Medicare Savings From Conservative Management of Low Back Pain

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ABSTRACT

OBJECTIVES: Low back pain (LBP) is a common and expensive clinical problem, resulting in tens of billions of dollars of direct medical expenditures in the United States each year. Although expensive imaging tests are commonly used, they do not improve outcomes when used in the initial management of idiopathic LBP. We estimated 1-year medical costs associated with early imaging of Medicare beneficiaries with idiopathic LBP.

STUDY DESIGN: We used a 5% random sample of Medicare fee-for-service enrollees between 2006 and 2010 to determine 12-month costs following a diagnosis of idiopathic LBP. We analyzed costs of care and patient outcomes according to whether or not the patients had been referred for early imaging following their initial diagnosis.

METHODS: We employed an instrumental variables analysis using risk-adjusted physician-level propensity to order imaging for patients without LBP as an instrument for imaging use among patients with LBP. We selected this approach to adjust for confounding by indication when estimating the relative costs of early imaging of LBP compared with conservative management.

RESULTS: Early imaging is strongly associated with increased costs of care in the first year following LBP diagnosis. Patients receiving an early magnetic resonance imaging scan accrued $2500 more in Medicare expenditures than conservatively managed patients, and patients who received computed tomography accrued $19,900 more.

CONCLUSIONS: Medicare beneficiaries with low-risk LBP frequently receive early imaging studies. Early imaging was associated with greater long-term costs than a conservative diagnostic strategy; Medicare expenditures could be reduced by $362 million annually by managing newly diagnosed LBP in accordance with clinical guidelines.

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Low back pain (LBP) is the most common type of pain reported by adults and represents the fifth most common reason for physician visits in the United States.[1,2] One-fourth of adults in the United States report experiencing back pain lasting at least 1 day in the past 3 months,[1] and more than 80% of adults will experience LBP at some point in their lives.[3] The condition is costly: A 2008 study estimated that spine problems led to $85.9 billion in medical expenditures in 2005.[4]

Although serious medical conditions, including neurological compromise, infectious and inflammatory processes, and malignancy, can cause LBP, most episodes of back pain are considered mechanical in nature and do not require specific therapy. Observational studies and randomized controlled trials have demonstrated that routine lumbar spine imaging (plain radiographic film followed by magnetic resonance imaging [MRI] or computed tomography [CT]) does not improve clinical decisions[5,6] or patient outcomes.[7,8] Further, such routine imaging leads to increased costs, unnecessary patient exposure to radiation and subsequent invasive treatments, and emotional turmoil.[9-12] Given the robust evidence against routine imaging for LBP, medical specialty societies[13-15] and governmental organizations[16,17] recommend against lumbar spine imaging for LBP within the first 6 weeks of diagnosis, unless patients present with "red flags" for underlying conditions such as malignancy, infection, or spinal fracture.[13]

Thus, the standard of care is to defer imaging, relying instead on a focused history and physical exam in initial evaluation of patients with no red flags.[17] Despite these clinical recommendations, however, diagnostic imaging has been employed in a steadily increasing proportion of initial evaluations of back pain among both privately insured patients[18] and Medicare beneficiaries since the 1990s.[19-21] An estimated 20% to 50% of patients undergo imaging studies for LBP within the first 6 weeks of diagnosis, often on the date of their initial physician visit. Further, a significant proportion of patients with LBP do not receive a physical exam when they first present to a physician.[22]

Although a conservative approach to LBP has been shown to be cost-effective, it has not been adopted widely in clinical

settings. According to the findings of one study, if guidelines for diagnosing LBP were fully implemented in practice, whether via cultural shifts in physician approaches to care or implementation of new incentive structures, annual cost savings in the United States could reach $300 million.[11] However, that estimate is based on older prevalence and cost estimates collected through meta-analysis, rather than primary claims data; further, it did not account for regional and provider-specific variations in patterns of care, with resulting variability in costs.[19]

TAKEAWAY POINTS

Low back pain (LBP) is a common and expensive clinical problem, resulting in tens of billions of dollars of direct medical expenditures in the United States each year. Although expensive imaging tests are commonly used, they do not improve outcomes when used in the initial management of idiopathic LBP. Early imaging is strongly associated with increased costs of care in the first year following LBP diagnosis.

