Whistleblowers, The False Claims Act, and the Behavior of Healthcare Providers

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Abstract

This paper studies the effects of litigation by whistleblowers against healthcare providers for misreporting claims for payment to the Medicare program. Under the U.S. False Claims Act, whistleblowers bring lawsuits on behalf of the government in exchange for a share of recovered payments. I combine a new dataset on whistleblower cases from the Department of Justice with the universe of Medicare Feefor-Service claims from 1999-2016. First, I measure the deterrence effects of successful whistleblowing lawsuits using a synthetic control design. I find that whistleblower settlements totaling to \$1.9 billion in recovery generated future cost savings of more than \$18 billion over 5 years. Next, I examine how whistleblowing impacts care decisions by providers. Using a case study of spine procedures for osteoporotic patients, I find that after a whistleblower settlement, care shifted from inpatient to less-expensive outpatient treatment and towards patients with the greatest expected benefit.

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1 Introduction

Misreporting, overbilling, and fraud hinder governmental provision of public goods and services. The American federal health insurance programs are particularly susceptible to misreporting by medical providers, driven by the information asymmetry between the federal insurer and the private healthcare providers these insurers reimburse. This information asymmetry, compounded by the sheer size of the federal healthcare programs, makes monitoring both expensive and challenging. With the United States government spending more than a trillion dollars per year on health care, even small shares of financial impropriety can be very expensive, motivating the concern that healthcare has become a source of illicit profit for those providers willing to misreport.

Whistleblowing is a potentially valuable method to curb improper behavior by providing incentives for individuals to come forward with private information about this behavior. The False Claims Act (FCA) is a federal law that since 1986 has allowed whistleblowers to recover over-billed money for the government and receive a share of the recoveries. This creates strong financial incentives for whistleblowing. Uniquely, FCA whistleblowers conduct litigation on behalf of the federal government in federal civil court, without the need for government approval nor necessarily receiving government support in conducting the case. As such, the FCA combines a reward for private information with financial incentives for private enforcement. The FCA, which is frequently used to combat fraud in healthcare, has become a powerful tool for uncovering impropriety, generating thousands of whistleblowing cases and tens of billions of dollars of recovered money over the past 30 years. In fiscal year 2018 alone, whistleblowers recovered almost \$2 billion from FCA healthcare lawsuits, for which whistleblowers were awarded \$266 million (Civil Division, U.S. Department of Justice, 2018).

There has been substantial disagreement in the public sphere over the value of the FCA. Proponents of whistleblowing point to the volume of settled cases and the billions of dollars recovered as evidence of the effectivity of the Act. Attorney General Eric Holder said in a 2012 press release: "In the last quarter century, the False Claims Act's success has been unparalleled with more than \$30 billion dollars recovered...and \$8.8 billion since January 2009" (United States Department of Justice, 2012). Yet detractors suggest that profitseeking whistleblowers use civil litigation to force settlements from providers, regardless of the validity of their allegations. In an *amicus* brief to the Supreme Court, the U.S. Chamber of Commerce, a pro-business organization, wrote: "[whistleblowers] can extract settlements from defendants averse to high discovery costs, the risk of large losses, and...reputational harms" (Chamber of Commerce, 2015).

The private enforcement of law has many potential benefits and costs. By compensating whistleblowers

for conducting the enforcement, the False Claims Act has been very effective at producing lawsuits and recovering funds for the federal government. In addition, whistleblowing can have deterrence effects, both by changing spending on the types of conduct litigated against by whistleblowers, which I call direct deterrence, and also by preventing potential fraud from being committed, which I call ex-ante deterrence. In contrast to these benefits, private enforcement faces the risk of unnecessary and costly over-enforcement. Lawsuits have both public and private costs, including to the court system, to both plaintiff's attorneys and defense attorneys, and to medical providers who face increased litigation risk and may change their care decisions.

In this paper, I examine the economics of whistleblowing under the False Claims Act and conduct empirical analyses of two effects of whistleblowing. First, I measure the direct deterrence effects of whistleblower cases, and second, I study the effects of whistleblowing on provider care decisions. Data on whistleblowing cases were obtained through a Freedom of Information Act request filed with the Department of Justice, as well as hundreds of press releases from the Department of Justice archives and federal court documents. These are paired with large samples of Medicare claims data from 1999-2016, which detail medical procedures conducted, federal expenditures, and some patient health outcomes.

To measure direct deterrence effects, I conduct a series of case studies of successful whistleblowing lawsuits and analyze their effects on Medicare claims and spending. First, I create categories of whistleblower lawsuits that have similar allegations of misreporting or fraud. For example, one category is the profitable manipulation of the Medicare outlier payment system; this category contains 11 Department of Justice press releases. I analyze the 4 highest-recovery categories as case studies, looking at post-lawsuit claims and spending. These categories combined contain 29 press releases detailing \$1.9 billion in total settlements. I apply a synthetic control methodology to these case studies to estimate counterfactuals in the absence of whistleblowing. The standard synthetic control methodology is augmented by an additional parameter, a time-shift for each control, which I estimate. This method allows the comparison between similar trends in spending that occur at different points in time. Using the time-shifted controls, I compare spending on treated types of medical care to a synthetic control group constructed of similar, untreated types of care. The difference between spending on treated care and the synthetic control group provides the measure of direct deterrence in the post-whistleblowing periods.

My results point to a high direct deterrence value of whistleblower cases. The total direct deterrence effect of the 4 case studies exceeds \$18 billion in the first 5 years after the cases were filed. On average, direct deterrence is about 6.7 times the case's settlement value, with wide variation in this ratio. For comparison, total whistleblower compensation for all healthcare related cases in my data from 1986-2012 totals to \$4.29 billion, indicating that the deterrence effects of just the few largest cases outweigh the collective costs of paying whistleblowers. Importantly, these direct deterrent effects do not count the ex-ante deterrence value of fraud that is never committed by providers who face increased litigation risk, and therefore these amounts constitute a lower bound of the total deterrence effects of these cases.

Next, I examine the effects of whistleblowing on provider care decisions. Whistleblowing has the potential to change provider care decisions by changing the compliance requirements, litigation risk, and profitability of care that doctors conduct. I conduct a case study on kyphoplasty, a spinal procedure for patients with osteoporosis. A set of whistleblower lawsuits alleged that many hospitals fraudulently admitted patients for inpatient kyphoplasty rather than perform this procedure outpatient. Kyphoplasty is linked to decreased mortality in the medical literature, and there was a large effect of whistleblowing on treatment. This motivates a case study of kyphoplasty as it is uniquely positioned for understanding changes in care decisions. I model the effects of kyphoplasty on Medicare patient death among two cohorts of roughly 8 million patients each, from before and after the lawsuits. My model interacts patient covariates and medical history with treatment, which produces estimated treatment effects of kyphoplasty for each patient. These effects provide a scale by which to measure how beneficial it is for a patient to receive treatment.

This modeling exercise finds that, in the case of kyphoplasty, whistleblowing had positive overall effects on patient care. Following whistleblowing, there was better targeting of the procedures to those patients for whom greater benefit is predicted. Patients who were more likely to die upon receiving kyphoplasty were 7% less likely to be treated, while patients less likely to die if treated were 7% more likely to be treated. This targeting change was concurrent with a substitution from inpatient kyphoplasty to less expensive outpatient kyphoplasty and vertebroplasty, a close substitute. This indicates that whistleblowing can have positive effects on care delivery by changing the incentives in the care decision process by providers, even while reducing spending.

This paper relates to a variety of literature on the False Claims Act, private enforcement, whistleblowing, and Medicare fraud. Despite the volume of lawsuits and funds recovered under the FCA, there has been little empirical economic analysis of this law. Engstrom (2012; 2013) presents descriptive statistics on FCA case length, settlement values, defendant characteristics, and more, although he does not measure any of the effects of whistleblowing. Depoorter and De Mot (2006) present a theoretical analysis of FCA whistleblowing and government intervention. In the accounting literature, Heese and Cavazos (2019) show that firms which settle under the FCA receive reduced procurement contracts from the federal government, and Heese (2018) shows that hospitals prosecuted under the FCA are less likely to participate in broad measures of overbilling. Related to whistleblowing more generally, Dyck, Morse, and Zingales (2010) analyze the types of whistleblowers who come forward under the Securities and Exchange Commission whistleblower program, which provides compensation but does not allow direct private enforcement. This paper also relates to the legal literature on private enforcement, of which Polinsky (1980) is a seminal work; and on deterrence, for which Becker and Stigler (1974) began a wide literature. In the medical fraud literature, Silverman and Skinner (2004) and Dafny (2005) describe the financial incentives for upcoding inpatient DRGs among for-profit hospitals, which relates to the analyses in Section 4 that describe overbilling for inpatient care. Nicholas et al. (2019) present observational evidence that patients treated by Medicare providers subsequently excluded from the program for fraud or abuse face increased mortality risk, which relates to the analysis in Section 5 on provider care and patient mortality. This paper fills a gap in the existing literature by providing empirical evidence of the effects of whistleblowing and private enforcement in the context of Medicare fraud.

This paper is organized as follows. Section 2 describes the institutional details of the False Claims Act and gives a deeper treatment of the economics of private enforcement. Section 3 describes the data and provides stylized facts about FCA lawsuits and recoveries. Section 4 presents the time-shifted synthetic control method, describes a series of case studies of successful whistleblower lawsuits and measures direct deterrence. Section 5 presents the effects of the kyphoplasty lawsuits on patient care, and Section 6 concludes.

2 The False Claims Act: Background and Economic Framework

2.1 Background and Institutional Details

Medical care has a fundamental information asymmetry between providers, insurers, and patients (Arrow, 1963), which creates opportunities for misreporting. A patient who receives medical care rarely observes the billing process, which is conducted by the provider. Conversely, insurers have limited means of directly observing care, relying on provider's claims for payment. This asymmetry provides opportunities for misreporting by providers, whose billing practices tie directly to their profits. It is difficult to uncover this misreporting using top-down enforcement, as insurers generally lack other sources of information besides the provider's claim and supporting documentation. As such, private information from providers or their staff is useful for uncovering any misreporting or fraud.

When the insurer is the federal government, as is the case with Medicare and Medicaid, these problems are exacerbated. Medicare and Medicaid are massive programs, spending respectively around \$700 and \$400 billion per year (Congressional Budget Office, 2019), creating bureaucratic issues due to the sheer volume of claims. Indeed, the Government Accountability Office (GAO) estimates that around 8% of Fee-for-Service Medicare expenditures in 2017 were "improper," i.e. lack necessary documentation to ensure the correct amount was paid to the right person for a valid claim (United States Government Accountability Office, 2019). Though most improper payments are not fraudulent, this underscores the opportunism that may arise from expensive and overwhelmed federal programs. Even small shares of fraud in Medicare spending can amount to tens of billions of dollars per year.

With these issues in mind, in 1986 Congress amended¹ the False Claims Act to enable whistleblowers to directly conduct lawsuits against those who over-bill the government (United States Department of Justice, 2012). Though not restricted to healthcare, the False Claims Act has largely been used against healthcare-related fraud, overbilling, and misreporting. Under the False Claims Act, individuals who uncover misreporting against the US government, themselves often healthcare workers (e.g. a disgruntled nurse), hire their own attorneys and sue those committing the impropriety in federal civil court. The whistleblower sues qui tam, i.e. on behalf of the US government. These civil court cases have 3 parties: the whistleblower, the defendant, and the US government. In some cases, the Department of Justice intervenes in what it believes to be a lucrative lawsuit by assigning its own attorneys and conducting the investigation and litigation. In other cases, the whistleblower does not receive federal support, and either pursues the case alone or drops it. All cases are filed under seal, meaning the defendant is not immediately notified of the filing, giving the government an opportunity to investigate and elect to intervene before the defendant is made aware. The Department of Justice must also approve any settlements between the whistleblower and the defendant, regardless of their intervention status.

False Claims Act lawsuits can be high stakes for all parties involved. These cases are conducted in civil court, and the burden of proof is the preponderance of the evidence, i.e. "more likely than not." Because litigation is expensive, few cases go to trial; unsuccessful cases are often voluntarily dismissed by the whistleblower, and clear-cut cases are settled. In successful cases, the federal government can recover up to 3 times the amount of the proven false claims from the defendants, plus potentially large criminal fines. Upon settlement, the whistleblower is entitled to 15-25% of the recovery amount if the government intervened, and 25-30% if the government did not intervene. Whistleblowers regularly earn 6-figure payouts and above from these cases, of which their attorneys, working on contingency, take around 30%. Defendants are also often hit with criminal fines and can furthermore be sued for legal fees by successful whistleblowers. Enforcement is compounded by the use of Corporate Integrity Agreements, where settling providers agree

 $^{^{1}}$ The FCA was amended in 1986, but originally existed during the Civil War to combat fraud. It was ineffective and out of use in the 20th century before the 1986 amendments.

to additional federal oversight, or by the use of exclusion of the provider from the Medicare and Medicaid programs.

2.2 The Economics of Private Enforcement

The private enforcement of law faces a tradeoff between the benefits of privatization, which include incentives for enforcement and deterrent effects, and the downsides of privatization, which include spurious litigation and distortionary effects on medical provision.

