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MARYLAND HEALTH CARE COMMISSION

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January 8, 2015

The Honorable Peter Hammen
241 House Office Building
6 Bladen Street
Annapolis, MD 21401

Dear Chairman Hammen:

The Maryland Health Care Commission (MHCC) is submitting the MRI (Magnetic Resonance Imaging) Self-Referral Study that you requested on behalf of the Health and Government Operations Committee at the conclusion of the 2013 legislative session. The study found that financial ownership was not related to MRI referral rates for practices that owned MRI equipment during the period of the study. However, practices that had a financial interest in MRI equipment had higher MRI referral rates than comparison practices in 2010 prior to divestiture and in 2012 after the Court of Appeals affirmed the divestiture order.

Braid-Forbes Health Research, LLC conducted the study under a small procurement contract awarded in May of 2014. The study examined 2010 and 2012 Medicare and privately insured claims for the eight most commonly ordered MRI procedures by orthopedists. The claims data used in the study are part of the MHCC's Medical Care Data Base for 2010 and 2012. The study tested the effects of ownership on utilization patterns before and after the forced divestiture of ownership in MRI devices by comparing the MRI use rate of orthopedic practices that owned MRIs in 2010 and after divestiture in ownership in 2012 with use rates for similar orthopedic practices that did not have a financial interest in MRI devices.

Despite a limited budget, the study was rigorous and included a systematic review of previous research, a descriptive analysis, and an inferential statistical component. A systematic assessment of previous research on self-referral for office-based services is complicated because much of the work has been sponsored by specialty societies with strong positions on the issue of

self-referral. For studies without known biases, such as those conducted by the U.S. Government Accountability Office (GAO) and several academic researchers, findings consistently show that physicians with financial gain in referring for a procedure tend to have higher utilization rates than physicians without a financial ownership interest.

In the descriptive analysis, the consultant found that practices with a financial interest in MRI equipment compared to other orthopedic practices had higher MRI use rates in 2010. The MRI use rate per capita declined for all orthopedic practices from 2010 to 2012, but rates were somewhat higher at the practices that formerly had a financial interest in MRI imaging equipment. This finding is consistent with national trends between 2010 and 2012.

The consultant developed a statistical model that accounted for the probability of receiving an MRI based on:

- financial ownership of the MRI equipment in 2010,
- patient's age and sex, insurance status (high deductible for the privately insured or Medicaid eligibility for Medicare), and
- practice attributes specific to a practice (practice attribute variable).

The practice attribute variable reflected characteristics of a practice that could not be separately defined, including age of the practitioners, prevailing practice patterns, and geographic location. When controlling for patient characteristics, insurance status, and practice attributes, financial ownership did not have a statistically significant impact on the rates of MRI use. The practice attribute variable was statistically significant for privately insured patients for all practices. For Medicare patients, the MRI use rate is higher and statistically significant for three of the five practices. Stated simply, ownership of an MRI did not increase the probability that a patient would receive an MRI, but other practice attributes associated with these same practices did increase the probability. The increased probability of receiving a MRI is statistically significant for both Medicare and the privately insured populations in most practices.

The Commission heard two presentations on this study. At the November meeting, Ms. Braid-Forbes presented the principal research findings. MHCC staff presented the statistical results and the draft final report at the December meeting. Prior to the November meeting, MHCC staff met with physicians from the orthopedic practices and their legal counsel. A draft of the report was provided to the practices in December and several comments provided by the group's legal counsel are reflected in the final report.

The Commission wishes to emphasize that the results of this study need to be carefully qualified due to its limited scope. The challenge for policy makers is that the results of this study show both that the practices with a financial interest in MRI equipment in 2010 had higher use rates and that those higher rates of use did not change compared to other practices after divestiture. It is unclear why these practices did not have a steeper decline in use rates. It could be that the use rates decline more slowly over time after divestiture than has been shown in the literature for the increase in use rates and that the timeframe for the study was too short. This study design presumes that a change in MRI ordering behavior will be abrupt following a change in the ownership of MRI equipment. Several research studies have documented abrupt increases in referrals when practices acquire a financial interest in MRI equipment, but the impact of divestiture has been studied only in Maryland. Differences in patient clinical conditions

relevant to MRI use could play a role. Some orthopedists have suggested that the age of the physician also plays a role in MRI use rates, with younger physicians who trained when MRIs were readily available being more likely to order MRIs than older physicians who trained before MRIs were widespread. Investigating how the specific patient risks or practice factors contribute to use are outside the scope of the current study.

The MHCC also notes that the orthopedic practices that were forced to divest their interest in MRI equipment in 2011 represent a small number of the total patients seen by orthopedists and the MRIs received by their patients represent a small proportion of the total number of MRIs performed in the State. In 2012, the five practices saw about 60,000 Medicare and privately insured patients. Control practices saw over 300,000 Medicare and privately insured patients in the same year. Any change to current Maryland law that would exempt MRIs from the self-referral prohibition would apply to all orthopedists and other specialties such as urology, cardiology, and neurology as well. These other specialties would significantly expand the numbers of practices and patients affected. If the experience described in the literature on gaining a financial interest is a guide, MRI use rates would be expected to rise in Maryland absent any other delivery or payment reforms. If the law were narrowly construed to only apply to practices which previously had an interest in MRI equipment, one would predict that MRI use rates would not increase more than are currently seen due to this change. However, such a narrow solution would likely prove unworkable.

A better solution may be to link the longstanding issue of self-referral to two broad positive health care trends. The first trend is the widely endorsed effort to realign care on dimensions of value. The second is the movement toward growing practice integration either through outright consolidation or through collaborative arrangements. In a more integrated system of care delivery where providers receive gainsharing or shared savings payments while being held accountable for patient health outcomes, incentives to provide unneeded care will diminish. Decisions on whether to own advanced office-based equipment, as opposed to referring the service to an efficient collaborator, will be based on cost calculations and quality considerations. Some orthopedists argued that when they owned MRI equipment and managed the imaging staff, image quality improved and the need for repeat images declined. Ownership of equipment could be viable and cost effective, if large group practices, likely to own these devices, committed to delivering care under the new payment models now taking root in the health care system.

Under a new model, ownership of office-based imaging could be permitted if three conditions are met:

1. the practice demonstrates that a very high proportion of care is reimbursed under risk-based financial arrangements;
2. the practice can demonstrate sufficient scale as to make ownership of imaging equipment viable and agrees to bundle imaging use under the risk-based arrangement; and
3. the practice commits to ongoing reporting of quality metrics linked to its patient outcomes.

These conditions would represent significant challenges to all large single specialty practices operating in Maryland today. Medicare is slowly moving toward risk-based financial arrangements through the Medicare Shared Savings Program (MSSP), but Medicaid and private

carriers have been slow to introduce these innovations in Maryland. Even under the MSSP program, specialists have been slow to engage in the program. MHCC believes more time is needed to introduce these changes before an exemption should be considered. MHCC would be happy to work with specialty groups and payers to develop program ideas that could meet the three conditions identified.

If you require further information regarding this study please contact me at 410-764-3566.