- Patients receiving an early magnetic resonance imaging scan accrued $2500 more in Medicare expenditures than conservatively managed patients, and patients who received computed tomography accrued $19,900 more.
- Medicare would save $362 million annually if all patients with newly diagnosed idiopathic LBP were managed in accordance with clinical guidelines.

We sought to estimate the cost implications to Medicare of full adoption of an initial conservative approach to LBP. To do so, we first estimated 1-year costs and the clinical sequelae associated with initial diagnostic strategy options. Because treatment assignment is not random, we used instrumental variable (IV) methods to account for confounding by indication. In this approach, a doctor's risk-adjusted propensity to use imaging technologies for patients without back pain is treated as a quasi-randomizing variable. Finally, we estimated potential Medicare savings from switching those who receive initial imaging to conservative management.

METHODS

We conducted an observational study evaluating clinical and cost outcomes at 1 year for Medicare patients with acute uncomplicated LBP who received either conservative management or imaging (MRI or CT) within 6 weeks of their initial diagnosis.

Data Sources and Description

We analyzed a 5% sample of Medicare administrative claims data from 2006 to 2010 to perform this analysis. These data included patient claims, associated diagnosis and procedure codes, socio-demographic information (eg, age, race, zip code of residence, and Medicaid eligibility status), and clinical characteristics (eg, diagnosis of LBP and the presence of comorbid medical conditions). Data were restricted to those of patients enrolled in fee-for-service Medicare and included data from Medicare Part A (inpatient) and Part B (outpatient).

Study Population

In identifying patients with idiopathic LBP, we sought to ensure that their initial management would be uncorrelated with the etiology of their back pain. To construct the analytic sample, we first identified all patients who had at least 2 diagnoses of LBP (*International Classification of Diseases, Ninth Revision* [*ICD-9*] code 724.2) within 6 weeks in the outpatient setting between 2006 and 2010 and who did not have another diagnosis of LBP in the preceding year. We restricted our sample to those who (1) had at least 1 year of Medicare claims prior to and following the index LBP diagnosis and (2) were continuously enrolled in Medicare parts A and B from the date of diagnosis until death or the end of the study period. Because most beneficiaries become eligible for Medicare at 65 years, we limited our sample to patients 66 years and older to allow for 1 year of prior claims data.

Finally, to ensure that we were comparing patients who were similar at initial diagnosis, we restricted the final cohort to patients who did not have any red flag diagnoses in the 1 month prior to or 8 weeks following the index diagnosis and to patients surviving the first 6 weeks after the index diagnosis. Our red flag diagnoses are standard indications for early imaging in the context of LBP: spinal fracture, cancer, infection, disc herniation, spinal cord compression, aortic aneurysm, and nephrolithiasis. We also excluded patients with diagnoses in which imaging may have been contraindicated (patients with renal failure, pheochromocytoma, or hyperthyroidism; patients with implanted medical devices; patients relying on mechanical ventilation). After these exclusions, the remaining population largely consisted of patients whose LBP was idiopathic in nature.

Diagnostic Strategy Designation

We determined initial diagnostic strategies based on procedure codes within the Medicare claims data submitted within 6 weeks of the index diagnosis. We categorized patients as either receiving no lumbar spine imaging or receiving lumbar spine imaging (stratified as MRI or CT). Standard Current Procedural Terminology codes were used to define each lumbar spine imaging strategy.

Cost Analysis

When used to assess the relation of overall costs of care to early imaging of LBP, standard multivariable statistical methods can be compromised by confounding by indication: Physicians are more likely to order imaging studies early for patients with LBP who are in worse initial health.

To address this problem, we used risk-adjusted physician-level propensity to use imaging on patients without LBP over the previous 12 months (hereafter, physician propensity) as an IV. An IV adjusts for unobserved confounders by acting as a quasi-randomizer; it stratified our population using a variable that is unrelated to the unobserved confounder (in this case, severity of patient illness)

but is associated with likelihood of receiving the treatment being studied (in this case, referral for early imaging). Here, we stratify by physician propensity to refer for imaging to remove the potential unobserved confounder of severity of the patient's illness.