The False Claims Act creates a bounty program for the private enforcement of law. The opportunity for a large payout creates incentives for a whistleblower to come forward with their private information about fraud or misconduct, which can alleviate personal and professional costs arising from whistleblowing on one's employer. Furthermore, the ability for the whistleblower to conduct the case in lieu of the government creates a profit motive for rooting out impropriety that may be otherwise lacking in the federally-administered programs. This profit motive is in contrast to the usual incentives of federal bureaucrats, and thus can alleviate principal-agent problems within the government that can cause inefficient investment in monitoring and enforcement. Prosecution conducted by the government has capacity constraints due to the limited resources of the Department of Justice, while privatized enforcement creates a market for whistleblowing information and generates substantially more litigation than the federal government conducts alone. ²

Whistleblower cases also have the potential for valuable direct deterrence effects. Following a lawsuit, both the defendants and other providers of the same care face incentives to change their behavior to avoid further litigation or to comply with the terms of their settlement agreements and avoid exclusion from the Medicare and Medicaid programs. Because the defendants may be only a small share of those committing impropriety, these direct deterrent effects have the potential to affect providers far exceeding the scope of the settlement. One might expect that providers who commit "rational fraud" do so having fully internalized the expected costs of their behavior, and observing settlements would not affect their decisions. However, observing settlements can either update other providers' beliefs about being caught, or increase the salience of the expected costs, thus causing behavioral changes and direct deterrence effects. Finally, behaviors that constitute litigable FCA violations may be "gray areas" of billing or care, in which case settlements can draw a clear line on what is acceptable behavior, and can prompt rule changes and clarifications from the Medicare

 $^{^{2}}$ The False Claims Act has a provision for enforcement by the Department of Justice without whistleblowers, if for some reason the government has information about misreporting or fraud against federal programs without a whistleblower filing a lawsuit. Since 1993, FCA lawsuits filed by whistleblowers have exceeded FCA lawsuits by the government; in 2016, there were 501 new whistleblower suits to 69 non-whistleblower suits (Civil Division, U.S. Department of Justice, 2018). Non-whistleblower suits are not used in any analysis for this paper; these statistics are included as a point of comparison.

administrators.

In addition to direct deterrence, whistleblowing can cause ex-ante deterrence by increasing litigation risk. Because anyone can file a whistleblower lawsuit, and whistleblowers regularly receive large and well-publicized payouts, providers face the threat of whistleblowing from their entire staff as well as any contractors with whom they interact. This increased risk may cause providers who have an opportunity to commit fraud to forgo the overbilling in the first place. These ex-ante deterrent effects are difficult to quantify, as they come from fraud opportunities never pursued by a provider. Even without knowing the magnitude, the ex-ante deterrence effects must weakly decrease spending on fraudulent or misreported procedures, under the assumption that providers are weakly less likely to commit fraud given increased scrutiny.

The value of deterrence effects is policy-relevant in evaluating the compensation of whistleblowers. Whistleblowers are paid a portion of the settlement recovery, which is itself proportional to the amount of damages due to pre-settlement overbilling. Therefore, whistleblowing compensation is purely retrospective. However, the value of whistleblowing depends on both the settlement and the deterrence effects, the latter of which does not factor into whistleblower compensation.

Figure 1 shows the relationship between the levels of damages and direct deterrence. The damages due to fraud are the difference between fraudulent and non-fraudulent spending, integrated up to the time of the lawsuit. Whistleblowers are paid 15-30% of the federal recovery, which is 2-3 times the damages. The direct deterrence effect is the integrated difference between spending without whistleblowing and spending with whistleblowing in the post-whistleblowing period. In some circumstances, the prior damages may make the expected settlement value too small to be worth pursuing. Yet from a social welfare perspective, these cases might be valuable to litigate if the direct deterrence value is large. This disconnect between whistleblower compensation and whistleblower value added may indicate that whistleblowers are inefficiently compensated in some circumstances.

There are other potential circumstances in which the direct deterrence values are small. Direct deterrence is the difference between spending with and without whistleblowing, and when these values are similar then direct deterrence is small. This could occur when the increase in spending due to fraud all occurs before the whistleblower files, and future spending would look the same with or without whistleblowing. In this circumstance, the settlement serves as a transfer from the defendant to the government and whistleblower for past bad actions, but there is no direct deterrence. However, this still retains the potential prospective benefit of deterring others from committing fraud in the first place, if observing this transfer changes their beliefs about their own enforcement probability or about the profitability of fraud. Another circumstance with little direct deterrence effect is one in which whistleblowing is not meaningful; for example, if fraud continues to be profitable even following a settlement, whistleblowing may not deter future bad behavior. In these circumstances, whistleblowing is potentially inefficient because the settlement only serves to correct retrospective damages, and the lawsuit incurs its full costs without providing social value into the future.

The timing of whistleblowing also factors into its social benefits as well as the whistleblower's compensation. The faster that fraud is litigated against, the smaller the retrospective damages and, therefore, the smaller the whistleblower's share. This could in theory cause whistleblowers to increase their payout by waiting before filing their lawsuit. However, these effects are mitigated by a priority race, in which the firstto-file whistleblower generally receives the bulk of the compensation. The False Claims Act also has a statute of limitations of at most 10 years from the date of the fraud to the filing of the whistleblower lawsuit (31 U.S. Code Section 3731, 1986). From a social welfare perspective, the timing of the whistleblower lawsuit is ambiguous, because smaller damages are reflected in greater deterrence amounts. In practice, plaintiff attorneys report that they tend to file the lawsuit as quickly as they are able to put together a good case.

Private enforcement also comes with many potential costs. Unlike other whistleblower programs, such as the IRS or SEC whistleblower programs, False Claims Act prosecution is conducted directly by the whistleblower. This eliminates any prosecutorial discretion by the government, and may lead to the litigation of cases for which there is little social harm or even explicit misconduct. Because civil lawsuits can be filed by anyone for any reason, there is a potential for spurious litigation by profit-motivated whistleblowers seeking a settlement. Defending against FCA lawsuits can be expensive, and defendants should settle if the expected cost of settlement is below the expected costs of fighting the lawsuit (and potentially losing), regardless of the truthfulness of the whistleblower's claims. Litigation is also costly for other parties, expending public resources as well as the time and costs of whistleblowers' attorneys. Even in circumstances where the government chooses not to intervene in a lawsuit, Department of Justice officials spend time reviewing all cases, and the judicial system expends resources on the litigation process. Furthermore, in the face of increased litigation risk, medical providers must undertake greater investment in compliance measures to ensure their conduct does not inadvertently violate the FCA.

There are some institutional barriers to whistleblowing that deter low-quality cases. First, whistleblowers are not allowed to represent themselves in court (United States District Court, D.C., 2003). Due to the costs of litigation, and the fact that plaintiffs' attorneys work on contingency, plaintiffs' attorneys have incentives not to take on low-quality lawsuits. This provides a barrier to filing spurious cases. Furthermore, FCA cases are most likely to be successful if the government intervenes, due to the resources and investigatory power the federal government brings when litigating a case. Since low-quality lawsuits are unlikely to generate an intervention from the federal government, this further exacerbates the unwillingness of plaintiffs' attorneys to self-fund any low-quality cases. Empirically, Kwok (2013) studies data on whistleblower attorneys and finds no evidence for "filing mills", i.e. law firms pursuing a large volume of low-quality cases.

In light of the costs of whistleblowing cases, the net efficiency of the law relies on the extent to which deterrence effects outweigh the costs of private enforcement. For this reason the measurement of deterrence effects, and the ratio of future deterrence to retrospective damages, is necessary (though not sufficient) for understanding the overall efficiency of the False Claims Act. Section 4 undertakes an exercise to measure these effects.

In addition to all of the cost and benefit analyses above, whistleblowing cases may also have impacts on patient care. Following lawsuits, providers may change actual care and not just the way in which it is billed. Healthcare providers have immense compliance requirements, and False Claims Act cases may inform providers' care decisions as they seek to comply with the shifting landscape of regulation and litigation risk. These changes in provider behavior can be consequential to patient health outcomes, as whistleblowing has touched such critical types of care as acute inpatient hospitalization and spine surgery. These patient health outcomes may be either an additional cost or a benefit to whistleblowing, depending on whether whistleblowing changes care in a way that benefits patients or in a way that disrupts valuable care. I expect that the patient effects differ between cases. In section 5, I conduct one such case study and present an example where whistleblowing changed provider care decisions for the better.

3 Data

The data for this project come from a variety of complementary sources which aggregate information on whistleblower cases and their downstream impacts on medical care provision and patient health outcomes.

Data on Medicare claims and payment are necessary for the analysis of the medical and fiscal impacts of whistleblowing cases. My available data include 100% samples of Fee-for-Service Medicare, i.e. Parts A and B, from 1999-2016, of all types. This includes inpatient and outpatient claims, the MedPar files that aggregate inpatient care at a hospital stay level, data on durable medical equipment, hospice care, skilled nursing facilities, home health data, Part D drug data from 2006-2016, and beneficiary information through the base files and chronic condition segments. Outpatient data are only available as cleaned files from 2002 onwards. Death dates are available at a patient level through the base files. These data, containing 100% samples of each type of care over nearly 20 years, cover tens of billions of claims from hundreds of millions of patients. Section 4 presents the methodology by which I selected whistleblowing cases for analysis, which translates into the usage of these data. Medicare data are used only as they related to each case presented there, and for the analysis of patient health outcomes in Section 5. As such, only a portion of the available data is used in these analyses.

Data on whistleblower lawsuits was compiled from multiple federal sources. Overview data on whistleblowing at a case level comes from a FOIA request I conducted on the Department of Justice for data on all completed (settled or dismissed) *qui tam* FCA cases.³ These data describe more than 5,000 whistleblowing cases and include information on the defendant, whistleblower, filing date, federal agency to which the case relates, federal court district of filing, government intervention election status and date, settlement amount, and whistleblower share. These data start with the introduction of the law in 1987, and the coverage declines after 2012, as many newer cases are still under seal. These data are used for descriptive statistics and stylized facts in section 3.1, as well as for providing supplementary information on whistleblower lawsuits for each case study in Section 4. See Appendix A for more details on the data cleaning process.

For substantive information on whistleblower cases related to Medicare, I scraped the Department of Justice website for all press releases related to Medicare and whistleblowing. Generally, each press release corresponds to one settlement, and my data contain 262 Medicare-related press releases through 2014. I handcoded these press releases for the type of care and type of fraud as well as settlement value reported. I group lawsuits of similar nature into categories, and I find settlement totals within each category. As an example, one category of enforcement is the manipulation of the outlier payment system of inpatient hospitalization; this category contains 11 press releases for a total of \$923 million in settlements. Each lawsuit and press release in this category contains nearly identical allegations against the defendants. Section 4 describes this process and presents its results.

For more detailed information on the whistleblower lawsuits for which I conduct case studies, I collected whistleblowers' original court filing documents (complaints), settlement agreements, and other court documents from a variety of sources. These documents detail exact filing dates, settlement timing, allegations of fraud, and the conduct covered by the settlement agreements. Sources for these documents include the federal court record system (PACER), the Department of Justice digital archives, SEC filings of publicly traded companies, and the legal database of Taxpayers Against Fraud, a not-for-profit supporting whistleblowers' attorneys. Combined with the press release and FOIA data, the court filings give a complete picture of the

³This data set is similar to that used in (Engstrom 2012; 2013), which also came from a DOJ FOIA request. However, to access the most recent data, I conducted an original FOIA request.

allegations and outcomes of a subset of the whistleblower lawsuits.

3.1 Stylized Facts About False Claims Act Lawsuits

An analysis of the DOJ case-level whistleblowing data underscores the strong incentives it provides for whistleblowers to litigate, and also raises questions about over-enforcement.

Since the 1986 introduction of qui tam whistleblowing, the volume of FCA litigation has grown immensely. The number of cases rose from 32 filed in 1987 to nearly 400 in 2012. There were 5,949 completed cases from 1999-2012, of which 3,262 come from the healthcare sector. Of these healthcare cases, only 36% result in a recovery of funds; the rest were dismissed by the whistleblower, the judge, or the Department of Justice. This points to a high level of cases for which the federal government receives no compensation, yet bears the burden of administrative costs on the court system and Department of Justice.

Figure 2 shows the trend of healthcare whistleblowing cases by year of filing and whether they end in a settlement. Settlements rose between 1990 and 1995 to around 50 cases per year, and have stayed rather constant since. Conversely, the total number of cases and the share of dismissed cases have both risen substantially since 1987, and continue to grow. Cases that are ultimately dismissed now constitute the majority share of whistleblowing. In terms of the raw case count, the high volume of dismissed cases reinforces the issue that privatized enforcement allows for the filing of spurious and costly cases.

