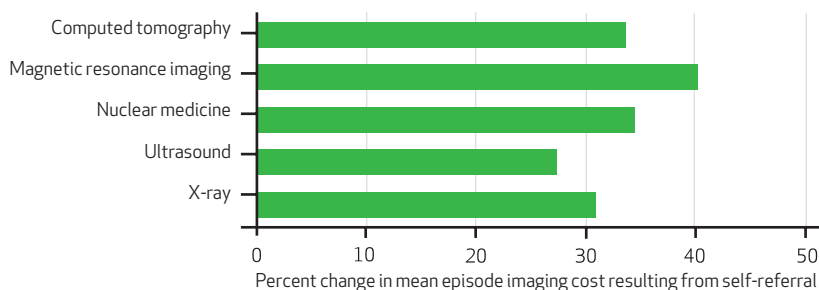
It is possible that x-rays alone are associated with shorter episodes because they are the only type of self-referred imaging that typically takes place on the same day as an office visit. For advanced imaging such as CT, MRI, and nuclear medicine, in only 10 percent of cases do self-referred scans take place on the same day as an office visit.²⁰

We also reject the hypothesis that total episode costs are no higher with self-referral than without. In our twenty analyses, thirteen showed significantly higher costs with self-referral, and only one showed a significantly lower cost. Depending on the type of imaging used, costs averaged 4–10 percent higher with self-referral.

In addition, we found that imaging costs per episode were higher when associated with self-referral than without. Imaging costs were significantly higher in fifteen of twenty analyses and lower in none. They averaged 27–40 percent

EXHIBIT 4

Average Effect Of Self-Referral For Imaging On Mean Episode Imaging Cost



SOURCE Authors' analyses of Medicare data from 5 percent Research Identifiable Files for 2004–7.

higher.

We also found that non-imaging costs per episode were not lower in cases associated with self-referral. In six of the twenty analyses, non-imaging costs were significantly higher when imaging was self-referred than when it wasn't. In twelve analyses, there was no significant difference, and in only two analyses were non-imaging costs lower when imaging had been self-referred.

Our findings cannot be attributed to factors such as patients' age, health status, or severity of illness, to the specialty of their physicians, or to the geographic locale of care, because our analyses controlled for these factors.

In general, the results indicate that within our research sample, physician self-referral for imaging is not associated with significant benefits for patients in either illness duration or health care costs. One possible exception is when a treating physician self-refers for x-rays. In the case of x-rays for chest pain, the shorter episode duration is not accompanied by any significant difference in total episode costs. Therefore, if only episode duration and cost are considered, self-referral in this case has an overall advantage because it combines a health benefit—shorter duration—with no cost disadvantage.

In the case of x-rays for sinusitis, the 7.8 percent shorter duration associated with self-referral was accompanied by 3.6 percent higher costs. At the mean of the data—duration of 16.1 days and a cost of \$108—this amounts to 1.3 illness-free days gained at a cost of \$3.92. In the case of x-rays for respiratory illness, self-referral's 5.9 percent shorter duration is accompanied by 6.2 percent higher costs. At the mean of the data—15.0 days' duration and \$157 total costs—this amounts to a duration of 0.9 day shorter in exchange for a \$9.79 higher cost. For the remaining condition-imaging combinations studied, we identified no similar potential net benefits.

OTHER STUDIES Our finding that self-referral is associated with higher imaging costs is consistent with a recent Medicare Payment Advisory Commission (MedPAC) study of twenty-two medical condition-imaging-type combinations among Medicare beneficiaries in six major US markets in 2005.¹⁵

In each of the twenty-two combinations, MedPAC found that self-referring physicians had higher ratios of observed-to-expected spending on imaging than doctors who did not self-refer. MedPAC also found a positive correlation between higher imaging costs and higher total episode costs. This suggests that total episode costs may be higher with self-referral.

Importantly, the MedPAC study did not exclude episodes with evaluation and management claims in hospital settings, and it used defini-

tions of *self-referral* that differed slightly from ours. The similarity of results with methodologies that differ somewhat in their details provides evidence that the findings of both studies are probably robust.

Conclusions

Our study provides broad evidence that physician self-referral for imaging typically is not associated with substantial benefits in treatment duration or costs. We found that self-referral for imaging is associated with significantly and substantially higher total care costs in the majority of medical conditions and imaging types we examined. Additionally, we found that self-referral is not associated with shorter illnesses, except in the case of self-referred x-rays for some conditions.

Federal law governing Medicare and Medicaid generally prohibits a physician from referring a patient to a facility in which the doctor has a financial interest.²¹ However, there is an exemption for designated “ancillary” services, including imaging, if they are delivered in the treating physician’s office. Among the rationales for this exemption are the convenience of one-stop service and expediting the care process.