The IV method has been used in the medical literature to study a wide variety of topics for which unobserved confounders may introduce bias, including treatment of acute myocardial infarctions,[23,24] effects of health insurance,[25] management of bladder and pancreatic cancer,[26,27] screening for congenital birth defects,[28] and interpretation of neuroimaging data.[29] To the best of our knowledge, the IV approach has not yet been used in the medical literature to study management of LBP.

To adjust appropriately for confounding by indication, the IV method requires that physician propensity be (1) strongly correlated with the use of imaging in initial management of patients with LBP and (2) uncorrelated with the unobserved determinants of clinical management outcomes and costs among patients with LBP after the initial treatment period. Our statistical work strongly supported the first requirement, whereas the second requirement is true by construction: Physician propensity is measured for patients without LBP, so it cannot be correlated with the unobserved health of those with LBP. Regression analysis illustrating the strong correlation between physician propensity and the use of imaging in initial management of patients with LBP is available in the **eAppendix Table** (eAppendix available at **ajmc.com**).

In addition to the IV approach, we adjusted for patient age, race, sex, Medicaid eligibility (as a proxy for socioeconomic status), inpatient visits during the previous 12 months (binary variables for 1 or 2 or more visits), skilled nursing facility (SNF) or hospice stays during the previous 12 months (binary variables for 0 or 1 or more visits in either setting), Elixhauser comorbid medical conditions (using *ICD-9* diagnosis codes during the year prior to index diagnosis),[30] and geography (using a complete set of indicator variables for each hospital referral region).

To calculate cost outcomes, we identified all Medicare parts A and B claims and summed these to total Medicare costs by year from date of diagnosis for each patient. We inflated costs to 2010 US$ using the gross domestic product deflator. We accounted for the possibility of nonnormal distribution of costs by log-transforming costs and employing a standard statistical method that eliminates bias that might arise from the presence of patients with LBP with zero costs after the initial management phase.[31]

Medicare Savings Model

To better illustrate the implications of our statistical analyses, we simulated the effects of switching all Medicare patients with LBP to a strategy of no imaging during the initial management phase (the first 6 weeks after diagnosis). The parameters and structure of our simulation matched the statistical models we used to analyze costs in the year after the initial visit. Using the simulation, we first calculated 1-year expenditures for patients with a particular set of demographic and health characteristics (as per the IV models described previously) if they had received no imaging instead of MRI or CT. We then compared this estimate with the original calculated cost for each diagnostic group and extrapolated the difference across the Medicare population.

RESULTS

Using a 5% sample of all Medicare beneficiaries from 2006 to 2010, we identified 744,262 patients with any diagnosis of LBP in the outpatient setting, of whom 250,771 (34%) qualified for the final study sample. A cohort diagram of the construction of the analytic sample, including all exclusion criteria, is available in the **Figure**. Characteristics of the patients in the sample are presented by initial diagnostic strategy (conservative management, MRI, or CT) in **Table 1**. MRI was the most common form of early imaging, accounting for 21% of the study cohort. Only 3% of the cohort received CT, and 76% of patients received neither form of early imaging.

In general, patients undergoing MRI and patients receiving conservative management had similar characteristics in terms of age, race, socioeconomic status (as determined by Medicaid eligibility), history of recent hospitalization, recent medical costs, and observed comorbidities (Table 1). Thus, the observable characteristics of patients receiving MRI in our sample were similar to those of patients receiving conservative management, even before adjustment for relevant comorbidities and quasi-randomization with our IV. This implies that observed differences in medical costs for patients receiving MRI and patients receiving no imaging in our sample can reasonably be attributed to differences in the management of their LBP, rather than differences in the etiology of that LBP. However, patients in our study cohort who received CT imaging were slightly older at initial diagnosis and were more likely to be male, to be eligible for Medicaid, and to have had a hospitalization or received SNF or hospice care in the year prior to diagnosis. Patients undergoing CT also accrued higher medical costs in the year prior to their diagnosis and were more likely to have certain comorbidities, including diabetes, heart failure, and chronic obstructive pulmonary disease (Table 1). Patients receiving CT may have had contraindications to MRI that were associated with higher medical costs beyond those captured in our models.