Despite the relatively stable level of settled cases, settlement dollar amounts have grown substantially. Successful healthcare cases have had settlements as high as billions of dollars, although the median is substantially lower at around \$1.5 million. Total healthcare settlement values have increased vastly, dominated by a few extremely large settlements. Total settlements were just \$85 million in 1995, when the number of settled cases grew to its current stable levels. However, settlement totals exceed \$3.5 billion in 2012, the last year of the data. The 2012 total was in a large part due to a single \$1.5 billion settlement against GlaxoSmithKline for allegedly promoting its pharmaceuticals for non-FDA-approved uses. Appendix Figure A1 plots the histogram of healthcare-related settlement values. The healthcare-related settlements in my data total to \$26.4 billion of recovery.

Whistleblowers face a potential for a very large payout. Among settled healthcare whistleblowing cases, the mean whistleblower payout is \$3.8 million. However, the distribution has a long right tail; median whistleblower payout is only \$250,000, while 4 cases have had whistleblower payouts in excess of \$100 million. Appendix Figure A2 plots the histogram of healthcare-related whistleblower shares. Total whistleblower payouts for all of the healthcare-related cases in my data is \$4.29 billion. These awards are split between the whistleblower and their attorney, who usually take 30%.

The Department of Justice Data also include lawsuits from outside of the medical field, and exhibit the broad use of the False Claims Act. Medical-related suits, those categorized by the DOJ as relating to the Department of Health and Human Services, the Food and Drug Administration, or the Center for Medicare and Medicaid Services, constitute 55% of cases. But suits regarding the Department of Defense account for 11% of the nearly 6,000 whistleblower lawsuits, and cases have arisen from nearly all parts of the federal government, including the Department of Education (3% of cases) and the Goods and Services Administration (2% of cases). The use of FCA whistleblowing outside of the medical field is beyond the scope of this paper and poses an opportunity for future research.

4 Deterrence Effects

The economic effect of False Claims Act cases depends not only on the money they recover, but also the savings to the government from fraud or misreporting that is not committed due to the deterrent effects of these lawsuits. This deterrence takes two forms: direct deterrence, from changes in spending on types of care named as improper in whistleblower lawsuits, and ex ante deterrence, from fraud that is never committed in the first place due to litigation risk. This analysis measures the dollar value of the direct deterrence of the largest categories of whistleblower cases. However it does not consider the ex ante deterrence, which is substantially more difficult to measure, and therefore provides a lower bound of the total deterrence effects.

4.1 Method

4.1.1 Motivation

The goal of this analysis is to estimate the amount of direct deterrence caused by FCA lawsuits that change provider behavior and Medicare spending. The measurement of deterrence requires an analysis of a counterfactual, between the real world in which enforcement happened and one in which it did not. Synthetic controls, first introduced in Abadie and Gardeazabal (2003), provide a mechanism by which to produce such a counterfactual. Here, the outcome of interest is spending on the type of medical care treated by whistleblowing, and the treatment effect of interest is the change in spending following whistleblowing. The idea of synthetic controls is to use untreated control groups to construct a series that most closely matches the treated unit in the pre-treatment periods. Then, the difference between the treated unit and the synthetic control group in the post-treatment periods can be used to measure treatment effects. My analysis builds on the traditional synthetic control method with the inclusion of a time-shift parameter for each control. Under traditional synthetic controls, control groups are used to estimate the counterfactual of the treated unit under the assumption of shared time fixed effects. In many circumstances, the assumption of shared time fixed effects is valuable. For the whistleblowing cases estimated here, as well as in other situations, these assumptions do not accurately reflect the circumstances. Whistleblowing often affects types of care with unusual trends: they exhibit high growth in spending and claims, potentially driven by the improper conduct of the defendants. Yet there are many reasons why certain types of medical care may exhibit a rise in spending besides fraud, such as technological changes or changes in best practice. When the treated unit is on a different time trend than the untreated units, traditional synthetic controls can fail to find a sufficient fit in the pre-treatment periods.

The addition of a time-shift parameter allows for the treated unit to be compared to control units that exhibit similar patterns at different points in time. When a treated unit experiences a large pre-treatment increase and a subsequent post-treatment fall, the relevant counterfactual question is whether the increase would have persisted in the absence of treatment. Rather than comparing the treated unit to untreated units at the same time, which may not have seen the same pre-treatment increase, the relevant control units are other treatments that saw a similar rise at other points the available data. In practice, this is implemented with a two step procedure: first, I shift the control units forward or back in time to match the pre-treatment series of the treated type of spending; and second, I construct a synthetic control group by assigning weights to the time-shifted controls. The resulting synthetic control unit is used to estimate the post-treatment trends of the treated unit in the absence of treatment. The following model details the econometrics of this procedure and closely resembles that of Abadie et al. (2010).

4.1.2 Model

Synthetic controls with time shifts are motivated by the assumption that treated and untreated units have common trends at different times.

Consider spending on a type of medical care that could be affected by whistleblowing treatment. For i = 1, ..., N and time t, we would observe the spending level Y_{it}^U in the absence of treatment and Y_{it}^I following treatment. Call T_i the treatment period for unit i, which is the filing of the whistleblower's lawsuit. Assume that the treatment has no effect on periods $t < T_i$; then $Y_{it}^U = Y_{it}^I$ for all $t < T_i$. Let δ_{it} be the effect of treatment at time t. Because Y_{it} represents spending, δ_{1t} represents the change in spending on a procedure following whistleblowing. Thus the spending level can be written as:

$$Y_{it}^I = Y_{it}^U + \delta_{it} \mathbb{I}_{t \ge T_i}$$

Let i = 1 be the unit treated by whistleblowing, which is the only unit subject to treatment; thus $Y_{it}^U = Y_{it}^I$ for all i > 1 for all t, and units i > 1 serve as control groups. The treatment effect of interest is δ_{1t} , which is given by:

$$\delta_{1t} = Y_{1t}^I - Y_{1t}^U$$

in periods $t \geq T_i$.

Because Y_{1t}^I is always observed for all times $t \ge T_i$, estimation of the treatment effect relies on estimation of Y_{1t}^U , which is not observed in those periods.

Suppose that control units exhibit similar time trends at different points in calendar time, beginning at t_{0i} , which varies between units. Suppose that for all units, Y_{it}^U is given by the factor model:

$$Y_{it}^U = \kappa_\tau + \lambda_\tau \mu_i + \epsilon_{it} \tag{1}$$

Here, $\tau = t - t_{0i}$ is the time after the start of the control unit's trend begins; κ_{τ} is a common shock across all units at time τ relative to the starting point; λ_{τ} is a vector of common factors describing the trajectory of an outcome along a common trend; the parameter μ_i is an unknown vector describing the individual factor weights; and ϵ_{it} is a set of unobserved shocks of 0 mean.

Consider a $(N - 1 \times 1)$ vector of weights $\vec{W} = (w_2, w_3, \dots, w_N)$, such that $w_i \ge 0$ for $i = 2, \dots, N$ and $\sum_{i=2}^{N} w_i = 1$. These values represent weights on the untreated control units, and every value of the vector \vec{W} represents a possible synthetic control. Then, a weighted average of the control units is given by:

$$\sum_{i=2}^{N} w_i Y_{it} = \kappa_\tau \sum_{i=2}^{N} w_i + \lambda_\tau \sum_{i=2}^{N} w_i \mu_i + \sum_{i=2}^{N} w_i \epsilon_{it}$$

If weights w_i^* can be constructed such that:

$$\sum_{i=2}^{N} w_i^* \mu_i = \mu_1$$

Then it holds that

$$E[\sum_{i=2}^{N} w_{i}^{*} Y_{it}] = E[\kappa_{\tau} + \lambda_{\tau} \sum_{i=2}^{N} w_{i}^{*} \mu_{i} + \sum_{i=2}^{N} w_{i}^{*} \epsilon_{it}]$$

$$= E[\kappa_{\tau} + \lambda_{\tau}\mu_1] + \sum_{i=2}^{N} w_i E[\epsilon_{it}] = E[Y_{1t}^U]$$

Therefore, the weighted average of the control units provides an unbiased estimator of the untreated counterfactual of the treated unit:

$$\widehat{Y_{1t}^U} = \sum_{i=2}^N w_i^* Y_{it}$$

and we can estimate $\widehat{\delta_{1t}} = \widehat{Y_{1t}^U} - Y_{1t}^I$.

By integrating $\widehat{\delta_{1t}}$ over the post-treatment periods, we can estimate a discounted deterrence effect:

$$D = \int_{t=T_1} (\widehat{Y_{1t}^U} - Y_{1t}^I) \beta^{t-T_1} dt$$
(2)

where T_1 is the treatment period and β^{t-T_1} is a discount factor starting at the treatment period.

4.1.3 Implementation

The practical estimation of this model can be performed as a two-step procedure: shifting control units in time to match the pre-treatment spending on the treated unit, and then finding synthetic control weights w_i .

First, I align the control units with the treated unit to ensure they are on common trends in the pretreatment period. For each control, I construct a set of leads and lags, and find the lead or lag with the best fit to the treated series in the pre-period. With any fixed set of data, producing leads and lags creates missing data at the front or back of the series: in a monthly series, if one uses a 5 month lag, the first 5 months of available data have no value. In practice, this means that shifting the control units too far forward or back in time leaves a limited set of data for the evaluation of pre-treatment fit and post-treatment effects. Here, I bound the time shifts to ensure that there are 36 months of pre-treatment data, used to construct the synthetic control weights, and 60 months of post-treatment data, used to compute the deterrence effect.⁴

 $^{^{4}}$ In circumstances where the treatment period is too close to the start of the data, 36 pre-treatment periods are unavailable, and all of the available periods are used.

Within these bounds, I select the appropriate lead or lag for each control unit that minimizes average square distance from the treated unit in the pre-period:

$$\min_{d} \frac{\sum_{t}^{M} (Y_{1t} - Y_{it+d})^2}{M} \tag{3}$$

for control unit i, where d indexes the different leads and lags, and M is the number of pre-treatment periods in which the shifted control and the treated unit overlap. ⁵ Figure 3 provides a simple graphical explanation of the time-shifting process for two controls, one shifted forward in time and one shifted backward.

After associating each control with a time shift, I conduct the standard synthetic control process to choose weights as per Abadie et al. (2010). Weights are chosen to minimize mean-square error over all pre-treatment periods in which all of the controls overlap:

$$\min_{\vec{W}} \sum_{t \in M^*} (Y_{1t} - \sum_{i=2}^N w_i Y_{it+d^*})^2 \tag{4}$$

where M^* is the set of periods for which all of the time-shifted controls overlap with the treated unit; d^* is the optimal time shift found by 3; and \vec{W} is the set of all potential $(N - 1 \times 1)$ vectors of weights (w_2, \ldots, w_N) where $w_i \ge 0$ and $\sum_{i=2}^N w_i = 1$. Given the optimal shift for each control, the Stata package "Synth" finds the optimal weights w_i^* .

Once these weights are found, the synthetic control unit is produced as the weighted sum of the control groups:

$$\widehat{Y_{1t}^U} = \sum_{i=2}^N w_i^* Y_{it+d'}$$

The two-step procedure for time-shifted synthetic controls is a tractable way to implement this methodology by leveraging existing methods. Separating the time shift component from the weighting component is necessary, because allowing weights to be applied to the entire set of leads and lags could produce synthetic control units constructed of multiple instances of the same control at different points in time. However, a better search algorithm over the full space of time shifts and weights could theoretically outperform the two-step procedure by jointly choosing time shifts with weights to better estimate the treated unit in the pre-treatment periods.

 $^{^{5}}$ Average square distance and not total square distance must be used because the number of points over which this sum is evaluated depends on the time shift.

In this paper, the outcome variables Y_{it} are all spending amounts. Therefore, the difference between the synthetic control and treated unit is a difference in spending, which can be integrated over the posttreatment periods. I estimate the direct deterrence effect as the discounted difference between the treated and synthetic control over 5 years post-treatment:

$$\widehat{D} = \sum_{t=T}^{T+60} \frac{\widehat{Y_{1t}^U} - Y_{1t}}{(1.1^{1/12})^{t-T}}$$
(5)

where t is the time in months, T is the treatment period, and the denominator $1.1^{1/12}$ provides the monthly rate for a 10% annual discount rate. Deterrence is totaled for 5 years from the treatment date of filing. A positive deterrence value indicates that post-whistleblowing spending Y_{1t} is lower than that of the synthetic control group $\widehat{Y_{1t}^U}$.

The analysis conducted here is conservative in two ways. First, the use of time-shifted synthetic controls extends the donor pool of potential controls to anything on a similar pre-whistleblowing trajectory as the treated units at any time. Because a time shift of 0 is available for all control units, time-shifted synthetic controls uses a superset of the controls used for a traditional synthetic control methodology. Second, I compute deterrence using only 5-years of post-treatment effects. In the absence of whistleblowing, fraud or abuse may have continued indefinitely into the future, in which case the total deterrence effect would be like a perpetuity, providing value at all later periods. Rather than assume that the deterrence effects persist indefinitely, the use of 5 years of post-treatment effects is a conservative estimate of the deterrence effects and avoids excess extrapolation.

In order to conduct inference on my results, I employ a permutation test as per Abadie et al. (2010). Each synthetic control is substituted in for the treated unit, and the same two-step procedure detailed above is performed, fitting leads and lags and constructing weights, using all other controls. These weights give a synthetic control unit for the placebo, from which the deterrence measurement can be computed. The deterrence effects corresponding to each control unit form an empirical distribution against which the deterrence effect of the treated unit can be compared.