Sincerely,

Ben Steffen
Executive Director

Enclosure
cc:

Thomas M. Middleton, Chair, Senate Finance Committee
Joan Carter Conway, Chair, Senate Education, Health and Environmental Affairs
Kirill Reznik, State Delegate
Laura Herrera, M.D., Acting Secretary, DHMH
Craig Tanio, M.D., Chairman MHCC
Lisa Simpson
Patrick Carlson

Assessment of Changes in Advanced Imaging Referrals by Orthopedists 2010-2012

Prepared by Braid-Forbes Health Research, LLC

For the Maryland Health Care Commission

December 23, 2014

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I. Executive Summary

This study examines trends in the prescribing of magnetic resonance imaging (MRI) services in Maryland. Specifically, it examines the ordering of MRI services by non-radiology group practices in Maryland that owned or leased MRI equipment and furnished MRI services in their medical offices prior to June 2011.

Section 1877 of the Social Security Act (the Stark law) and its amendments prohibit physicians from referring Medicare patients for a designated health service to an entity in which the physician or a family member has a financial interest unless an exception applies. Radiology and certain imaging services are subject to this prohibition. The Stark law allows for certain exceptions, including a broad exemption for certain in-office services that are ancillary to an office visit, leaving open the possibility that non-radiologist physicians could provide their Medicare patients' radiological imaging services. The General Maryland Assembly passed a self-referral law in 1993 that regulated self-referral for all local insurers. This law explicitly excluded MRI and CT imaging from in-office ancillary services. The prohibition against non-radiology practices self-referring patients for MRI and CT services was confirmed by the Maryland Court of Appeals in January 2011.

Beginning in the middle and late 1990s outside of Maryland, physicians began to purchase MRI equipment and perform these services in their own offices, rather than refer them to an outside facility. Concurrent with this trend was an increase in the total number of MRI services performed. The U.S. Government Accountability Office (GAO) and other researchers have studied the effect of financial ownership on physician referral and care patterns. Studies consistently find that physicians with financial gain in referring for a procedure tend to have higher utilization rates than physicians without a financial stake.

This study tests the effects of ownership on utilization patterns since the Maryland Board of Physicians enforced the divestiture of ownership in MRI devices by several orthopedic practices in 2011. This study compares the use rate of these orthopedic practices before (2010) and after (2012) the divestiture in ownership. These practices are compared to two control groups: selected similar orthopedic practices, and other orthopedists in the state. Medicare and private insurance claims data were examined for more than 120,000 patients for the orthopedists practices which divested in 2011 and for a similar number of patients for the similar orthopedic practice control group, and over 300,000 patients for the second control group. The study accounted for different patient characteristics, e.g., age, gender, coverage by a high deductible plan for privately insured patients and Medicaid dual eligibility with Medicare, using logistic regression to control for these differences.

This study found no evidence that financial interest influenced MRI rates in 2010 compared to 2012 for patients with either private insurance or Medicare. Differences in the rates of MRI use do not seem to be related to the period when the practices had a financial interest in MRI equipment. Practices with a financial interest in the equipment in 2010 had higher rates of MRI use in both 2010 and 2012. The higher rate is statistically significant for privately insured patients for all practices. For Medicare patients the MRI use rate is higher and statistically significant for three of the five practices.

It is possible that the timeframe required for this study one year before divestment and the year immediately following divestment was too short a timeframe to capture changes in physician behavior. The study design presumes that a change in MRI ordering behavior will be abrupt following a change in financial interest in the equipment. Other factors could influence MRI use, such as age of physician, income of patient, and other patient conditions that could not be measured in this study.

II. Introduction

The Health and Government Operations Committee requested this study of trends in the prescribing of magnetic resonance imaging (MRI) services in Maryland. This request arose from the Committee's consideration of House Bill 536 during the 2013 General Assembly Session. The HB 536 would have required that the Department of Health and Mental Hygiene conduct a study on the ordering of MRI services by non-radiology group practices in Maryland that owned or leased MRI equipment and furnished MRI services in their medical offices prior to June 2011.[1]

Section 1877 of the Social Security Act, known as the Stark law,[2] prohibits physicians from referring Medicare patients for a designated health service to an entity in which the physician or a family member has a financial interest unless an exception applies. This law was originally enacted in 1989 to apply to clinical laboratory services and was expanded in 1993 and 1994 to include additional services.[3] Radiology and certain imaging services are included as designated health services that are subject to this prohibition.

The Stark law allows for certain exceptions, including a broad exemption for certain in-office services that are ancillary to an office visit, leaving open the possibility that non-radiologist physicians could provide their Medicare patients' radiological imaging services. Advanced imaging such as MRI and computerized tomography (CT) scanners were not common in-office services at the time of passage of the Stark law. As MRI and CT equipment became less expensive, more non-radiology practices began to purchase and operate this equipment under the in-office ancillary exception.[4] In Maryland, the General Assembly passed a unique self-referral law in 1993 that regulated self-referral for all local insurers. This law explicitly excluded MRI and CT imaging from in-office ancillary services.[5] Some non-radiology practices interpreting specific language of the Maryland law began owning MRI equipment and self-referring for these services. There is complicated history of attempts to enforce the law by the Maryland Board of Physicians, legal challenges, and eventually confirmation by the Court of Appeals in January 2011 of the prohibition against non-radiology practices self-referring patients for MRI and CT services. [6]

The initial federal Medicare exemption for in-office ancillary services from anti-self-referral laws came about because it was thought to be more convenient for the patient to have the service performed the same day as the office visit. At the time of this exemption, X-ray equipment was the in-office imaging modality that was most common. MRIs were not yet in physician offices. By the middle and late 1990s this began to change. Physicians, including orthopedists, who previously referred patients for MRIs to independent radiology practices, began to purchase MRIs and perform these services in their own offices. Concurrent with this trend was a tremendous increase in the total number of MRI services

[1] Letter from Peter A. Hammen, Chair, Health and Government Operations Committe to Ben Steffen, Executive Director, Maryland Health Care Commission, dated July 10, 2013.
[2] 42 U.S.C.§1395nn, the regulations are at 42 CFR. §411.350 - §411.389.
[3] See https://www.cms.gov/Medicare/Fraud-and-Abuse/PhysicianSelfReferral/index.html?redirect=/physicianselfreferral/
[4] Quadri, Rehan et. al. "The Maryland Self-Referral Law: History and Implications." *Journal of the American College of Radiology* 11.8 (2014: 771-776).
[5] Ibid.
[6] Potomac Valley Orthopaedic Associates v. Maryland State Board of Physicians, No. 18, 2011 WL 198239, at 1 (Md. 2011)

performed. Many studies have attempted to examine the extent to which the financial interest of the self-referring physicians contributed to the explosive growth in the number of services, and whether the excess number of these services was of any benefit to the patient or was unnecessary care.