Our motivation for using an IV, physician propensity to refer for imaging, as a quasi-randomization tool in this analysis was that the health of patients who receive early imaging may differ from that of patients who do not receive imaging. This difference may be reflected in their observed health characteristics (Table 1) and addressed in part by including patient characteristics in a multivariable regression. However, such an approach does not account for unobserved health characteristics, which we address here by implementing IVs.

Another indication of unobserved differences in health between our patient groups would be differences in survival after their LBP diagnosis. We used Cox proportional hazard models to estimate the survival of patients who received MRI, CT, or no early imaging

after their initial LBP diagnosis. We found no differences in survival across these groups, both in an unadjusted analysis (**eAppendix Figure 1A**) and in a survival analysis that adjusted for patients' pre-existing conditions and for geographic variation in service use (**eAppendix Figure 1B**).

Although early use of imaging in LBP does not appear to be associated with improved clinical outcomes, our IV analyses of patient costs indicate that patients who receive early imaging have substantially higher average medical costs in their first year after diagnosis. Cumulative estimated Medicare expenditures in the 1 year post diagnosis are reported for each diagnostic strategy in **Table 2** (see eAppendix for full regression output). The conservative management strategy was associated with the lowest annual Medicare expenditures, whereas those receiving an MRI accrued $2512 more and those receiving CT accrued $19,899 more in total Medicare expenditures in the year following diagnosis.

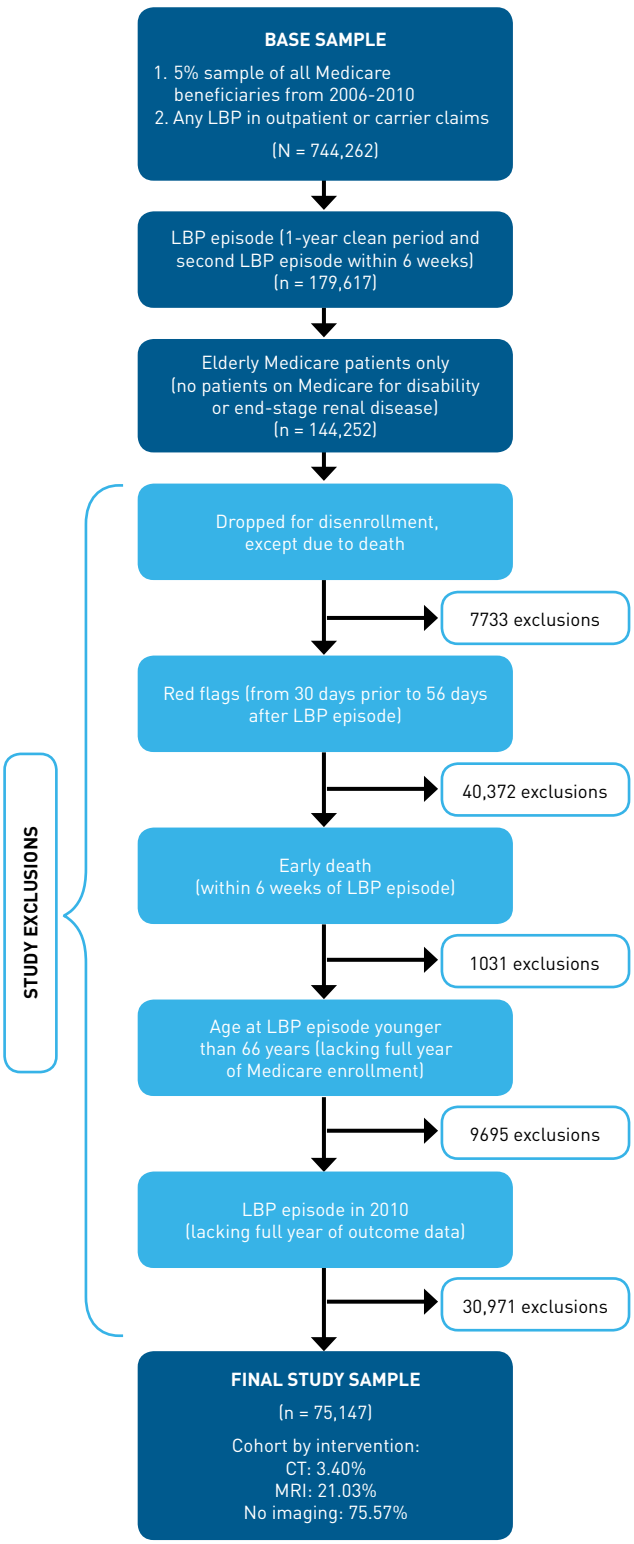
Table 2 also shows potential Medicare health expenditure savings from increased use of conservative diagnostic strategies for patients diagnosed with LBP. Shifting patients who receive CT to no imaging would save $203 million annually ($19,899 saved per patient per annual diagnosed cohort), and shifting those who receive MRI to no imaging would save $159 million annually ($2512 saved per patient per annual diagnosed cohort).