4.2 Case Selection

FCA whistleblowing has impacted many different types of Medicare payment and care delivery. Yet mapping from data on whistleblower lawsuits to the Medicare data is difficult, hindering a complete analysis of all lawsuits. The DOJ case-level data do not provide information on the nature of the cases nor the alleged false claims, beyond naming the defendant and whistleblower. To find details on successful whistleblowing cases, I scraped the universe of press releases from the Department of Justice website that relate to Medicare and whistleblowing, from 1994 (the start of the archives) through 2014. From these press releases, I hand-coded categories of cases that contain similar allegations of fraud in similar types of medical care. For example, one category is the misuse of the outlier payment system, which contains 11 press releases from different settlements with similar allegations. I omit categories for which I do not have data, including enforcement that precedes the start of my data, or allegations related to falsification not visible in the Medicare claims. Appendix B describes this process in detail. Table 1 lists the 4 categories of enforcement with the largest total settlements. In the following sections, I conduct case studies for each of these 4 categories. For each case study, I use court documents including whistleblower complaints and settlement agreements to gather details about the alleged conduct and guide the analysis of claims.

4.3 Case Details

4.3.1 Outlier Payment Falsification

The first category concerns the misuse of outlier payments for inpatient hospitalization, for which over 900 million in settlements was recovered by the government between 2004 and 2010. Medicare pays providers of inpatient medical care a fixed reimbursement amount for the diagnosis related group (DRG) under which the patient is coded. By fixing reimbursement for each diagnosis, providers have incentives to keep costs down. However, this raises concerns that providers would be unwilling to treat high-cost patients. In response to these concerns, the Medicare system contains a provision for outlier payments, which are additional reimbursements for very-high-cost patients. Before 2004, to qualify for outlier payments, a patient must have exceeded a cost threshold, computed with a complicated formula based on the provider's labor costs, capital costs, historic charges, and a geographic adjustment factor ⁶. This formula provided an opportunity for misreporting: by manipulating charges over time, hospitals were able to change their thresholds and collect more outlier payments.

On November 4, 2002, Tenet Healthcare, a large investor-owned hospital company, was sued under the ⁶Rawlings and Aaron (2005) provide a detailed analysis of this computation. False Claims Act for manipulating its cost reports in order to illicitly receive additional outlier payments. ⁷⁸ This lawsuit was settled in June, 2006, with Tenet paying \$788 million to resolve these allegations without admission of guilt. The DOJ press releases describe 10 other settlements for alleged manipulation of outlier payments. Appendix C.3 contains additional details about the related lawsuits.

Outlier payments constitute their own type of spending by the Medicare system. Therefore, for its controls, I consider all types of payments made by Medicare that are observable in my data. The controls I use include durable medical equipment, home health care, hospice care, nursing care, and disproportionate share payments for hospitals that serve many low-income patients. The two largest categories of Medicare expenditures, inpatient and outpatient claims, are not comparable in scale to outlier payments and are omitted from the donor pool. Spending on drugs via Part D is also not included because these data only start after 2006.

4.3.2 Medically Unnecessary Botox

The second case regards medically unnecessary usage of Botox. Despite popular branding as an "anti-wrinkle" procedure, Botox is FDA-approved for a number of important medical uses, including treatment of crossed eyes (strabismus) and neck spasms (cervical dystonia). Medicare covers medically necessary Botox injections for FDA-approved uses, but not for non-FDA-approved uses. Between 2007 and 2009, Allergan, the sole manufacturer of Botox, was sued by a set of whistleblowers who alleged that Allergan had illegally promoted Botox for non-FDA-approved ("off-label") uses, including headaches. In order to ensure that Medicare would pay for the injections, Allergan allegedly instructed physicians to miscode the injections, using diagnosis codes for approved uses. Additional details about the outpatient coding of Botox and the whistleblower lawsuits are presented in Appendix C.2. On August 31, 2010, Allergan settled with the federal government for \$600 million, of which \$210 million was for federal civil liability, \$375 million was a criminal fine, and \$14.85 million was to recompense affected state Medicaid programs.

For the synthetic control design, Botox is compared to other outpatient procedures that saw similar pre-whistleblowing trends in spending. Spending for Botox under the relevant diagnoses codes grew from

⁷One lawsuit against HealthSouth, settled in 2004, contains allegations about outlier payment manipulation and an \$89 million settlement for those allegations. This settlement related to lawsuits originally filed in 1998, but the original allegations did not concern outlier payments. The HealthSouth settlement does not attribute these allegations to any whistleblower cases (which would make the whistleblowers eligible for compensation for this portion of the recovery); instead, it appears the DOJ added enforcement of outlier overuse to a pending case, following the filing of the Tenet lawsuit. Therefore, I consider the Tenet lawsuit the first outlier lawsuit, and use its filing date as the treatment date.

⁸Around the time of filing, Tenet also received substantial negative press regarding its overuse of outlier payments; the timing of these reports, days before the filing of the lawsuit, may indicate that the whistleblowing case was leaked to investors. Rawlings and Aaron (2005) provide further details about the Tenet case.

2 million dollars in 2003 to more than \$5 million in 2006, the year before the lawsuit against Allergan was filed. As controls, I use other outpatient treatments for which spending started between \$2 million and \$5 million and saw a 2-3x rise over any 3-year period between 2002 and 2011, of which there are 67 control units. Appendix C.2 contains additional details about these control units.

4.3.3 Unnecessary Inpatient Kyphoplasty

Kyphoplasty is a spine procedure to repair vertebral compression fractures that cause pain and deformity of the back, often observed among patients with osteoporosis. Kyphoplasty involves the percutaneous (through the skin) injection of bone cement into an inflatable balloon placed within the affected vertebra. Because the procedure is performed percutaneously, kyphoplasty can be safely conducted as an outpatient procedure. The kyphoplasty procedure was developed, patented, and marketed by the company Kyphon, which sold a spine surgery kit as well as other related medical devices (Kasper, 2010).

In December, 2005, Kyphon was sued by FCA whistleblowers who alleged that Kyphon illegally promoted the procedure as an inpatient procedure, as opposed to outpatient, to receive greater reimbursement. Furthermore, by keeping patients inpatient for a short stay, providers could receive the inpatient reimbursement level for a low amount of inpatient care, very similar to the outpatient procedure. Inpatient stays under the relevant diagnosis-related groups (DRGs) were reimbursed in the \$6,000 - \$11,000 range, as opposed to outpatient kyphoplasty which was reimbursed between \$500 and \$2000. In May 2008, Kyphon settled these allegations with the Department of Justice for \$75 Million, without admission of guilt. Between 2009 and 2015, the DOJ released another 9 press releases detailing settlements with 140 hospitals having performed unnecessary inpatient kyphoplasty. The sum of the settlements against Kyphon and the defendant hospitals was \$214.2 Million. Appendix C.3 provides additional details for these lawsuits. I analyze spending on short stays of 7 or fewer nights under the inpatient DRGs promoted by Kyphon, and outpatient spending on all spine procedures. As controls for short-stay inpatient visits, I use inpatient spending for short stays of 7 or fewer nights under other DRGs. For controls on outpatient spine procedures, I use spending on other outpatient surgical procedures on the musculoskeletal system. Appendix C.3 describes the coding of inpatient and outpatient Kyphoplasty and the control units used.

4.3.4 Unnecessary Inpatient Admission

The fourth case study concerns the unnecessary admission of Medicare beneficiaries for inpatient care at hospitals, instead of receiving observational or outpatient care. Starting in 2004, there were a series of

whistleblowing lawsuits that alleged that hospitals around the country unnecessarily admitted patients. Many of these patients presented at the hospital's emergency department and should have been held under observational or outpatient status, which are reimbursed much less than inpatient care. The first successful lawsuit of this type was filed in October 2004, and in total, 7 settlements were reached regarding 135 hospitals for a total of \$172.3 million in recovery between 2007 and 2014. The majority of the enforcement comes from the settlement with Community Health Systems, the country's largest operator of acute care hospitals at the time, which settled for \$98 million in 2014 for similar conduct in 119 of their hospitals. Appendix C.4 provides additional details about these lawsuits.

Unnecessary admissions were concentrated among certain hospitals, motivating an analysis of the defendants of these lawsuits. The set of potential controls for the defendants are other hospitals not litigated against for unnecessary inpatient procedures. To mitigate spillover effects into the control groups, I restrict the controls to hospitals in the 23 states that contained no defendants. These hospitals treat different patient pools than the defendants and are less likely to have doctors or administrators cross-employed with the defendant hospitals. For each of the defendants, I construct a random sample of 100 control units, using the same number of hospitals as the defendant. For example, two defendants were groups of 6 hospitals each; I create 100 control units of 6 randomly grouped control hospitals, drawn with replacement, from the set of controls. Similarly, to measure substitution by the defendant providers to increased outpatient expenditure, I use randomly grouped outpatient providers from the unaffected states. Appendix C.4 provides further details about this process.

4.4 Results

Figure 4 shows the main results of the synthetic control method. Spending is used as the outcome variable for each case study. For each case, the first vertical line shows the date of filing of the first lawsuit of that category, which is used as the treatment date, and the second line shows the first settlement. For the unnecessary inpatient admissions case, where I analyze multiple defendants, this graph includes the results from Community Health Systems (CHS), which constituted the bulk of the defendant hospitals. In each case, the control groups provide a good pre-period fit for each case, matching the trends and levels of the treated units. However, there is divergence from the control units in each of the post-whistleblowing periods.

The largest of these effects is in the outlier case (top left): the 5-year discounted deterrence measurement for the outlier payments computed is \$17.46 billion, which is roughly 19 times the total settlement value of the outlier whistleblowing lawsuits of \$923 million. This is largely driven by the scale of spending on outlier payments, which exceeded \$500 million per month in its pre-whistleblowing peak, and then dropped off substantially following the lawsuits. The synthetic control group, constructed of other types of Medicare payments, shows a similar pre-period rise and continues to rise in the absence of whistleblowing. Appendix Table A3 shows the synthetic control weights and time shifts for the control units. Most of the synthetic control weight is placed on disproportionate share payments, with only a 1-month time shift. Disproportionate share payments operate very similarly to outlier payments in that they are additional payments for inpatient stays. The fact that the synthetic control is mostly made up of such a similar type of spending, and with very little time shift necessary to fit the pre-period, reinforces the validity of this control group in estimating outlier payments in the counterfactual without whistleblowing.

Notably, for the Botox case (top right), there is a small negative deterrence effect: Botox spending exceeds the synthetic control group post-lawsuit. The 5-year discounted deterrence effect is -\$3.99 million, a little smaller than 1% of the settlement value of \$600 million. One potential reason for the negative deterrence effect is that Botox gained FDA approval for migraine coverage about 2 months months after settling with the Department of Justice for illegally promoting botox for headaches (Singer, 2010). Because civil litigation and settlement negotiations can stretch out for indefinite periods of time, it is possible that Allergan timed the settlement to coincide with its expected FDA approval. This case exhibits that deterrence effects are not necessarily positive, and that the future value of misconduct is not necessarily large when compared to the past costs and settlement amount. In this circumstance, the \$600 million settlement paid by Allergan to the United States functioned as a penalty for promoting its product for a use that was not yet FDA approved. But given that FDA approval did ultimately arise, the future value of the damages and the direct deterrence effect are small.

For the kyphoplasty case (bottom left) and unnecessary admissions case (bottom right), Figure 4 shows that inpatient spending declined relative to the respective synthetic controls. The short-stay inpatient deterrence total for kyphoplasty is \$538.9 million, caused by a post-whistleblowing decline in short kyphoplasty stays and a continued increase in the synthetic control group. Appendix Table A5 displays the synthetic control weight and time shift for each control group. For the unnecessary inpatient admissions case, inpatient deterrence for the defendant Community Health Systems is \$693.2 million, and the total inpatient deterrence for all defendants is \$1.124 billion. The corresponding plots for the other defendants are included in Appendix Figure A3. Inpatient spending at CHS rose before whistleblowing and fell after whistleblowing, while the synthetic control group shows a continued rise in inpatient spending in the absence of whistleblowing. While the difference between CHS spending and the synthetic control group is visually modest, the large deterrence amount arises because the rate of spending at the time of treatment was more than \$150 million per month.

The decreases in inpatient spending in the kyphoplasty case and the unnecessary admissions case must be weighed against an expected increase in outpatient spending in both cases. Figure 5 plots the substitute outpatient spending for these cases. Inpatient kyphoplasty spending was substituted for outpatient spending on kyphoplasty, vertebroplasty, and other outpatient spine procedures, as evidenced by a rise in outpatient spending relative to the synthetic control group. The increase in outpatient spending totals to \$257.8 million; when compared with an inpatient spending decrease of \$538.9 million, this results in a net deterrence effect of \$281.1 million. For the unnecessary admissions case, outpatient spending at the defendant CHS did not rise relative to the control providers. The total estimated change in outpatient spending for all defendants combined is a small negative number, indicating if anything that outpatient spending at these hospitals fell post-lawsuit. Appendix Figure A4 displays the similar synthetic control setup for each of the other defendants' outpatient spending, and shows heterogeneity, with some defendants' outpatient spending rising post-lawsuit and others' falling.