III. Study Design

This project tests the effects of ownership on utilization patterns since the Maryland Board of Physicians enforced the divestiture of ownership in MRI devices by several orthopedic practices in 2011. This project provides a unique natural experiment in physician self-referral to determine whether practice patterns changed after divesting a financial interest, compared with gaining a financial interest. Because exactly which practices had MRIs and divested their financial interest are known, there is greater certainty about the groups with the financial interest. The availability of the all-payer database in Maryland allows a nearly complete look at the practices' utilization patterns.[7] We can also control for insurance type, i.e., Medicare versus private insurance. This study compares the use rate of these orthopedic practices before (2010) and after (2012) the divestiture in ownership. These practices are compared to two control groups: selected similar orthopedic practices, and other orthopedists in the state. Regression analysis is used to control for other confounding factors.

There are dozens of CPT™[8] medical procedure codes describing MRI scans. This study focuses on eight specific procedure codes. MHCC selected the following codes for study:

- 72146 Magnetic resonance (e.g., proton) imaging, spinal canal and contents, thoracic; without contrast material
- 72148 Magnetic resonance (e.g., proton) imaging, spinal canal and contents, lumbar; without contrast material
- 72195 Magnetic resonance (e.g., proton) imaging, pelvis; without contrast material(s)
- 72141 Magnetic resonance (e.g., proton) imaging, spinal canal and contents, cervical; without contrast material
- 73221 Magnetic resonance (e.g., proton) imaging, any joint of upper extremity; without contrast material(s)
- 73721 Magnetic resonance (e.g., proton) imaging, any joint of lower extremity; without contrast material
- 73718 Magnetic resonance (e.g., proton) imaging, lower extremity other than joint; without contrast material(s)
- 73218 Magnetic resonance (e.g., proton) imaging, upper extremity, other than joint; without contrast material(s)

These codes are billed with a modifier to indicate whether the service provided is the professional service (reading and interpreting the MRI results) or technical (conducting the scan). If no modifier is billed, the services is presumed to be global (including both the professional and technical proportion). Counting claims billed with a professional service modifier (26) and a technical component modifier (TC) would count one service twice. For this study to obtain a correct count of unique services, we counted claims with a professional service modifier (26) and global claims (no technical or professional service modifier).

[7] Medicaid claims data and information on care provided to the uninsured are not included.
[8] CPT Copyright 2012, American Medical Association.

IV. Literature Review

The effect that financial ownership has on physician referral and care patterns has been studied both by the U.S. Government Accountability Office (GAO) and many other researchers. Studies consistently find that physicians with financial gain in referring for a procedure tend to have higher utilization rates than physicians without a financial stake. Several studies also have examined whether this increased utilization has benefits, such as detecting more cancer or reducing episode of care costs. These studies failed to find a benefit. Detection of cancers was lower and the cost of the episode of care was higher for those with a financial interest, suggesting that the increase in utilization was unnecessary care. Some studies also looked at whether the same physicians change their ordering behavior after entering into a financial relationship, so-labeled "switchers." Again, researchers found an increase in utilization associated with gaining a financial interest.

While the evidence is significant, there are some limitations to these studies and gaps in our knowledge. First, all the studies compared utilization differences, not differences in the services ordered. In theory, patients could obtain an order and choose not to receive the scan or test. Without access to data that systematically captures the physician orders, utilization is the best proxy for orders. From a payer and policy perspective, actual utilization is of greater interest than orders. Some of these studies had to identify the physicians with a financial interest through algorithms involving the identifiers on their claims and matching to third-party sources of information. Some of the studies used Medicare claims or privately insured data, which would not have contained all of the physicians' practice. For those that studied specific practices where the financial interest was known and the entire practice was studied, the samples were small. There is a gap in the literature in studying the effect on change in utilization of divesting from a financial interest, compared to entering into a financial relationship.

Numerous articles in the literature have studied the relationship between physician financial interest and self-referral for services. The services studied have often been diagnostic imaging such as MRI and CT, but also have included pathology biopsy for prostate cancer detection. Authors of these studies had several different approaches to studying the relationship of self-referral and utilization. Those approaches included:

- Difference in utilization patterns between physicians with a financial interest and those without at the same point in time (Hillman, 1990; Baker, 2010; Shah et al., 2011; Mitchell, 2012; GAO, 2012)
- Difference in utilization patterns before and after a physician enters into a financial relationship, known as "switchers" (Bhargavan et al., 2011; GAO, 2012; Baker, 2010)
- For diagnostic tests, a difference in positive findings as a marker for inappropriate utilization. (Mitchell, 2012; Paxton et al. , 2012; Lungren et al., 2013)
- Benefits to patients who received diagnostic services from a physician with a financial interest, compared to patients who received referral to diagnostic services from a physician without a financial interest, to assess if the increased utilization associated with self-referred services led to lower total costs or shorter length of illness. (Hughes et al, 2010; Baker, 2010; Shreibati and Baker, 2011)

In each of the studies, physicians with a financial interest in a service had greater utilization. In those that looked at possible benefits to the increased utilization, no benefit was found either in higher cancer detection or in lower total episode of care costs.

However, a recent study by the GAO on self-referral for physical therapy (PT) services found mixed results. While self-referring family practice and internal medicine providers in urban areas generally referred more PT services than non-self-referring physicians in the same specialties, self-referring orthopedic surgeons referred on average fewer PT services than non-self referring orthopedic surgeons. For all three specialties, the physicians who self-referred referred more beneficiaries, but referred for fewer services per beneficiary. (GAO, 2014a)

In the *Journal of Law, Medicine and Ethics,* Christopher Robertson et al. (2012) reviewed the literature on the effect of financial relationships on the behaviors of health care professionals. Robertson reviewed three types of financial relationship: physician's role as referrers; physician payer interactions, including reimbursement schemes intended to reduce costs and pay-for-performance; and financial relationships between physicians and representatives from the drug and device industries. Their review found evidence that financial relationships bias physician decisions to divergent degrees in all three areas. However, they noted that the studies had limitations. The studies were observational, rather than randomized controlled trials. As such, the physicians choosing to enter the financial relationship may be different in some way from those physicians choosing not to enter into the financial relationship under study. The measures were means and other measures of central tendency. It is possible that all physicians are not equally susceptible to financial interests. More importantly, while some studies included practice guidelines and independent review to demonstrate that the financial interest was against the interests of the patient, many do not specify the optimal rate for the service studied.