DISCUSSION

Our analysis confirms that imaging studies are overused in the initial management of low-risk patients with LBP[32-34] and suggests that substantial Medicare savings could be realized from guideline-compliant care in this setting. We found that 24% of Medicare patients with uncomplicated acute LBP diagnosed from 2006 to 2010 received advanced imaging within 6 weeks of diagnosis. The proportion of patients receiving advanced imaging (MRI or CT) remained constant throughout this period, although clinical guidelines published in 2007 recommended an initial conservative diagnostic strategy (ie, no imaging within the first 6 weeks following diagnosis).[15] Diagnostic strategies that included advanced imaging were associated with greater long-term costs than a conservative diagnostic strategy and were not associated with improved outcomes; patients receiving CT accrued the highest costs in the year following diagnosis. We find that $362 million could be saved annually within the Medicare context by treating patients with newly diagnosed LBP with a conservative initial diagnostic strategy, per clinical guidelines.[13-15]

A fundamental premise of our IV approach is that physician practice patterns vary. One physician may adopt a practice style that favors less intervention while another may adopt a more aggressive attitude toward patient management. Early imaging may be a component of a broader management approach that some physicians take with patients with LBP. Furthermore, physician practice patterns change surprisingly little in response to new evidence and clinical guidelines.[35] A key lesson that accompanied the Dartmouth Atlas's observation of marked variation in physician

FIGURE. Study Population



CT indicates computed tomography; LBP, low back pain; MRI, magnetic resonance imaging.

TABLE 1. Characteristics of Medicare Patients With Uncomplicated Acute LBP, by Initial Diagnostic Strategy

Characteristic	Conservative Management (no imaging)	MRI	CT
n	57,217	15,803	2555
% of total	76	21	3
Age, years, mean (SD)	75.35 (6.48)	75.27 (6.43)	77.47 (7.12)
Male, %	33	33	37
Race, %			
Black	5	5	4
White	90	92	92
Other	5	3	4
Medicaid dual eligibility (any dual code in ±1 year), %	16	14	19
IP hospitalization in observation period, 1 instance, %	13	14	20
IP hospitalization in observation period, 2 or more instances, %	6	5	12
Any SNF or hospice in observation period, %	3	3	4
Total Medicare expenditures in 1 year prior to index LBP diagnosis	$6594.33	$6379.06	$10,250.49
Selected comorbidities, %			
Cardiac arrhythmias	20	17	42
COPD	14	15	19
Depression	10	10	12
Diabetes, uncomplicated	27	29	33
Heart failure	11	10	24
Hypertension, uncomplicated	73	76	83
Metastatic cancer	1	2	2
Obesity	5	5	7
Renal failure	7	7	11

COPD indicates chronic obstructive pulmonary disease; CT, computed tomography; IP, inpatient; LBP, low back pain; MRI, magnetic resonance imaging; SNF, skilled nursing facility.