Table 2 summarizes the deterrence effects for these cases and provides totals, deterrence values, and deterrence ratios. These 4 whistleblower case studies recovered around \$1.9 billion for the federal government, but exhibit even greater benefit in deterrence effects, totaling around \$18.9 billion. The average deterrence effect for these cases is around 6.7 times the settlement value over 5 years. There is substantial heterogeneity in the deterrence ratios, from a small negative deterrence effect in the botox case to a particularly high positive deterrence ratio for the outliers case. Notably, the deterrence metric used here is computed using a discounted difference between the treated and control units for only 5 years after the filing of the case, and thus may potentially understate the true benefit of whistleblowing. Overall, these results indicate that the direct deterrence benefits of whistleblowing cases often exceed the settlement values. This indicates a large savings to the Medicare program as a result of these whistleblowing cases, exceeding both the direct recoveries to the government from the settlement as well as the whistleblower compensation.

Placebo testing allows for inference on these results. For each control, I conduct a series of placebo studies by applying the time-shifted synthetic control method to a every other control group in the donor pool. The deterrence for each real treated unit is compared to the deterrence values from each of these placebos. I conduct a 1-tailed test, which counts what fraction of placebos exceed the value of the treated unit's deterrence amounts, comparing positive deterrence values to other positive deterrence values and negative to negative. Importantly, the distribution of placebo controls is only one piece of evaluating the synthetic control strategy, and does not account for pre-period fit or the timing of the post-whistleblowing trends. Therefore, while my estimates are statistically significant, these placebo results must also be evaluated in the context of the good pre-period fit of the results displayed in Figures 4 and 5.

Table 3 presents the results of the placebo test. These results indicate that the large positive deterrence effects I find are not due to chance, while the small negative finding for botox is indistinguishable from the value of the placebos. The deterrence figure for outlier payments exceeds 100% of the placebo units. The small negative deterrence effect for Botox does not exceed 10 of the 67 placebos, indicating that this effect may be due to noise, and that the negative point estimate is not distinguishable from 0. For the kyphoplasty case, the reduction in inpatient spending exceeds 26 of the 30 placebos, and the corresponding increase in outpatient spending exceeds 14 of the 15 placebos. For the unnecessary inpatient case, there is strong evidence that the reduction in inpatient spending is not a chance finding; the 5 largest defendants (of 7) exceed between 93 and 99 of the 100 placebo units. However, substitution to outpatient spending shows mixed results, including statistically significant values in both the positive and negative direction. This mix of positive and negative effects indicates heterogeneity in how whistleblowing changed outpatient spending at the defendant hospitals.

5 Whistleblower-Induced Changes in Patient Care

In addition to the fiscal effects described in the previous section, whistleblowing under the FCA creates incentives for providers to change the way they conduct healthcare. These changes can could be either positive or negative: if whistleblowing curbs behavior that was profitable to providers at the expense of patient health, then we expect whistleblowing to benefit patients. However, whistleblowing could also induce defensive behavior among physicians, influencing their care decisions away from what is beneficial to patients and instead to what would be justifiable if they were sued.

To examine one instance of these effects, I examine provider care decisions following changes in kyphoplasty care as discussed above. Kyphoplasty is an ideal case study for the discussion of provider care decisions for a few reasons. First, the analysis of claims performed above shows that there was a large reduction in inpatient procedures and a substitution to outpatient procedures, indicating a change in actual care decisions by providers. This is in contrast to the outlier payments case, which seems to be a change in billing procedures, or to the Botox case, where there was little effect on usage. Second, kyphoplasty is a single procedure with previously-studied health effects (discussed below), allowing for a targeted analysis of the effects of the whistleblowing lawsuits on patient care. This is in contrast to the unnecessary inpatient admissions case, which related to a broad set of medical procedures. As such, kyphoplasty is the largest-settlement-value case study for which I can conduct an analysis of provider care decisions.

Kyphoplasty is a spine procedure to repair compressed vertebrae in patients with osteoporosis, and can be very beneficial for patient health. Kyphoplasty is similar to vertebroplasty, a similar, older procedure that does not use a balloon (Denaro et al., 2009). A meta-analysis of vertebral compression fractures (VCFs) shows that patients with VCFs have 2.5 times the mortality rate of patients without them, and that kyphoplasty and vertebroplasty are successful at reducing mortality rates compared with non-operative care (Kurra et al., 2018). Estimates in this meta-analysis range from 35% to 70% mortality reduction over a 3 to 5 year period after receiving kyphoplasty, indicating a substantial health benefit to the procedure. As shown in above, short-stay inpatient treatment for kyphoplasty was drastically reduced following whistleblowing, which could therefore have an impact on patient mortality.

To understand the impact of these changes, I model patient death as a function of receiving inpatient kyphoplasty within a heterogeneous treatment effects framework. The goal of this exercise is to measure how patient changed due to whistleblowing, based on whether the patient is expected to benefit from the procedure. First, I construct two non-overlapping cohorts of patients from before and after the Kyphoplasty lawsuit. For the purposes of this analysis, I define "treatment" as receiving a 1-night inpatient stay under the DRGs allegedly promoted by Kyphon⁹. My 2005 cohort includes every 70-75 year old treated for the first time in 2005 and the full population of never-before-treated 70-75 year old control Medicare patients. My 2011 sample similarly contains every every 70-75 year old treated for the first time in 2011 and the full population of never-before-treated 70-75 year old control patients. These cohorts are non-overlapping, and therefore all 2011 cohort members are not potential controls for the 2005 cohort. The 2005 cohort consists of 8.2 million patients, and the 2011 cohort consists of 9.3 million patients.

For each patient, I analyze extensive data, including treatment, all inpatient medical history, chronic conditions, and demographic data.. Patient covariates include age, state, sex, race, original and current reasons for Medicare qualifications (i.e. age or disability), and HMO coverage. Inpatient medical history was taken from the 100% MedPar files for 6 years before the cohort year, i.e. 1999-2004 for the 2005 cohort

⁹In contrast to this setup, the spending amounts used to compute deterrence in Section 4 used all short stays (7 nights or fewer) under these DRGs and all outpatient spine spending. This was useful to compute fiscal effects, but potentially lumped in some non-kyphoplasty treatment, which was unaffected by whistleblowing and was differenced out when computing deterrence values. To compute health effects, I focus on 0 or 1-night stays under these DRGs, which almost completely vanished post-whistleblowing, as I have greater confidence that kyphoplasty was performed during these inpatient visits. Correspondingly, outpatient treatment is restricted to the outpatient codes specifically for kyphoplasty and vertebroplasty.

and 2005-2010 for the 2011 cohort, and includes an indicator for any inpatient stay, the number of stays, the patient's total inpatient stay length, a count of the number of stays under each DRG, and the total Medicare payment amount for that patient's inpatient treatment. Furthermore, I include chronic condition indicators for each patient in the cohort year, which detail a patient's history of chronic conditions such as Alzheimer's, hip fractures, or osteoporosis. Finally, for each patient I collect death dates, and produce an indicator of whether the patient died within 5 calendar years post-surgery, i.e. 2005-2010 for the 2005 cohort and 2011-2016 for the 2011 cohort. The length of the medical history and death data used are due to the availability of data, which span from 1999-2016, and the requirement that the cohorts not overlap.

Using these data, I directly estimate the heterogeneous treatment effects of patients who receive short-stay inpatient treatment among the 2005 cohort, with the following logistic regression:

$$Death_i = \alpha + \beta T_i + \gamma' C_i + \delta' T_i C_i + \eta' M_i + \theta' T_i M_i + \varepsilon_i$$
(6)

The outcome variable $Death_i$ is an indicator if patient *i* died within 5 years. This limited dependent variable motivates a logit framework for the regression. T_i is the treatment indicator, C_i is the matrix of patient covariates and M_i is the matrix of patient medical history and chronic conditions. This specification models death in terms of treatment interacted fully with these controls. As such, the fitted model captures the effect of each covariate and each aspect of medical history on death, with or without short-stay inpatient kyphoplasty treatment. Appendix Table A1 details the results of this regression.

Using this model fitted to the 2005 sample, I can then predict the effects of kyphoplasty among both 2005 and 2011 patients. I construct: $\widehat{Y_{i1}} = P(Death|M_i, C_i, T_i = 1)$ and $\widehat{Y_{i0}} = P(Death|M_i, C_i, T_i = 0)$ for each patient, using the regression coefficients fit to the 2005 sample. I then produce a predicted treatment effect for each patient:

$$\widehat{TE}_i = \widehat{Y_{i1}} - \widehat{Y_{i0}} = P(Death|M_i, C_i, T_i = 1) - P(Death|M_i, C_i, T_i = 0)$$

$$\tag{7}$$

It is important to note that treatment T_i is not assigned randomly. This model makes the standard conditional independence assumption: that conditional on a rich set of controls, here medical history, chronic conditions, and patient covariates, that potential outcomes Y_{1i} and Y_{0i} under treatment or non-treatment are independent of actual treatment status. That is, by controlling for the factors that influence probability of treatment, one can construct both potential outcomes for each patient, despite only ever observing Y_1 or Y_0 for any given patient. Appendix Figure A7 shows the histogram of estimated treatment effects for patients in 2005 and 2011. These histograms exhibit a similar shape between the cohorts, which means the comparison between these cohorts is between like populations.

Figure 6 plots the probability of short-stay inpatient treatment by estimated treatment effect in each cohort 10 . The estimated treatment effect on the horizontal axis is the difference in estimated probability of death when receiving treatment versus not receiving treatment. Therefore, units to the left of 0 are estimated to be less likely to die if treated, while units to the right of 0 are more likely to die. The ideal targeting of treatment to patients who benefit would place all of the mass to the left of 0. In both 2005 and 2011, patients who stood to benefit from the procedure were about twice as likely to receive treatment. The comparison between 2005 and 2011 shows that there was a reduction in inpatient probability treatment across the spectrum of treatment effects, both for those harmed and helped by the treatment.

Total inpatient treatment volume for kyphoplasty was counteracted by substitution to outpatient treatments. Figure 7 plots the probability of receiving an outpatient kyphoplasty or vertebroplasty within each group. Because these procedures are similar whether performed inpatient or outpatient, differing mostly in terms of billing, the estimated inpatient treatment effect on the horizontal axis is a reasonable way of understanding the effect of having had the procedure in either location. In both cohorts, the probability of receiving treatment is higher for those helped by the treatment, to the left of the distribution. Between 2005 and 2011, outpatient treatment probability grew for all types of patients, but substantially more for patients with expected health benefits, i.e a lower estimated probability of dying when receiving treatment¹¹.

To examine the net effect of the substitution from inpatient to outpatient procedures, I examine the probability of either inpatient or outpatient treatment by heterogeneous treatment effect. Figure 8 breaks the population into two categories: those less likely to die if they receive the procedure (negative value treatment effect) and those more likely to die (positive valued treatment effect). The results show an overall decrease in treatment probability to those harmed by the procedure between 2005 and 2011, and an increase in treatment probability to those who benefit from the treatment across the same time period. Those helped by the procedure saw an increase from 0.144% to 0.155% probability of treatment, a 7.6% increase. The small raw percentages reflect the fact that the analysis sample is the entire never-before-Medicare treated 70-75 year old population in these years, and that kyphoplasty is relatively rare. Correspondingly, patients who were expected to by harmed by the procedure saw a decrease in probability of treatment from 0.0547% to 0.0506%, a decrease of 7.4%. Appendix Figure A9 breaks this same analysis into finer groups, and plots

 $^{^{10}}$ To satisfy Medicare data cell-size suppression rules against reporting any result with n < 11, the bins in Figure 6 have been top coded at .4 and -.2 to achieve a minimum number of treated units within the extreme bins.

 $^{^{\}bar{1}1}$ Similar to Figure 6, bins in Figure 7 have been top coded to achieve a minimum number of treated units within the extreme bins, in compliance with Medicare cell-size suppression rules.

the probability of receiving either inpatient kyphoplasty or outpatient kyphoplasty or vertebroplasty by heterogeneous treatment effects. There was, in general, an increase in the probability of receiving treatment between 2005 and 2011 for those who benefit from the procedure, and a decrease in treatment for those harmed by the procedure.

These results are consistent with the better targeting of kyphoplasty following the whistleblowing cases that reduced the volume of care. Patients who benefit from kyphoplasty were more likely to receive the procedure following the lawsuit, and those harmed were less likely to receive the procedure. One potential explanation is the change in incentives for providers, who before the lawsuit were more profit-motivated in their treatment, picking low-cost patients to receive procedures that could be heavily reimbursed, with less focus on the patient's expected health outcomes. Under this explanation, whistleblowing refocused provider attention on expected patient health outcomes, creating better targeting toward individuals who benefit the most.