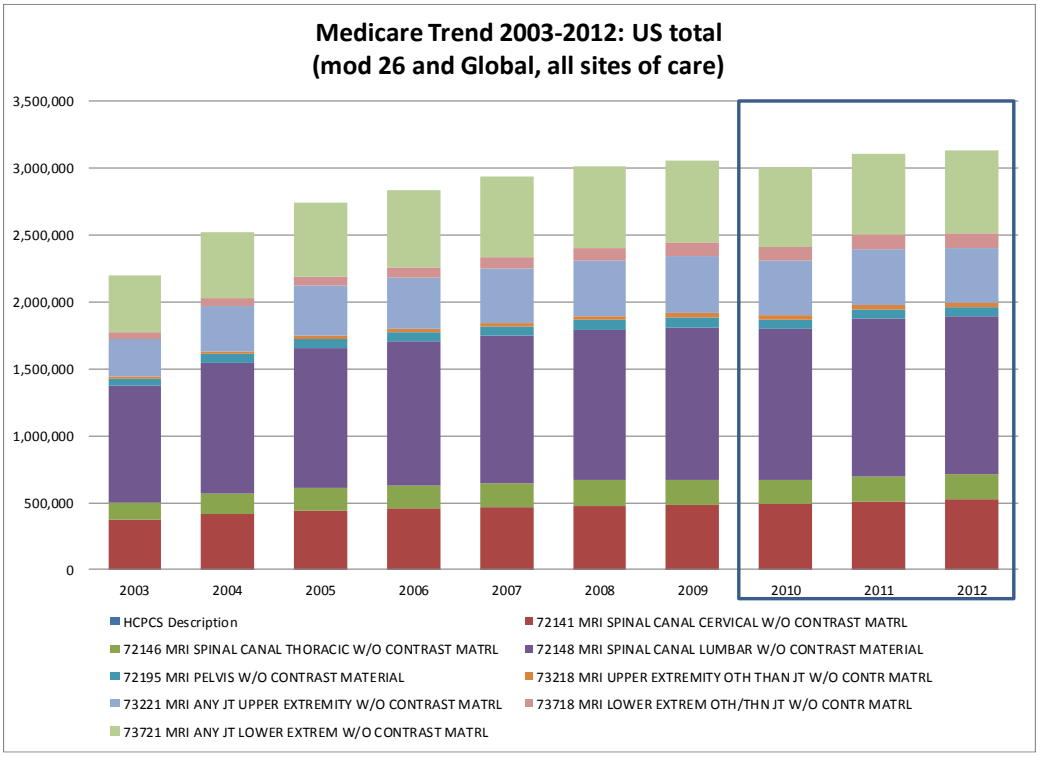
V. MRI utilization trends

Nationally, MRI use rates for the Medicare population rose quite rapidly in the early 2000s and then leveled off in recent years. It is important to take account of temporal trends in use rates unrelated to ownership. While Medicare is not the entire population receiving MRI services, this population uses a disproportionate number of medical services. High use rates for imaging has also caught the attention of the Centers for Medicare and Medicaid Services (CMS) and Congress, which has made adjustments to Medicare payment policy related to imaging services over the past 10 years. Changes in reimbursement for MRI services for the Medicare population could potentially affect providers' incentives to provide these services.

Figure 1 shows the national utilization for the selected MRI procedure codes. Utilization is presented for all sites of care (hospital, physician office, free-standing)[9] and without regard to the specialty ordering the service. In 2003, 2.1 million of these MRI services were provided to traditional Medicare beneficiaries (Medicare Advantage HMO claims are not included). By 2005, that had grown to 2.7 million services, an increase of 25 percent in just two years. However, growth moderated after 2005 and even declined slightly in 2010. The GAO (2014b) found similar trends for advanced diagnostic imaging services in general. Figure 1 shows total counts of services and do not take into account the number of Medicare beneficiaries. The time period for this study is 2010 through 2012, which corresponds to a national leveling off of utilization of these services.

[9] We count services that are billed either global or with a professional component modifier 26.

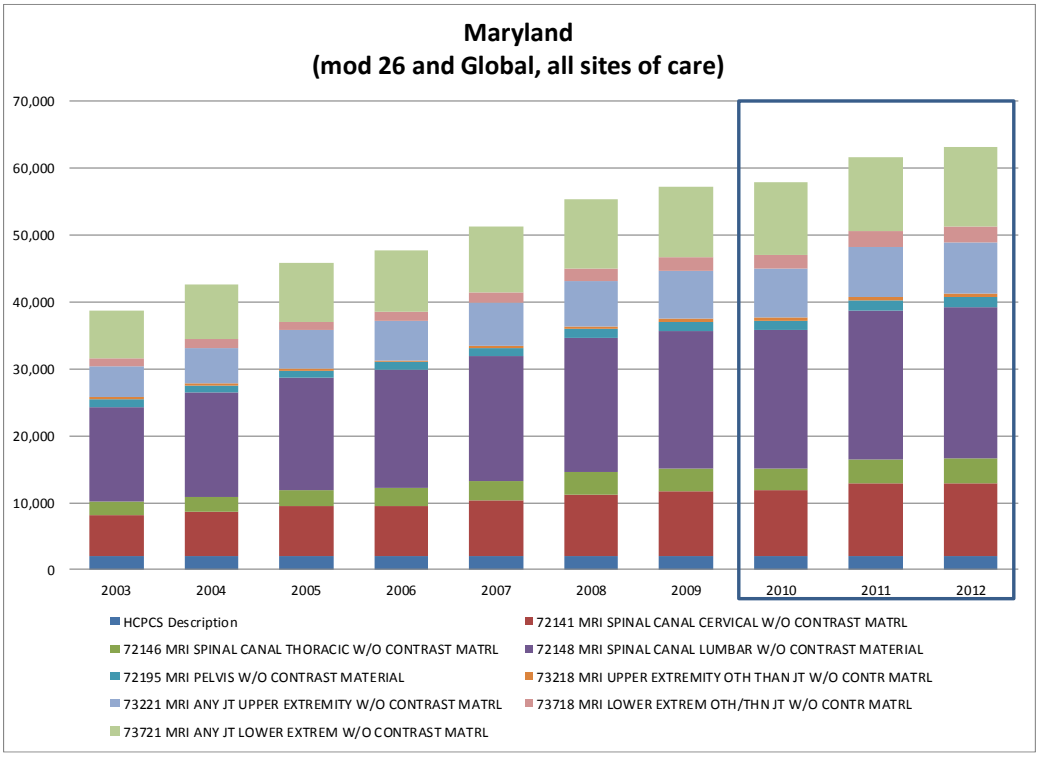
Figure 1 Medicare Trend Selected MRI Services 2003-2012: US Total



Source: Braid-Forbes Health Research analysis of Medicare Physician Supplier Procedure Summary Files (PSPS,) 2003-2012.

Interestingly, the pattern of total utilization in Maryland for these services has not mirrored the national pattern. Figure 2 shows the same MRI services for Maryland only. The growth in services in Maryland during this same period was less steep from 2003 to 2005, but since then has continued growing at greater than the national percentage rates for these same MRI services. Over the entire 10-year span, the number of services grew from just over 36.6 thousand in 2003 to 61 thousand in 2012, a 67 percent increase, compared to a national increase of 43 percent over the same period.