TABLE 2. Annual Costs of LBP Per Patient by Initial Management Strategy and Estimated Total Annual Savings to Medicare From Switching to a Conservative Management Strategy[a]

Initial Management Strategy	Estimated Costs (95% CI)		Estimated Medicare Savings From Switching to No Early Imaging	
	Ordinary Least Squares Regression	IV Analysis	Regression	IV Analysis
CT	$13,031 ($12,233-$13,829)	$27,598 ($14,750-$40,445)	$51,466,182	$203,367,780
MRI	$10,259 ($10,027-$10,492)	$10,211 ($5712-$14,709)	$143,132,195	$158,788,544
No early imaging	$7995 ($7908-$8082)	$7699 ($6862-$8535)	N/A	N/A

CT indicates computed tomography; IV, instrumental variable; LBP, low back pain; MRI, magnetic resonance imaging; N/A, not applicable.

[a]This table shows our estimates from a least squares and an IV analysis of the effect of early imaging of patients with LBP on Medicare costs. Our estimates of Medicare savings from conservative management (shown in the right 2 columns) are based on the regression results in the Estimated Costs columns.

practice was that these variations are driven more by a physician's own impressions and experience than by the publication of new guidelines and research.[36]

Limitations

Among the limitations of this study is the absence of data on Medicare Part D costs, which prevented us from assessing the use of opioids and other medications to control LBP. Although our IV directly addresses the problem of confounding by indication, there may be residual confounding that the instrument has failed to account for. For example, we did not measure practice type or the physician's financial incentives to order advanced imaging, both of which have been shown to influence the choice of LBP diagnostic techniques.[19] We minimized such biases by using the IV method and by adjusting for a variety of patient demographic and health characteristics. We further limited the influence of high-cost outliers by using log-transformed 2-stage least squares regressions. Additionally, as with all analyses of a random 5% Medicare sample, our conclusions are drawn from a subset of the Medicare population rather than the entire population.

Finally, our research only addresses potential savings from adoption of a conservative diagnostic strategy for LBP. Clinical societies have been recommending conservative strategies for many years, with seemingly little success. Chou et al have hypothesized that financial incentives, including incentives linked to patient satisfaction and self-referral, along with defensive medicine considerations, promote overuse of advanced imaging techniques in this setting.[10] Other studies have shown that patients at baseline may feel more satisfied if they receive advanced imaging for LBP; however, those who instead receive a 5-minute educational intervention on the risks associated with lumbar spine imaging and its minimal clinical usefulness feel equally satisfied with their care.[19,37]

CONCLUSIONS

Insofar as payment moves from a per service basis to models closer to capitation, the culture of clinical practice will change: Physicians may be incentivized to adhere to more cost-effective

and conservative diagnostic strategies through payment structures incorporating quality measurement, such as LBP-specific measures sponsored by the Agency for Healthcare Research and Quality National Quality Measures Clearinghouse.[38] These shifts in physician preferences must come hand-in-hand with shared decision making, in which patients receive trustworthy information on the clinical usefulness of early imaging for LBP.[39] Results from this study demonstrate that such shifts in clinical practice toward adoption of conservative diagnostic strategies for LBP, as supported by comparative effectiveness research, could lead to large health expenditure savings. ■