Overall, in the case of kyphoplasty, whistleblowing seems to have had positive effects on patients by inducing better targeting of the procedure to those who benefit from it. This evidence indicates that kyphoplasty was overused in 2005, before the lawsuit, as evidenced by treatments performed on those expected to be harmed by the procedure. Whistleblowing enforcement was successful at reducing treatment to those individuals as well as increasing treatment to individuals likely to be helped by the procedure. This indicates that, at least in this case, the positive effects of whistleblowing went beyond financial benefits to the Medicare program, and indeed had substantial positive effects for patient care.

6 Conclusion

Whistleblowing under the False Claims Act is an effective way to both penalize and deter overbilling and fraud to the Medicare program. I undertake a set of case studies of the top categories of whistleblowing enforcement and measure direct deterrence effects. Settlements for the 4 categories of whistleblowing analyzed here recovered \$1.9 billion in federal funds; I estimate that they generated more than \$18 billion in direct deterrence effects. For comparison, the entire federal judiciary system had a budget of around \$8 billion in 2018, and the Department of Justice spent \$3.4 billion in 2018 on the entirety of its litigation and attorney costs. To first order, while unsuccessful cases put a burden on the federal courts and US attorneys, the recovery and deterrence effects of these few cases far exceed even the entire annual costs of running these departments. Furthermore, the deterrence effects for just these cases exceeds the total payment of \$4.29 billion to whistleblowers for all healthcare-related cases in my data.

Changes in medical care induced by whistleblowers can have a variety of effects on patient care. In the example of kyphoplasty, I find beneficial changes to patient care, with better targeting to patients who are expected to benefit from this procedure. This case study motivates further analysis of the effects of whistleblowing on patient care. Whistleblowing generates changes to the care of patients that are potentially unrelated to the quality of the provider or the procedure, and this may provide experimental variation that other researchers find useful in the analysis of medical outcomes.

Whistleblowing has other potential costs and benefits not analyzed in this paper. The risk of litigation may cause providers to forgo misreporting in the first place, particularly when whistleblowers are empowered to directly sue for their own profit. These ex-ante deterrence effects are hard to measure without knowing the types of potential fraud that could have been committed. Conversely, increased compliance requirements impose costs on providers that are not measured here. FCA whistleblowing also incurs attorney expenses for both plaintiffs and defendants, for which little data are available. I do not impose the assumptions necessary here to compute net welfare. However, this paper estimates some of the parameters required for a broader efficiency computation, and motivates future work measuring other costs and benefits of the False Claims Act.

The results of this paper estimate the fiscal benefits of privatized enforcement as compared to the absence of such enforcement. However, a different counterfactual would be better public enforcement. Paying whistleblowers 15-30% of recovered funds is expensive if the government could produce similar recoveries without whistleblowing. Given the vast amount of data collected by the Medicare program, some of the effects of whistleblowing could likely be accomplished through machine learning, pattern detection, and automated audits. The fact that these programs are not yet in place may point to the limited capacity of the federal bureaucratic institutions. From this perspective, a major benefit of the False Claims Act is not just the information provided by the whistleblower, but also the profit motivation to conduct private enforcement.

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Figures and Tables



Figure 1: The Theoretical Effects of Whistleblowing



Notes: This figure describes the theoretical effects of a successful whistleblowing case on federal spending. When fraud is committed, the government has damages that are the difference between spending with fraud and the counterfactual spending without fraud. After the whistleblower sues, spending decreases back to its pre-fraud levels. The direct deterrence effect is the difference between how much would have been spent without whistleblowing and how much is spent after whistleblowing occurs. Because whistleblowers are paid proportionally to the damages, they have incentives to blow the whistle later and allow the damages to accumulate; however, because the first whistleblower to come forward receives greater compensation, they have countervailing incentives to file as soon as possible.



Notes: This figure plots the number of healthcare-related whistleblower lawsuits by year and splits the data by the outcome of the lawsuit. Data begin in 1986, when Congress amended the False Claims Act to allow for whistleblower lawsuits, and go through 2012, the last available year of data. Settlements rose to around 50 per year in 1995 and have stayed relatively constant, while total cases and dismissed cases have both continued to rise.





Notes: This figure exemplifies the time fitting process for time-shifted synthetic controls. Spending on the treated unit is a solid black line that increases pre-treatment and decreases post-treatment. Control A exhibits a similar rise to the pre-period, but at an earlier time, and is shifted forward. Control B exhibits a comparable rise at a later period, and is shifted backward. The shifts are picked to best approximate the pre-treatment period in both shape and levels. These fits are agnostic to how the controls develop in the post-treatment period; Control A falls while Control B continues to rise. Following these fits, a synthetic control unit can be constructed from Time-Shifted Control A and Time-Shifted Control B.



Figure 4: Effects of Whistleblowing on Medicare Expenditure

Notes: This figure plots the main effects of the 4 case studies: Outlier payments (top left), Botox (top right), kyphoplasty (bottom left), and unnecessary inpatient admissions (bottom right). For each case, the spending affected by whistleblowing is plotted in solid blue, while the synthetic control series is plotted in dashed red. The synthetic controls are produced using time-shifted control groups, and hence the period with which the synthetic control overlaps with the treated unit differs for each case. The grey dots represent the spending on the treated unit in the period before it overlaps with the synthetic control group. The first vertical line of each case represents the filing of the first related whistleblower lawsuit, which is used as the treatment date, and the second vertical line reflects the first settlement. Post-treatment effects are analyzed for 5 years after the treatment date. For the unnecessary inpatient admissions case (bottom right), multiple defendant providers were analyzed, and the series included here reflects Community Health Systems, the largest defendant provider. Appendix Figure A3 plots the same figure for the other defendants in that case. See the main text for the description of the control units used in each case.



Figure 5: Synthetic Controls for Substitute Outpatient Spending

Notes: This figure plots the substitution effect to outpatient spending for the kyphoplasty (left) and unnecessary inpatient admission (right) case studies. These graphs correspond to the bottom half of Figure 4 and are scaled identically to those panels for comparison. In both lawsuits, whistleblowers alleged that patients should have been treated outpatient instead of inpatient. Outpatient spine procedure spending (left) rose following the kyphoplasty case as compared to the synthetic controls. However, there is no increase in outpatient spending at defendant hospitals (right) following the unnecessary admissions case. For the unnecessary inpatient admissions case, multiple defendant providers were analyzed, and the series included here reflects Community Health Systems, the largest defendant provider. Appendix Figure A4 plots the same figure for the other defendants in that case and shows heterogeneity in the outpatient effects, with both increases and decreases at different defendants.





Notes: This figure plots the probability of receiving short stay inpatient kyphoplasty among the 2005 and 2011 cohorts, by the estimated treatment effect. Treatment effect is scaled as the difference in the probability of death in the next 6 years, and negative values correspond to a lower probability of dying. Absolute treatment probabilities are low, reflecting the inclusion of the full population in this analysis and the relative rarity of kyphoplasty. In both cohorts, patients with higher expected benefits are more likely to receive the treatment. The reduction in treatment probability occurs evenly across the treatment effect distribution.



Figure 7: Outpatient Treatment by Heterogeneous Treatment Effects

Notes: This figure plots the probability of receiving outpatient kyphoplasty or vertebroplasty by expected treatment effect among the 2005 and 2011 cohorts. The treatment effect is scaled as the change in probability of death in the next 6 years if one receives inpatient treatment; negative values indicate a lower probability of dying if treated. The whistleblower lawsuit settled in 2008 alleged that patients should have been treated outpatient instead of inpatient, and correspondingly, patients in 2011 were much more likely to receive outpatient treatment. These gains are greatest among patients to the left of the treatment effect distribution, which corresponds to the greatest benefits from the procedure.



Figure 8: Inpatient + Outpatient Treatment Probability by Health Benefit

Notes: This figure plots the probability of receiving either inpatient or substitute outpatient treatment by the estimated treatment effect, before and after the 2008 whistleblower settlement concerning unnecessary inpatient kyphoplasty. Patients in 2011 who are expected to benefit from the procedure were 7% more likely to be treated in 2011 than in 2005, and patients who are expected to be harmed were 7% less likely to be treated.

Type of Care	Type of Fraud	First Case Filed	First Settlement	# DOJ Press Releases	Settlement Total
Inpatient	Manipulation of Outlier Payments	Nov, 2002	Dec, 2004	11	\$923,033,623
Botox	Off-Label Promotion	June, 2007	Aug, 2010	1	\$600,000,000
Kyphoplasty	Inpatient Procedure Should be Outpatient	Dec, 2005	May, 2008	10	\$214,238,775
Inpatient	Unnecessary Hospital Admissions	Nov, 2004	Dec, 2007	7	\$172,296,460

Table 1: Categories of Medicare Whistleblowing Enforcement

Notes: This table shows the 4 highest settlement value categories of Medicare whistleblowing enforcement for which I have data. Categories are constructed using Department of Justice press releases to link cases with similar allegations. Cases filed before the start of the data are omitted, as are cases that concern allegations not potentially observable in the Medicare claims data. For each category, I conduct a case study of the effects of whistleblowing on spending on the related conduct. Appendix B contains more details about the construction of categories and on the smaller categories of enforcement not studied here.

 Table 2: Deterrence Effects of Major Whistleblowing Categories

Type of Care	Type of Fraud	Settlement Total	Direct Deterrence	Deterrence Ratio
Inpatient	Manipulation of Outlier Payments	\$923 Million	\$17.46 Billion	18.92
Botox	Off-Label Promotion	\$600 Million	-\$3.99 Million	006
Kyphoplasty	Inpatient Procedure Should be Outpatient	\$214.2 Million	\$281.1 Million	1.31
Inpatient	Unnecessary Hospital Admission	172.3 Million	\$1.124 Billion	6.52
	Total	\$1.91 Billion	\$ 18.86 Billion	
			Average Ratio	6.69

Notes: This table summarizes the results of case studies on the 4 largest categories of Medicare whistleblowing enforcement. Direct deterrence values are computed using a time-shifted synthetic control strategy to compare treated units to their counterfactual in the absence of whistleblowing. The direct deterrence is computed over 5 years post-treatment with a 10% annual discount rate compounded monthly. The deterrence ratio is computed as the ratio of the deterrence value to the settlement total.

Case	Deterrence Value	1-Tail Placebo Test		
Outlier Payments	+\$17.46 Billion	$0.0 \ (n=5)$		
Botox	-\$-3.99 Million	$0.149 \ (n = 67)$		
Case	Inpatient Deterrence	1-Tail Placebo Test	Outpatient Deterrence	1-Tail Placebo Test
Kyphoplasty	+ \$538.9 Mil	$0.133 \ (n = 30)$	-\$257.8 Mil	0.067~(n = 15)
Unnecessary Inpatient Admission:				
Defendant: St Joseph's Atlanta	+\$44.8 Mil	$0.01 \ (n = 100)$	-\$27.4 Mil	$0.00 \ (n = 100)$
Defendant: Wheaton Hospital	+\$5.8 Mil	$0.13 \ (n = 100)$	-\$83.8k	$0.31 \ (n = 100)$
Defendant: El Centro Medical Center	+\$5.3 Mil	$0.35 \ (n = 100)$	-\$4.0 Mil	0.02~(n = 100)
Defendant: Overlook Hospital	-\$16.0 mil	$0.02 \ (n = 100)$	+\$10.7 mil	0.08~(n = 100)
Defendant: Morton Plant Hospitals	+\$266.6 Mil	$0.01 \ (n = 100)$	+\$12.7 Mil	0.07~(n = 100)
Defendant: Shands Hospitals	+ \$124.2 Mil	$0.02 \ (n = 100)$	+\$50.7 Mi	0.00~(n = 100)
Defendant: Community Health Systems	+\$693.2 Mil	$0.07 \ (n = 100)$	+\$54.5 Mi	$0.20 \ (n = 100)$

Table 3: Placebo Tests for Synthetic Controls

Notes: This table summarizes the placebo test for the synthetic control strategy. For each control group, I compute the placebo deterrence effect, using the time-shifted synthetic control method with all other controls. The 1-tail test counts how many placebo groups exceed the deterrence value of the treated unit. For the kyphoplasty and unnecessary admissions cases, this test is conducted separately for the inpatient and outpatient spending. Deterrence effects are positive if spending on the treated unit is less than the control unit, and negative if spending on the treated unit is greater than the control unit.

Appendix

A Cleaning of the FOIA Data on Qui Tam Whistleblower Suits

Data on the full set of whistleblowing lawsuits were gathered from a Freedom of Information Act (FOIA) request I conducted on the Department of Justice. For each lawsuit, the available data include: the docket number, district of filing, and case caption; the date the Attorney General was served notice of the suit; the primary federal agency to which the lawsuit related; whether or not the government intervened, and what date that election was made; the date of the settlement, judgement, or dismissal; the settlement amount if any, and the whistleblower's share. Each line of the FOIA dataset contains information about a suit that was dismissed, or in the event of a settlement, a settlement related to that suit. Lawsuits against multiple defendants can have more than one settlement, and therefore appear in more than one line of the data. To correct this issue, I collapse the data by docket, filing state, and year: if two lawsuits contain identical docket numbers and were filed within the same state and year, I assume they are a single suit, and create a total of their settlement values. For the descriptive statistics on medical-related lawsuits provided in Subsection 3.1, I restrict to suits for which the primary federal agency is either Health and Human Services, the Center for Medicare and Medicaid Services, or the Food and Drug Administration.