Figure 2 Medicare Trend Selected MRI Services 2003-2012: Maryland

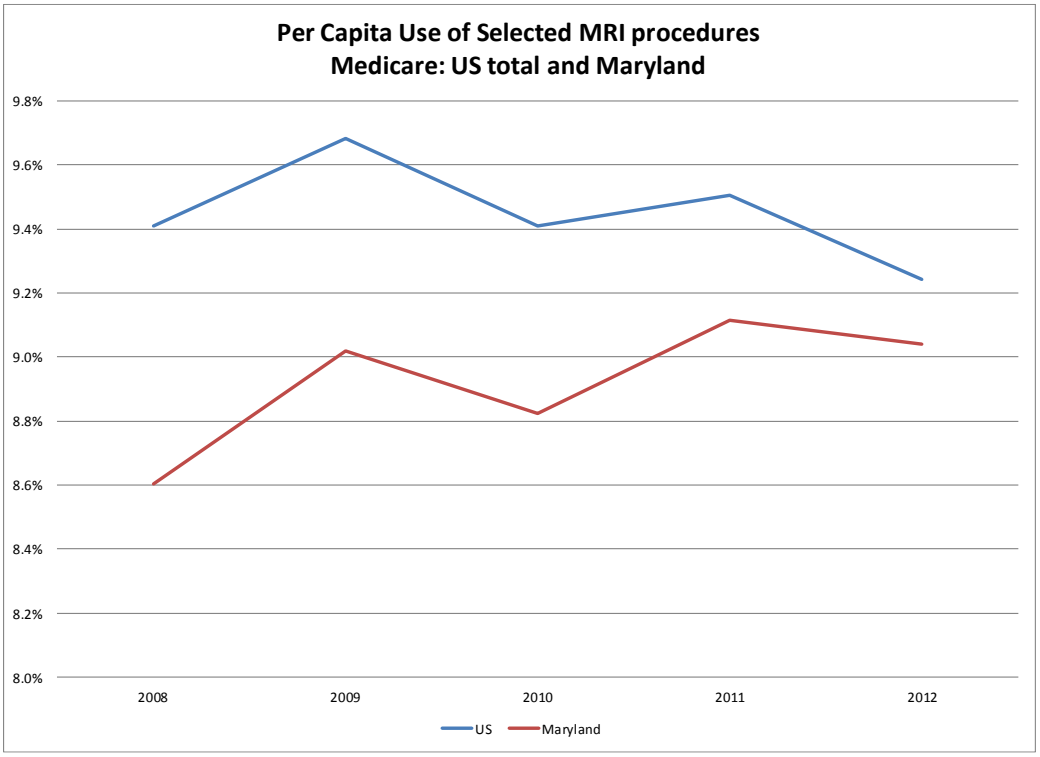


Source: Braid-Forbes Health Research analysis of Medicare PSPS files, 2003-2012.

Figure 3 shows a comparison between the national utilization and Maryland utilization on a per capita basis for years 2008 through 2012.[10] The Y axis shows the count of these MRI services as a percent of the total Medicare population with Part B coverage. Nationally, 9.4 of these MRI services were performed per 100 Medicare beneficiaries in 2008, increasing to 9.7 in 2010, and falling to 9.2 in 2012. In Maryland, 8.6 of these MRI services were performed per 100 Medicare beneficiaries in 2008, increasing to 9.0 in 2012. Again, the utilization is across all sites of care (hospital, physician office, free-standing) and without regard to the specialty ordering the image. Shifts between the site of care for the image, hospital and physician office or free-standing, are not shown. Changes in the specialty of the physician ordering the image also are not taken into account, as this would require a different dataset and a more complicated analysis.

[10] The Medicare Part B enrollment data by state was not available on the CMS website for years before 2008. The claims data used to compute the utilization trends are for traditional fee-for-service Medicare beneficiaries, and does not include Medicare Advantage (Part C). Medicare Advantage enrollment data is subtracted from the total Part B enrollment data. Medicare Advantage enrollment was not available on the CMS website for years before 2008.

Figure 3 Per Capita Use of Selected MRI procedures Medicare US and Maryland



Sources: Braid-Forbes Health Research analysis of Medicare PSPS files, 2008-2012; Medicare enrollment data, and Medicare Advantage enrollment data.

Medicare payment rates for diagnostic imaging service have declined sharply since 2009. CMS has changed the assumptions for utilization and interest rate in the formula that determines the practice expense portion of the payment rate. For high-cost equipment (such as MRI) the assumption of the amount of time the machine is in use has gone from 50 percent to 90 percent,[11] which decreased the allocation of the cost of the machine to each service. CMS also changed the assumption of the interest rate that would be associated with the purchase of any equipment. It has gone from 11 percent to a sliding scale based on useful life and total cost of the equipment; in this case for MRI it would be 5.5 percent. This has also reduced the total payment rate. The Deficit Reduction Act of 2005 required that, beginning January 1, 2007, Medicare payment for certain imaging services under the physician fee schedule not exceed the amount Medicare pays under the Outpatient Prospective Payment System (OPPS). The OPPS rates change from year to year and can trigger a reduction in the physician payment rate. Table 1 shows the Medicare payment rates for the code with the highest utilization (72148) for Maryland from 2009 through 2014. During the study period (2010 through 2012), Medicare payment for this service declined slightly.

[11] CMS's calculation of a 50 percent utilization rate was based on 25 hours per week out of a 50-hour work week, 50 weeks per year. The 90 percent utilization rate would translate to 45 hours per week. In a survey commissioned by MedPAC in 2006 of six markets, the median use rate among MRI providers was 46 hours per week.

Table 1: Medicare payment rate for 72148 for Maryland

	Maryland Technical Component (TC) Payment		National Practice Expense Assumptions	
Year	Locality 01 ($)	Locality 99 ($)	Utilization Assumption (%)	Interest Rate Assumption (%)
2009	479.87	442.70	50	11
2010A	405.39	380.03	90	11
2010B	414.31	388.39	90	11
2011	427.62	399.57	75	11
2012	393.97	371.65	75	11
2013	340.05	320.78	75	5.5
2014	186.31	175.89	90	5.5

Source: Medicare Physician Fee look-up tool, accessed at http://www.cms.gov/apps/physician-fee-schedule/overview.aspx.

Other policy changes affecting advanced diagnostic imaging such as MRI include the requirement in the Medicare Improvements for Patients and Providers Act of 2008 (MIPPA) that, beginning January 1, 2012, suppliers of the technical component of these imaging services, including MRI, be accredited by a designated accrediting organization in order to receive Medicare payment for these services. (GAO, 2014b)

VI. Study Questions

The study questions are:

1. Did orthopedic practices that divested interest in MRI machines in 2011 change how often they ordered MRIs for their patients?

2. Did practices that had a financial interest in MRI machines have different rates of ordering MRIs for their patients than similar practices for similar patients before and after their divesture of the financial interest?

VII. Methodology

Our analytic approach compared the difference in use rates by patients attributable to the orthopedic practices that divested MRI ownership over time compared that to those that did not have an ownership stake in MRI machines. The orthopedic practices that had a financial interest are referred to as “cases” and the comparison group “controls.” Use of an MRI includes MRI services received by patients, regardless of whether this was in the ordering physician’s office, a radiology practice, or at a hospital. Simplistically, this can be represented by a rate: the number of patients getting an MRI compared to total patient seen by each practice. We assume that the conditions of the patients seen at the practices

are similar over the time period of the study. There are two control groups: selected similar orthopedic practices, and all orthopedic practices in the state.

The practices identified as having a financial interest in 2010 are identified in Appendix A. The similar practices are identified in Appendix B. The methodology for selecting other orthopedists as a second control is described in Appendix C.