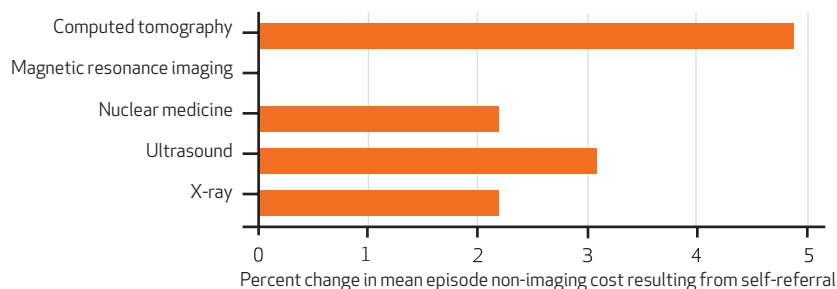
However, we found that illnesses are not resolved more quickly with imaging self-referral, except for some use of x-rays. Others have found that with the same exception, self-referral infrequently provides one-stop service.²¹

There are, in fact, two possible negative consequences of self-referral: our finding of higher costs for self-referred imaging, and literature that shows higher imaging utilization—which means more radiation exposure.

Based on our findings, we conclude that the Medicare exemption for self-referred imaging

EXHIBIT 5

Average Effect Of Self-Referral For Imaging On Mean Episode Non-Imaging Cost



SOURCE Authors’ analyses of Medicare data from 5 percent Research Identifiable Files for 2004–7.

should be narrowed so that it includes only x-rays, not other forms of imaging. To the extent that state laws or private payers permit self-referral for imaging, they would also do well to follow this policy.

MedPAC²¹ has suggested that, alternatively, the problem of self-referral could be successfully addressed by reducing payments for in-office imaging. The Deficit Reduction Act of 2005 instituted major reductions in payment for much of Medicare in-office high-tech imaging beginning in 2007, and further cuts are scheduled as a consequence of the regulatory changes that Medicare has adopted.

We question the reliability of this price-reducing approach because Medicare has long used, as a cost-estimating tool, the rule of thumb that payment reductions lead to increases in service volume. Additionally, one preliminary analysis¹⁶ indicates that major payment cuts instituted by the Deficit Reduction Act did not stop the rate of self-referred in-office MRI and CT from continuing to grow rapidly. ■

An earlier version of this paper was presented at the AcademyHealth Annual Research Meeting, June 2009, in Chicago, Illinois, and at the International Health Economics Association World Congress, July 2009, in Beijing, China.

NOTES

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ABOUT THE AUTHORS: DANNY R. HUGHES, MYTHREYI BHARGAVAN & JONATHAN H. SUNSHINE



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Danny Hughes collaborated with Mythreyi Bhargavan and Jonathan H. Sunshine on this paper about the economic and health care outcomes of “self-referred” imaging. This paper—and another in this issue by Sunshine and Bhargavan—clearly find that self-referrals do not offer some of the advantages frequently advanced by orthopedists, neurologists, and others who have invested in high-tech imaging. Examining scans ordered and carried out by nonradiologists who have purchased or leased the equipment, these colleagues from the American College of Radiology show that the practice is usually associated with

higher costs and hardly ever with shorter episodes of illness.

Lead author Hughes is assistant director for research at the college, where his work focuses on the role of technology, innovation, and economic incentives in the delivery of diagnostic services. Hughes says he is “first and foremost an econometrician”—one who applies mathematics and statistics to answer difficult questions in economics. Among other topics, Hughes is interested in whether physicians acquire technology because “it’s the newest and greatest machine” rather than because of its clinical value. He also wonders whether these physicians’ investments make sense not only from a societal standpoint, but also from the perspective of a medical practice trying to manage its budget.

At the same time, Hughes says the financial self-interest of physicians might not be the only force driving the trend of self-referrals. “It could be that patients

are sending the signal that they want to go to the physician who has the latest technology,” he says.

Before starting his present job in 2008, Hughes worked as a consultant to the defense industry, focusing on satellites and communications technology. He earned a doctorate in economics from the University of Georgia. He also collaborates with colleagues at the University of Maryland’s Department of Civil and Environmental Engineering.

Sunshine, who has been with the American College of Radiology for twenty-one years and heads its health services research department, hired both Hughes and Bhargavan for their expertise in econometrics. Bhargavan, who came to the organization in 2001, is now director for data registries. For more details on Sunshine and Bhargavan, see “About the Authors” for the article titled “The Practice of Imaging Self-Referral Doesn’t Produce Much One-Stop Service,” on page 2243.