B Constructing Categories of Enforcement from DOJ Press Releases

The FOIA data described in Appendix A present a complete set of court-related information, but do not give information about the alleged behaviors for which the whistleblower sued, which are necessary for the case studies conducted here. To find details about the nature of these lawsuits, I scraped the Department of Justice press release archives for all press releases that contain the words "false claims," "Medicare," and either "qui tam" or "whistleblower." The DOJ makes an effort to publicize all of its successful cases, in particular because this strengthens later cases against providers who claim ignorance about what conduct constitutes an FCA violation.

From this universe of press releases, I created categories of enforcement against different types of improper conduct. First, I read and hand-coded all press releases through 2014, which contained 325 press-releases. The majority of press releases describe settlements; however, press releases occasionally describe government intervention in a case, or provide year-end totals of successful recoveries, and were discarded. Then, each settlement press release was coded for the type of medical care and the type of fraud it pertains to.

Certain types of care and certain types of fraud are not analyzable with my data and were omitted from the pool of potential cases to study. For example, cases regarding hospital cost reports, cases against Medicare claims processors, or cases that primarily concerned Medicare Advantage plans were discarded due to the lack of data. Similarly, some of the alleged frauds involve illegal kickbacks or improper financial relationships between providers. However, my available Medicare data do not contain financial information of providers, and therefore these types of cases were excluded from this study.

Following these restrictions, there are 170 remaining press releases that I group into categories. Press releases are grouped by the type of fraud and the type of care they describe, and within each case I create a total settlement amounts. For 3 of the largest settlements, all against groups of hospital providers, the settlement press releases describe multiple types of allegations relating to different categories of conduct reflected in other press releases. In these cases, the settlements were apportioned to the different categories of conduct, as described in the settlement agreement or press release. For example, the June 2006 Tenet Healthcare settlement (described in Appendix C.4) was a \$900 million settlement, and the press release states that \$788 million was for outlier payments and \$46 million was for DRG upcoding. The outlier payment category therefore is apportioned \$788 million from this press release and the DRG upcoding category gets \$46 million.

The categorization process results in 54 distinct categories, most of which are very small. There are 23 categories with total settlements of less than \$10 million and each contain 1 or 2 press releases. The top 11 categories detail more than \$100 million in settlements each; these categories are described in Appendix Table A2. Within these categories, one final restriction was imposed, due to availability of data. If a lawsuit began before the data are available, I am unable to observe a pre-whistleblowing period, and therefore the case is omitted. In one category, hospice care, there is insufficient data in the court filings or within the public records to identify the defendant providers, and this case is omitted. Appendix Table A2 details the exclusion reasons for each of the top categories that were omitted, including the timing of the first lawsuit in circumstances where that drove the omission. Researchers with access to earlier data may be able to conduct similar analyses on these categories of whistleblowing.

The press release data do not contain sufficient detail to conduct analyses in the Medicare data, only to generally compare allegations. To augment the details of the press releases, I collect whistleblower complaints and settlement agreements from the lawsuits detailed by the press releases. The identification of these cases is done either by docket number, which the press release sometimes specifies, or by defendant name. The FOIA data described in Appendix Section A were also used for mapping from press releases to court case docket numbers, which allowed for the retrieval of court documents. Whistleblower allegations and settlement documents contain specifics on the allegations of fraud or misconduct, including information on the medical coding of related procedures.

C Lawsuit Details for Case Studies

C.1 Outlier Payment Case Study Details

Medicare reimburses most inpatient stays under a prospective payment system, with each stay classified under a Diagnosis Related Group (DRG). Hospitals are paid a fixed reimbursement for each DRG based on the average costs of treating patients under that DRG. This incentivizes providers to keep costs down, as they can recover profits by spending less per patient than the DRG pays. However, this contains the potential incentive to avoid treating high-cost patients. To correct this issue, Medicare has a system by which hospitals treating exceptionally high cost patients receive additional reimbursements called outlier payments. The gravamen of the accusations in the outlier payment lawsuits were that the defendants manipulated the reimbursement process for outlier payments to classify more patients as outliers and receive additional payments.

Between December, 2004 and March, 2010 the Department of Justice published 11 press releases detailing settlements related to outlier payment falsification. The outlier-related conduct from these press releases totals to \$923 million in settlements. The first press release in this category was in December 2004, for the case U.S. ex rel James Devage et al. v. HealthSouth et al. This case was originally filed in 1998; however, looking at the court documents from this case, whistleblowing was only a portion of this settlement, and the allegation of outlier falsification was not alleged by the whistleblower. Rather, it appears the Department of Justice included a provision for outlier falsification in this settlement at a later date. The first whistleblower complaint alleging outlier falsification comes from U.S. ex rel. [Under Seal] v. Tenet Healthcare Corporation. et al., Case No. 02-8309, (E.D. Pa.). The filing of the Tenet Case, November 4, 2002, is used as the treatment date for this case. This case settled in June 2006, and was followed immediately by a Department of Justice press release. The Tenet settlement contains \$788 million of recovery for outlier falsification, the bulk of the settlement total for this category.

Outlier data were gathered from the 100% Medpar files, which detail each inpatient stay paid for by

Medicare, from 1999-2016. There are more than 5 million total stays classified as cost outliers in this period, and at its peak usage in 2002 (pre-whistleblowing), outlier payments exceeded \$500 million per month. The outlier payment system also theoretically contained a provision for outpatient outlier payments. However, in practice there are almost no outlier payments listed in the outpatient claims files, even at the height of inpatient outlier spending. This analysis is therefore restricted to inpatient cost outliers.

The control groups for the Outlier payment case are other categories of expenditure that are of similar size and nature to outlier payments. Medicare pays for durable medical equipment (DME), home health aide services (HHA), hospice care (HOS), and skilled nursing facilities (SNF) as part of its broader package of benefits for older Americans. Spending on each of these types of care are included in the pool of potential controls. Furthermore, Medicare has a system for compensating hospitals who provide services to a disproportionate share of low income patients, called disproportionate share hospital (DSH) adjustments. Much like outlier payments, DSH payments are an adjustment above regular inpatient DRG pricing.

Table A3 details the time shifts (in months) and synthetic control weights for these control groups in constructing a synthetic control unit. The synthetic control method places greatest weight to DSH payments, which are the most similar in nature to outlier payments.

C.2 Botox Case Study Details

The whistleblower lawsuits against Botox alleged that Botox was prescribed for non-FDA approved, non-Medicare-reimbursable uses. The whistleblowers further allege that Allergan, the maker of Botox, explicitly promoted the product for these "off-label" uses, giving Allergan civil liability for the False Claims made to the Medicare and Medicaid programs. In September 2010, Allergan settled with the Department of Justice to resolve 3 pending whistleblower lawsuits of the same accusations: these cases have federal court docket numbers 1:07-cv-1288, 1:08-cv-1883, and 1:09-cv-3434, all conducted in the Northern District of Georgia. The first case was filed on June 5, 2007, which is used as the treatment date for this case. As part of this settlement, Botox agreed to pay \$600 Million to the federal government, which includes both a civil settlement and a criminal penalty, for which whistleblowers received \$37.8 million. This settlement was described in a Department of Justice press release in September, 2010.

Botox injections are outpatient procedures. Outpatient treatments are given a Current Procedural Terminology (CPT) or Healthcare Common Procedure Coding System (HCPCS) code that determines the reimbursement for the procedure, and an ICD-9 diagnosis code for the condition being treated. Documents from the whistleblower lawsuits provide details on the coding of outpatient Botox procedures. Medicare allowed reimbursement for Botox injections coded under CPT/HCPCS codes 64612, 64613, 64614, 64640, 64650, 67345, or J0585. The settlement agreement specifies that it resolves liability for false claims under ICD-9 diagnosis codes for spasm of muscle (728.85), other facial nerve disorders (351.8), spasmodic torticollis (333.83), unspecified torticollis (723.5), and bladder conditions (788.30 through 788.34, and 599.82).

Botox spending data were compiled from 100% samples of outpatient claims from January 2002-September 2015, using the CPT codes listed above and filtered for claims where the principal diagnosis matched the ICD-9 codes specified in the settlement. Data start at 2002 due to the availability of cleaned outpatient files, and data are truncated from October 2015 onwards due to the change from ICD-9 to ICD-10 diagnosis codes. Spending for Botox under the relevant diagnoses codes grew from 2 million dollars in 2003 to more than \$5 million in 2006, the year before the lawsuit against Allergan was filed.

There are thousands of CPT/HCPCS codes, motivating a restriction of these groups to better potential controls. The candidate groups for this study are all other outpatient CPT/HCPCS codes for which spending started between \$2 million and \$5 million and saw a 2-3x rise over any 3-year period between 2002 and 2011, of which there are 67 control units. Table A4 shows the weights and time shifts for the 10 control groups given the highest weights by the synthetic control method.

C.3 Kyphoplasty Case Study Details

The main allegation of the kyphoplasty lawsuits was that hospital providers, at the urging of the product manufacturer Kyphon, were conducting kyphoplasty as an inpatient procedure, rather than outpatient. Under Medicare, inpatient stays are paid a fixed amount for the Diagnosis Related Groups (DRG) under which a patient is coded. Therefore, for short stays, providers can receive the full reimbursement and incur relatively low costs. Kyphon allegedly instructed its sales representatives and marketers to push usage of the DRGs 233, 234, and 216, which are various non-specific inpatient spine surgery codes, not designed for kyphoplasty. The specific descriptors of these DRGs were, in 2005, the year the lawsuit was filed: DRG 234: "Other musculoskeletal system & connective tissue O.R. procedure without comorbidities and complications"; DRG 233, ibid, "... with comorbidities and complications"; and DRG 216: "biopsies of musculoskeletal system & connective tissue." (Center for Medicare and Medicaid Services, 2005)

Tracing spending on DRGs across time requires cross-walking when new versions of the DRG coding are released. This occurred twice in the relevant time period, in October 2007 and in October 2015. The October 2007 change was a complete overhaul of the DRG system, and changed from DRGs to a severity-based system (called MS-DRGs). Under this change, sets of 1 to 2 DRGs before October 1, 2007 usually correspond to

3 DRGs after that date. No 1 to 1 crosswalk exists, and so I collapse the DRGs into groups which can be cross-walked through this change. The DRGs allegedly promoted by Kyphon exhibit this pattern: DRG 216 became MS-DRGs 477, 478, and 479, and DRGs 233-234 became MS-DRGs 515, 516, and 517. I create groups for the DRGs that map across this change, and these DRG groups provide the control units. I omit DRGs that were entirely eliminated or newly generated during this switchover, as they cannot be analyze across the relevant time period. To handle the second DRG coding change in 2015, data from the 2016 fiscal year (starting October 1, 2015) are dropped and no crosswalk is implemented. This second change is close to the end of the available data and happened many years after the relevant lawsuit, so these are not necessary for analysis.

The treated unit for this analysis is the total payment for stays of 7 nights or fewer under the groups corresponding to DRGs 233, 234, and 216, the DRGs allegedly promoted by Kyphon. The set of controls are payments for stays of 7 nights or fewer under other DRG groups. I include DRG groups which experienced a more than double growth in annual spending over any 3-year period before 2011. The restriction to growing groups picks DRG groups on similar trajectories to the treated unit, which experienced a 2.5 times increase between 2002 and 2004, the year before the lawsuit was filed. The cutoff for growing controls is placed at 2011 to ensure that the data can be shifted back to match the Kyphoplasty series and still allow for 5 years of post-treatment comparison, as my data end in 2015. I exclude DRGs which saw discontinuous jumps (a 500%+ increase in any single month), or which were not in use for at least 12 months of the pre-whistleblowing period. There are 30 DRG groups included as controls. Appendix Table A5 details the time shift and synthetic control weights for these DRGs.

The kyphoplasty lawsuits alleged that kyphoplasty should have been coded as an outpatient procedure rather than inpatient. Outpatient procedures are billed to Medicare under HCPCS codes. Kyphoplasty was a new technology during this period, and coding for it changed over the course of the relevant period. Kyphoplasty was often billed under the catch-all unlisted spine procedure code 22899, but also was coded under the HCPCS codes 22523, 22524, 22525, 22513, 22514, 22515, C9718, or C9719 at various times, the latter two very infrequently. Furthermore, to measure substitution effects to outpatient procedures, I need to consider spending on vertebroplasty, a close substitute procedure, which was coded under HCPCS codes 22520, 22521, 22522, 22511, or 22512.