In our data investigation, we found that we could not use the National Provider Identifier (NPI) to identify claims for the selected practices in the Medicare data because organizational NPI was not routinely captured on that file. However, we could use the Federal Tax Identifier to identify Medicare claims for the specific practices. Further, we found that using the Federal Tax Identifier lead to a more robust capture of claims in the private insurance database. We used the Federal Tax Identifier for both datasets for consistency. For one of the practices identified as case, the federal tax identifier that we had did not capture all of their claims. We drop this practice from the analysis. The Federal Tax Identifier is not linked to physician specialty and so we could not have a second control group using the Medicare data. For the private claims we used the NPI, which does have a link to the specialty of the physician, to identify other orthopedists in the state.

We also looked for evidence of billing for MRI services among the practices with a financial interest in the case group. We did find claims for MRI services for all practices except one. It is possible that this one practice had shut down its MRI facilities before the final ruling required them to. It is also possible that this practice billed for MRI services under a different federal tax ID.

We assessed the extent to which a patient was seen by more than one orthopedic practice in the same year. We excluded these patients from the study, if they were seen by both the practices with the financial relationship (cases) and the similar orthopedic practices (control group 1). This was less than 2 percent of the private insurance patients in both years, and less than 2 percent of Medicare patients. If patients were seen by either the cases or the similar practices and were patients seen by the other orthopedists in the state (control group 2), the patient was included once with the case or control group 1. This was less than 10 percent of the patients seen by the second control group. For the practice specific effects, if a patient was seen by more than one case practice or by more than one control group 1 practice, the patient was assigned to the practice with the first visit.

Using regression to control for differences in patient populations: Difference in difference estimation using logit regression

The rate of MRI referral is an easily understandable way to measure the difference in practice patterns. However, the rates can vary based on patient characteristics. We used a logit regression model to account for these differences. The logit model is commonly used in assessing the contribution of various factors to the probability of a dichotomous event. Using a logit model, the predicted probabilities are bounded between zero and one, an attribute that is lacking when the more familiar ordinary least squares regression methodology is employed.

We specified two models, one using the private insurance claims and one using the Medicare claims. Both models take into account whether the patient was seen by a practice in the case or a control group, the patient's age and sex. For the private insurance claims model, we also include whether the

patient was covered by a high-deductible plan.[12] For the Medicare model, we include whether the patient was dually eligible for Medicaid. The second control group was included in the private insurance model, but could not be included in the Medicare model due to data issues. Including these patient variables allows us to account for possible differences in rates of ordering MRI by a practice due to these patient characteristics and isolates the practice differences. We also included the year 2012 to account for trends in use rates that occurred across all practices over time. Algebraically, the model is given by:

Private Insurance Patient Model

$$\ln\left(\frac{p_i}{1-p_i}\right) = const + \alpha_1 CG_1 + \alpha_2 CG_2 + \alpha_3 HIGH + \alpha_4 AGE + \alpha_5 SEX + \alpha_6 YEAR2012 + \sum_{k=1}^{K} \delta_k \text{PRACTICE}_k + \sum_{k=1}^{K} \beta_k FINANCIAL_k$$

Medicare Patient Model

$$\ln\left(\frac{p_i}{1-p_i}\right) = const + \alpha_1 CG_1 + \alpha_2 CG_2 + \alpha_3 DUAL + \alpha_4 AGE + \alpha_5 SEX + \alpha_6 YEAR2012 + \sum_{k=1}^{K} \delta_k \text{PRACTICE}_k + \sum_{k=1}^{K} \beta_k FINANCIAL_k$$

Where p_i is the probability that a patient receives an MRI. The transformation on the left-hand side of ensures that the estimated equation is nonlinear, with the marginal impact of any single explanatory variable contingent on the levels of the other regressors. The explanatory variables are defined as follows:

CG_1 is a binary variable that is equal to one if patient i's physician is a member of the first control group;

CG_2 is a binary variable that is equal to one if patient i's physician is a member of the second control group;

MEDICARE is a binary variable that is equal to one if patient i's has Medicare coverage;

HIGH is a binary variable that is equal to one if the patient was covered under a high deductible plan

DUAL is a binary variable that is equal to one if the Medicare beneficiary was dually eligible for Medicaid coverage;

AGE is patient i's age;

SEX is a binary variable representing patient i's sex;

[12] High-deductible plans are also known as consumer-directed health plans.

YEAR2012 is a binary variable that equals one if year equals 2012.

PRACTICE is a binary variable for each practice in the treatment group

FINANCIAL is a binary variable that is equal to one for each practice in the treatment group when it had a financial interest in administering MRIs.

Note that the model's specification permits the coefficient on the variable FINANCIAL to vary by practice, and thus it does not presume that practices in the treatment group respond identically to a financial interest. The model also does not presume that the practices behave identically in terms of MRI procedures in the absence of a financial interest.

VIII. Results

More than 60,000 patients in each year were identified for the practices with a financial interest in 2010 (cases) and the similar practices (control group 1). More than 150,000 patients were identified as having seen an orthopedist in the second control group. The counts of patients in each group, case, control 1 and control 2, for each year and insurance type are shown in Table 2. The average age of the patients seen by each group was similar, as was the percent of patients that were female. The number of patients with a high-deductible plan was slightly higher among the cases compared to either control group, and rose between 2010 and 2012 for all groups. The number of Medicare patients seen by cases were slightly more likely to be dually eligible for Medicaid, compared to similar practices in control group 1.

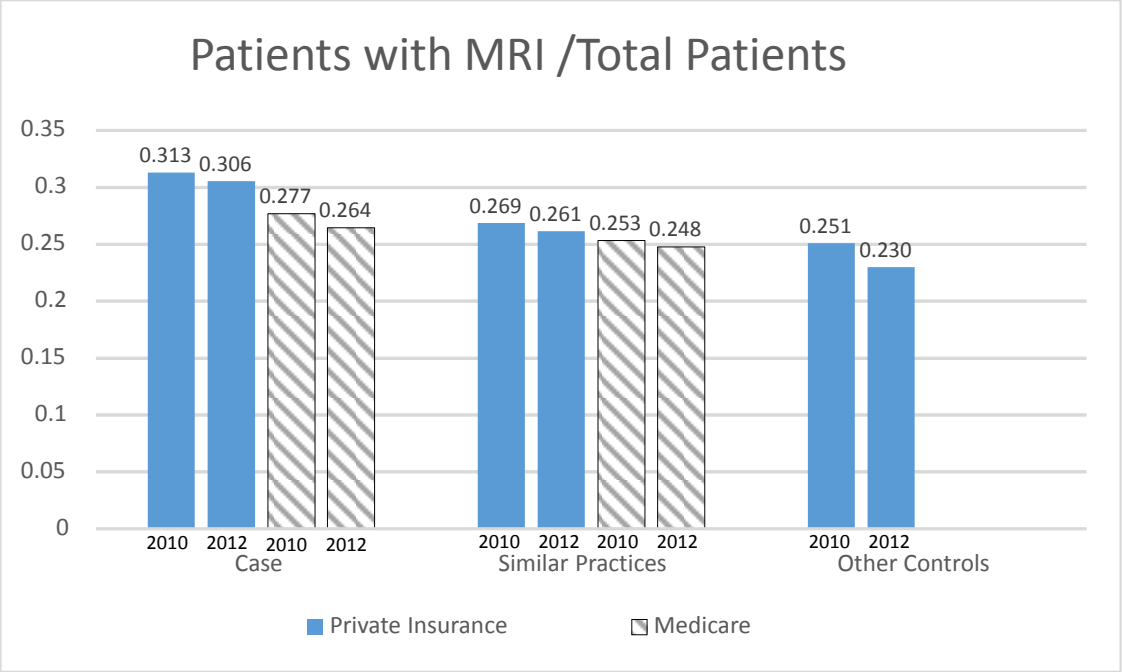
Table 2: Patient counts and demographics