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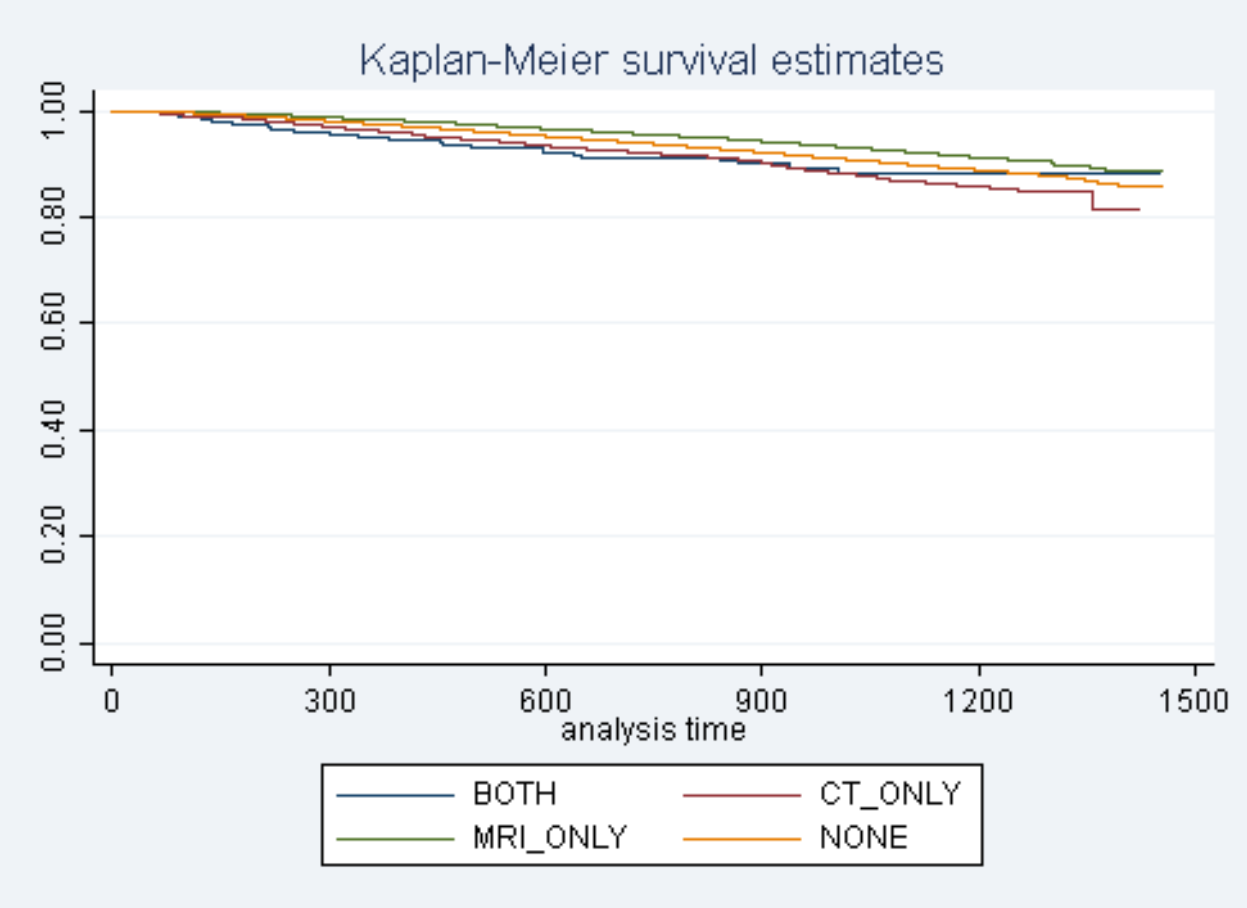
eAppendix Table 1. Association Between Receipt of Imaging and Physician Propensity to Refer Patients Without LBP to Imaging[a]

Instrumental Variable	Received MRI for LBP	Received CT for LBP	Received Any Imaging for LBP
Physician propensity to refer non-LBP patients to MRI	0.251 (*P* <.001)	N/A	0.253 (*P* <.001)
Physician propensity to refer non-LBP patients to CT	N/A	0.054 (*P* <.001)	0.028 *(P* = .002)

CT indicates computed tomography; IV, instrumental variable; LBP, low back pain; MRI, magnetic resonance imaging; NA, not applicable.

[a]This table shows the results from 3 separate ordinary least squares regressions, with the dependent variables listed in the first row of the table. The set of righthand-side variables include the IVs used in this paper, along with the full set of regressors listed in Table 1. The results show that physician propensity to prescribe their non-LBP patients for imaging (our IVs) is strongly correlated with physician propensity to refer patients with LBP for imaging.

eAppendix Figure 1A. Unadjusted Survival Between Diagnostic Groups



eAppendix Figure 1B. Adjusted Survival Between Diagnostic Groups