	Case				**Control 1: Similar Practices**				**Control 2: Other**	
	Private		**Medicare**		**Private**		**Medicare**		**Private**	
	2010	**2012**	**2010**	**2012**	**2010**	**2012**	**2010**	**2012**	**2010**	**2012**
Patients	41,250	43,376	19,403	20,264	46,583	50,635	14,465	15,621	171,368	208,261
Number of Images	12,927	13,252	5,371	5,358	12,529	13,233	3,665	3,870	43,139	47,914
Average Age	43.6	43.6	73.7	73.3	42.2	42.6	73.8	73.3	44.2	44.6
% Female	55%	56%	67%	66%	55%	55%	66%	66%	56%	56%
% Dual			13%	14%			12%	13%		
% High Deductible	15%	17%			13%	14%			14%	16%

Table 3 shows the rate of referral of patients for MRIs for the cases and two control groups. The rate decreased very slightly for the practices with a financial interest (case) for privately insured patients between 2010 and 2012. The rate also decreased very slightly for the similar practices in control group 1 and decreased by a greater degree in the second control group. The rate of referral was higher for the cases than either control group to start in 2010. The rate of referral for these practices before they had a financial interest in MRI equipment was outside the scope of this study; therefore, we cannot say whether the rate of referral for the case group was always higher or is higher due to their financial interest in 2010. For Medicare patients, the rate of referral for MRIs came down between 2010 and

2012 by a greater degree than seen in the privately insured patients for both the case and control group 1.

Figure 4: Rate of referral of patients for MRIs for cases and two control groups



The results of the logit regression analysis are shown in Tables 4 and 5. The logit regression analysis controls for measurable differences in the patient populations between the groups, as well as practice-specific effects among the different practices that make up the case group (those with a financial interest in 2010). Differences we are able to measure are patient sex, patient age, high- deductible plan (privately insured), and dual eligibility for Medicaid (Medicare beneficiaries). Standard risk adjustment methodologies were not developed to assess risk of needing an advanced diagnostic image, but are more typically used to predict mortality or inpatient resource use. For example the Elixhauser comorbidities[13] were developed to predict differences in length of stay and hospital charges for inpatient admissions. As such, these measures were too general for the specific needs of this study.

The variable column in Table 4 relates to the variables described above in the logit regression model. The parameter estimate column shows a positive number when the characteristic represented by the variable is more likely to contribute to the patient receiving an MRI referral and negative when the patient is less likely to be referred for an MRI with when the characteristic is present. The column labeled "Pr>|t|" shows a number less than 0.05 when the characteristic is statistically significant. If the number is greater than 0.05, the characteristic does not contribute to the outcome of being referred for an MRI.

Table 4 also shows that persons with a high-deductible plan (high) are less likely to receive an MRI, though only slightly so. The likelihood of having an MRI increases with age up to age 65. The 65 and

[13] Elixhauser A et al. "Comorbidity Measures for Use with Administrative Data" Medical Care 36 (1): 8-27.

older category was only as likely as the age 18 to 25 age group to receive an MRI. Even controlling for these patient characteristics, each of the case practices had higher rates of MRI use among their patients than the controls. These rates were higher in 2010 and 2012 and did not appear to be related to the period when the practice had a financial interest in MRI equipment (2010).

Table 3: Private Payers Regression Results

Parameter Estimates					
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	0.14121	0.00183	77.19	<.0001
year2012	1	-0.01847	0.00126	-14.70	<.0001
sex_cd	1	-0.01371	0.00116	-11.77	<.0001
high	1	-0.00661	0.00161	-4.10	<.0001
age_18_25	1	0.09956	0.00280	35.57	<.0001
age_25_40	1	0.12832	0.00216	59.29	<.0001
age_40_65	1	0.15594	0.00175	89.32	<.0001
age_GE_65	1	0.09239	0.00257	36.01	<.0001
Practice A	1	0.11188	0.00441	25.37	<.0001
Practice B	1	0.07149	0.00414	17.25	<.0001
Practice C	1	0.04183	0.00385	10.88	<.0001
Practice D	1	0.09549	0.00568	16.80	<.0001
Practice E	1	0.03448	0.00799	4.32	<.0001
F_ Practice A	1	-0.00928	0.00635	-1.46	0.1438
F_ Practice B	1	0.00395	0.00591	0.67	0.5045
F_ Practice C	1	-0.02290	0.00552	-4.15	<.0001
F_ Practice D	1	-0.02154	0.00820	-2.63	0.0086
F_ Practice E	1	-0.01653	0.01130	-1.46	0.1432

High deductible plan significant, less likely to get MRI

Age is significant 40-65 more likely to get MRI

All practices have significantly higher use than controls

Higher use does not seem to be related to MRI ownership

The results are similar for Medicare patients. In the Medicare data, only the patients of the first control group (similar practices) were able to be included. Again, age is a predictor of receiving an MRI: the older the patient, the less likely this is. Three of the five practices had higher MRI use rates than the control groups. The one group with a lower rate was the practice that that did not bill for any MRI services in 2010. For one practice, the rate was not significantly different. Consistent with the results for the private insurance practices, the differences in the rates of MRI use do not seem to be related to the period when the practices had a financial interest in MRI equipment, except for one practice.

Table 4: Medicare Regression Results

Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	-0.7594	0.0349	474.2658	<.0001
year2012	1	-0.0431	0.0268	2.5867	0.1078
dual	1	0.0147	0.0278	0.2807	0.5962
sex_cd	1	0.0195	0.0184	1.1269	0.2884
age_65_70	1	-0.1452	0.0322	20.3729	<.0001
age_70_75	1	-0.1940	0.0328	34.9410	<.0001
age_75_80	1	-0.3679	0.0343	114.9998	<.0001
age_80_85	1	-0.5798	0.0363	254.6780	<.0001
age_GE_85	1	-0.9191	0.0383	575.5514	<.0001
Practice A	1	0.0479	0.0408	1.3758	0.2408
Practice B	1	0.1870	0.0360	26.9392	<.0001
Practice C	1	0.0835	0.0425	3.8640	0.0493
Practice D	1	0.1538	0.0362	18.0203	<.0001
Practice E	1	-0.2575	0.0577	19.9061	<.0001
F_ Practice A	1	0.0907	0.0595	2.3219	0.1276
F_ Practice B	1	0.1174	0.0510	5.3009	0.0213
F_ Practice C	1	-0.0485	0.0593	0.6684	0.4136
F_ Practice D	1	-0.0529	0.0520	1.0317	0.3098
F_ Practice E	1	0.0706	0.0804	0.7716	0.3797

Age is significant Older less likely to get MRI

Several practices have significantly higher use than First Control Group

But does not seem to be related to MRI ownership, except for 1 practice

IX. Conclusions

For patients with private insurance and Medicare, this study found no evidence that financial interest influenced MRI rates in 2010 compared to 2012. For practices with a financial interest in the equipment in 2010, their rates of MRI use are higher in both 2010 and 2012. The higher rate is statistically significant for privately insured patients for all practices. For Medicare patients the MRI use rate is higher and statistically significant for three of the five practices. The higher rates persist even after controlling for factors such as age and coverage by a high-deductible plan (privately insured patients), and dual Medicaid eligibility (Medicare beneficiaries).

X. Limitations

It is possible that the timeframe required for this study one year before divestment and the year immediately following divestment was too short a timeframe to capture changes in physician behavior. The study design presumes that a change in MRI ordering behavior will be abrupt following a change in financial interest in the equipment.

The study could not make use of the broader population of patients receiving care from other orthopedists in the Medicare analysis, because the NPI field was not useable in the Medicare data.

Other factors could influence MRI use, such as age of physician, income of patient, and other patient conditions that could not be measured in this study.

Physicians can order tests without patients following through and getting the test. There is no record in the claims data of an order, only of the service when a patient actually receives the test. It is possible that patients with different insurance coverage may have different rates of fulfilling the test orders. We were able to control for insurance type, private and Medicare and for high-deductible plan design to control for different rates of fulfillment due to greater or lesser insurance coverage. It is also possible that patients with more social support are more able to comply with orders to obtain medical services.. It is well known that patients with low socio-economic status are less likely to receive many preventive measures. We were not able to control for patient income.

We did not explore whether the type of diagnostic scan that orthopedists made a referral for differs among the groups or changes over time, e.g., greater use of CT or other imaging modality. It is possible that groups with a financial interest in MRI equipment would be more inclined to use that equipment over another imaging modality, whereas groups without a financial interest in an MRI machine might use other modalities as well.

Other interesting questions that this study did not address due to funding and time constraints are:

- Was there a shift in site of service between office-based use of MRI services and hospital-based used of services?
- Was there a shift in modality of imaging service, e.g., from X-ray or CT to MRI?
- Is there a benefit to increased use of MRI, e.g., lower health care costs due to greater efficiency, increased patient convenience or compliance? When the MRI services are diagnostic, are there higher rates of detection of the anomaly?
- Are reimbursement rates for MRI services reasonable relative to the actual cost of providing the services?

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Appendix A
Practices with Financial Interest in 2010 – Cases

Orthomaryland

Orthopedic Associates of Central Maryland

Peninsula Orthopedic Associates, P.A.

Potomac Valley Orthopedics Associates

Robinwood

Appendix B
Similar Orthopedic Practices without a Financial Interest in 2010 – Control Group 1

Center for Advanced Orthopedics (Hollywood and Waldorf)

Greater Washington Orthopedic Group

Maryland Orthopedic Specialists

Metro Orthopedics and Sports Therapy

Mid-Maryland Musculoskeletal Institute

Montgomery Orthopedics

Orthopedic Surgeons of Montgomery Count

Orthopedic Associates

Orthopedic Solutions

Orthopedic Center

Southern Maryland Orthopedic and Sports

Summit Orthopedic

Appendix C
Methodology for Identifying Other Orthopedists

The steps used to identify other orthopedists in Maryland were as follows:

1) Identify most common CPT in the claims for the case and control group 1 that are also in musculoskeletal range 20000-29999 and those not likely to be used by other specialties

The top 5 CPT codes were:

20610	Arthrocentisis, aspiration and or injection; major joint (shoulder, hip, knee subacromial bursa	41.2%
20605	Arthrocentisis----intermediate joint	3.9%
20550	Injection, single tendon sheath or ligament aponeurosis	3.8%
29881	Arthroscopy, with meniscectomy	2.6%
29826	Arthroscopy, shoulder; decompression of subacromial space	2.1%

With the exception of 20550, we included these and arthroscopy procedures (excluding spine) as more likely to be done by orthopedists than other physicians. Those codes were:

- 20600 through 20610
- 23395 through 23491
- 24300 through 24498
- 25260 through 25492
- 26340 through 26596
- 27097 through 27187
- 27380 through 27499
- 27650 through 27745
- 28200 through 28360
- 29805 through 29848
- 29855 through 29907

These codes represented 67 percent of the CPT in the musculoskeletal range for patients of the case and control group 1 practices (58,010 out of 86,859)

2) Identify the NPI of all providers with these CPT (those already identified under the case and control group 1).

- Count = 289,655
- Unique NPI =10,466 (82% had 9 or fewer of these CPT)

3) Limit to NPI that had a threshold number of these CPT

We counted the number of times that the case and control group 1 billed one of the selected orthopedic CPT in 2010. Range was 16 to 8117. We applied a threshold of 10 or more of these CPT to the other orthopedic NPI.

- Count = 1843

4) Look up in NPI file to identify specialty

We matched the NPI to the subset of the national NPI file where Maryland was indicated in the state or practice state field. The NPI file was downloaded in July 2014. It is a cumulative file that includes expired NPI with an expiration date. All NPI with a Maryland address or Maryland practice location were extracted.

- Match = 1,125
- Did not match = 1843-1125= 718

5) Exclude if specialty is not orthopedic or generic specialty code

For the matches, we identified which had a taxonomy code[14] (any of the 15 positions) that was orthopedic:

Orthopaedic Surgery - 207X00000X
Adult Reconstructive Orthopaedic Surgery - 207XS0114X
Foot and Ankle Surgery - 207XX0004X
Hand Surgery - 207XS0106X
Orthopaedic Surgery of the Spine - 207XS0117X
Orthopaedic Trauma - 207XX0801X
Pediatric Orthopaedic Surgery - 207XP3100X
Sports Medicine - 207XX0005X

Any NPI with an orthopedics taxonomy code in any of the 15 taxonomy code fields was identified as an orthopedist. There was a total of 872 orthopedic NPIs in Maryland. NPIs can be for either the individual physician or the practice or billing entity. This number does not correspond to the number of individual orthopedic physicians in the state.

I also identified those that had a generic "specialist" taxonomy code= 174400000X

- Orthopedic count: 303
- Specialist count: 87
- Overlap: 8
- Total unduplicated: 382
- Drop from #5 count: 1125-382=743

There were 303 confirmed orthopedists that billed 10 or more of the CPT codes identified above.

For the 79 NPIs where only "specialist" was indicated but who billed the orthopedic CPT identified above, we selected seven where the name of the practice clearly indicated orthopedics.

[14] Taxonomy codes from http://www.wpc-edi.com/reference/):