For the purposes of the health analysis in Section 5, the codes listed in the previous paragraph are used to identify outpatient kyphoplasty and vertebroplasty, as almost everything under these codes were in fact those procedures. However, whistleblowers also alleged that Kyphon, the maker of the kyphoplasty kit, also pushed providers to miscode the procedure under HCPCS codes 22327, 22325, 22328 for open reduction of thoracic or lumbar vertebrae. Kyphoplasty is not an open procedure, but is rather percutaneous. To analyze the sum of the fiscal effects, and to construct appropriate control groups, the outpatient deterrence analysis considers spending on all outpatient spine procedures, in the CPT code range 22010-22899. Some of these procedures were unaffected by whistleblowing, and therefore will difference out on average before and after the treatment period and will not bias the deterrence measurement. As controls, I consider other categories of surgical outpatient procedures on the musculoskeletal system, all of which are in the 20000-29999 range, of which the treated unit is a subset. These categories are constructed from the AAPC Coder code ranges (AAPC Coder, 2019) and include procedures like shoulder surgeries, hip surgeries, etc. and are not substitutes for the treated procedure. Two other codes in this range, CPT Codes 20000 and 20005, which correspond to surgical drainage procedures, were also included; these codes were deprecated in 2019. Table A5 gives the time shifts and weights for these control units.

C.4 Unnecessary Inpatient Admission Case Study Details

When a patient visits a hospital, particularly for emergency services, physicians at that hospital make a decision on whether to admit the patient for an inpatient stay, which generally results in an overnight stay of at least one night. Besides admitting patients, doctors have the ability to treat a patient outpatient, or to hold them for observation without admission. Inpatient admission receives greater reimbursement than outpatient or observational care. Under Medicare rules, inpatient stays are reserved for acute illnesses, and hospitals are expected to conduct utilization reviews to ensure that patients are admitted appropriately. The allegations in this category of whistleblowing are that the defendant hospitals improperly admitted Medicare patients because of the greater reimbursement provided.

Between 2007 and 2014, the Department of Justice issued press releases detailing 7 settlements with different providers and provider chains regarding this conduct. Four of the settlements concerned a single hospital: St Joseph's Atlanta; Wheaton Hospital in Wheaton, Minnesota; El Centro Medical Center in Southern California; and Overlook Medical Center in Summit, NJ. Two of the settlements concerned groups of 6 hospitals: Shands Hospitals and Morton Plant Hospitals, both in Florida. The final settlement was against Community Health Systems (CHS), described the Department of Justice in this press release as the "nation's largest operator of acute care hospitals." CHS settled for \$98 million for conduct in 119 hospitals in 28 states. The total recovery from these 7 settlements was \$172.29 million.

The evidence suggests that the conduct described in these cases was localized among the defendants.

Appendix Figure A5 plots the total inpatient spending from all providers in the US and shows no changes with the filing of the first lawsuit in October 2004. This is unsurprising, as total Medicare inpatient spending was around \$10 billion per month at the time of filing, and the entirety of these settlements was less than \$200 million. Therefore, the computation of direct deterrence conducted here focuses only on the defendants. This may undercount spillover affects to other hospitals who were also deterred from unnecessary inpatient admissions as a result of these settlements.

The goal of this analysis is to measure the direct deterrence effects of these lawsuits on spending at the defendant providers. Because the lawsuits indicate that patients were unnecessarily admitted to the hospital rather than being seen outpatient, I expect a decrease in inpatient spending and an increase in outpatient spending. To measure this change, I construct control units using a set of untreated hospitals. Because some of the untreated hospitals may have been affected by spillovers, I restrict my control sample to hospitals in the 23 states (including the District of Columbia) with no defendant providers. These control units see different patient populations than the defendants and are less likely to be influenced by their behavior. This ensures the control units are isolated from the treated units, at least geographically, to mitigate spillover effects. Next, I construct a random sample of 100 control units for each defendant. For the four defendants that were 1 hospital, the control units are 100 randomly selected hospitals. For the two defendants which were 6 hospitals, the control units are 100 units of 6 randomly-grouped hospitals, drawn with replacement from the set of control hospitals. For CHS, which had 119 hospitals settle, I construct 100 control units of 119 randomly grouped hospitals, drawn with replacement from the set of control hospitals, drawn with replacement from the set of control hospitals, drawn with replacement from the set of control hospitals, drawn with replacement from the set of control hospitals, drawn with replacement from the set of control hospitals. These control units serve as the controls for the inpatient spending. For outpatient spending, I repeat the same process, drawing from the set of outpatient providers in states with no defendants.

Each of the 7 defendants here is conducted as its own case study. Each has its own controls, and the treatment date for each defendant is the earliest filing date of the lawsuit(s) settled in the settlement agreement with that hospital. Because CHS constitutes 119 of the 135 hospitals in this study, plots from CHS are included in the main results. Inpatient and outpatient plots from the other defendants are presented in Appendix Figures A3 and A4 respectively.

Appendix Figures



Figure A1: Histogram of Healthcare-Related False Claims Act Settlement Values

Notes: This figure plots the histogram of settlement values for settled False Claims Act whistleblower lawsuits related to healthcare from 1986-2012. Each bin is of width \$50 million, and all cases included here have nonzero settlement values. Appendix A describes the cleaning process for these data. The median settlement value is \$1.5 million, and the maximum is \$1.52 billion. The total of all settlements for healthcare-related cases is \$26.4 billion.



Figure A2: Histogram of Healthcare-Related False Claims Act Whistleblower Shares

Notes: This figure plots the histogram of whistleblower shares from settled False Claims Act lawsuits related to healthcare from 1986-2012. Each bin is of width \$5 million, and all cases included here have nonzero whistleblower share. Appendix A describes the cleaning process for these data. The median whistleblower share is \$250,307, and the maximum is \$300.7 million. The total of all whistleblower payments for healthcare-related cases is \$4.29 billion.



Figure A7: Treatment Effect Histogram by Cohort

Notes: This figure plots the histogram of expected patient health effects from receiving a short-stay inpatient kyphoplasty treatment among the population of never-before-treated 70-75 year olds in 2005 and in 2011, which correspond to pre- and post-whistleblowing in the kyphoplasty case. Each cohort contains roughly 8 million patients. The horizontal axis is the difference in probability of death in the next 6 years if one receives treatment; values greater than 0 indicate a greater probability of death if treated, and negative values indicate a lower probability of death if treated. This treatment effect is computed using a model fit to the 2005 pre-whistleblowing cohort. The similarity of these histograms indicates that the sample population did not change in composition following the lawsuit.



Figure A3: Inpatient Spending at Other Defendants in the Unnecessary Admissions Case Study

Notes: This figure plots the synthetic control strategy for inpatient spending at the other defendant providers in the unnecessary inpatient admissions case. The largest defendant, CHS, appears in the bottom-right panel of Figure 4. On average, inpatient spending at these providers fell relative to the synthetic control group.

Figure A4: Substitute Outpatient Spending at Other Defendants in the Unnecessary Admissions Case Study



Notes: This figure plots the synthetic control strategy for outpatient spending at the other defendant providers in the unnecessary inpatient admissions case. The largest defendant, CHS, appears in the right panel of Figure 5. On average, outpatient spending at these providers did not increase, even when inpatient spending fell. However, there is heterogeneity among the defendants, with some experiencing increases in outpatient spending and others experiencing decreases.



Figure A5: Total Inpatient Spending Over Time

Notes: This figure plots total inpatient spending against the timing of the first unnecessary inpatient admissions lawsuit. There is no visible change in overall inpatient spending, which motivates an analysis focused on the defendants in these lawsuits.



Figure A6: One-Night Inpatient Kyphoplasty Claims

Notes: This figure plots inpatient stays for the DRGs promoted by Kyphon for inpatient kyphoplasty that lasted 1 night or less. The first vertical line shows the filing of the lawsuit, and the second line shows the settlement of the lawsuit.

Figure A8: Kyphoplasty Short-Stay Inpatient Treatment Count by Heterogeneous Treatment Effect



Notes: This figure plots the number of patients receiving short-stay inpatient kyphoplasty among the 2005 and 2011 cohorts of never-before-treated 70-75 year olds. Inpatient treatment counts were vastly reduced following the lawsuits against Kyphon and hospitals providing this treatment, which first settled in 2008. The treatment effect is identical to the horizontal axis in Figure A7, and is scaled as the change in probability of death when receiving treatment. The reduction in treatment volume occurs across the treatment effect distribution. The shape of these distributions is mostly driven by the number of units in each bin, as shown in Appendix Figure A7, motivating an analysis by probability of treatment as shown in Figure 6.



Figure A9: Inpatient or Outpatient Treatment Probability by Treatment Effect by Year

Notes: This figure plots the change in total (inpatient or outpatient) treatment probability as a function of the estimated treatment effect. It presents the same result as Figure 8, broken out by the treatment effect bin. Treatment effects are scaled as the change in probability of dying when receiving inpatient kyphoplasty. To satisfy Medicare cell-size-suppression rules, patients with treatment effects in the tails of the distribution are recoded to ± 0.4 . Patients with beneficial treatment effects, i.e. less than 0, are on average more likely to receive treatment after whistleblowing, while patients that are expected to be harmed are less likely to receive treatment after whistleblowing.

	Coef	SE	95% CI
Treated	2.876	2.863	[-2.736, 8.488]
Age	.0928	.000716	[.0914, .0942]
Treated \times Age	-0.0117	0.0373	[-0.0848, 0.0614]
Female	-0.419	0.00222	[-0.423, -0.415]
Treated \times Female	-0.193	0.139	[-0.465, 0.0782]
Race White	0.00245	0.0354	[-0.0670, 0.0719]
Treated \times Race White	-1.35	0.679	[-2.68, -0.0220]
Race Black	0.0706	0.0356	[0.000847, 0.140]
Treated \times Race Black	-1.32	0.811	[-2.91, 0.273]
OREC = DIB	0.526	0.00310	[0.520, 0.532]
Treated \times OREC = DIB	-0.447	0.170	[-0.780, -0.116]
OREC = ESRD	0.558	0.0505	[0.459, 0.657]
Treated \times OREC= ESRD	1.28	1.99	[-2.62, 5.19]
Previous Inpatient Stay	0.253	0.00283	[0.248, 0.259]
Treated \times Previous Stay	-0.0688	0.134	[-0.331, 0.194]
Constant	-8.43	.0631	[-8.55, -8.31]

Table A1: Selected Logit Regression Coefficients for Heterogeneous Treatment Effects of Kyphoplasty

Notes: This table presents selected coefficients from the heterogeneous treatment effects regression described in Equation 6. The full model contains hundreds of coefficients due to the inclusion of state fixed effects and counts for stays under each inpatient DRG as well as full interaction with the treatment indicator. The coefficients presented here are given as examples. OREC indicates the original reason for Medicare qualification. ESRD denotes End Stage Renal Disease and DIB denotes disability insurance benefits.

Type of Care	Type of Fraud	First Settlement Year	Settlement Total	Included or Omitted	Reason for Omission
Pharmaceuticals	Off-Label Promotion	2004	14,359,380,000	Omitted	Part D Data Start 2006
Inpatient	Outlier Payment Falsification	2004	923,033,623	Included	
Botox	Off-Label Promotion	. 2010	600,000,000	Included	
Inpatient	DRG Upcoding	2000	458,260,000	Omitted	Case Filed 1995
Home Health	Medically Unnecessary Care	2000	424,700,000	Omitted	Case Filed 1995
Nursing Home	Inadequate Care	2001	219,000,000	Omitted	Case Filed 1996
Kyphoplasty	Inpatient Should be Outpatient	2008	214,238,775	Included	
Physical Therapy	Unlicensed providers; Group Therapy Billed as One-on-One	2004	185,600,000	Omitted	Case Filed 1998
Hospital	Unnecessary Admissions	2007	172,296,460	Included	
Nursing Home Therapy	Falsified Hours Spent	2000	132,700,000	Omitted	Case Filed 1996
Hospice	Ineligible Patients	2006	114,886,000	Omitted	Defendants Not Identifiable from Court Data
Laboratory Tests	Medically Unnecessary; Unbundling Tests	1997	111,161,000	Omitted	Case Settled Before Data Start

Table A2: More Categories of Medicare Whistleblowing Enforcement

Notes: This table describes the top categories of whistleblowing enforcement, as constructed from the Department of Justice press release data using the method described in Appendix B. Cases not related to Medicare claims data are excluded. These are all of the categories for which enforcement totaled to more than \$100 million. Four of the top categories are included as case studies. Seven cases are omitted from the case study analysis of this paper because the first lawsuit was filed before the data are available. My available data start in 1999 for all categories except outpatient care and pharmaceuticals, which start in 2002 and 2006 respectively. One category, ineligible hospice patients, is omitted because the lawsuit documents do not identify the defendant providers.

Control	Time Shift (Months)	Synthetic Control Weight
DME	+9	.049
DSH	+1	.837
HHA	+10	.024
HOS	-23	.083
SNF	+10	.007

Table A3: Synthetic Control Weights and Time Shifts for Outlier Payments Case

Notes: This table details the synthetic control time shifts and weights used for the Kyphoplasty case. The control units are other types of Medicare spending, described in detail in Appendix C.1. The time shift describes the number of months the control unit must be shifted to align with the treated unit in the pre-whistleblowing period. Positive values mean the control unit is shifted forward in time, and negative months mean the control is shifted back in time. For example, a time shift of +9 means that the control unit in March, 2005 serves as a control for the treated unit in December, 2005.

CPT Code	Descriptor	Time Shift (Months)	Synthetic Control Weight
85379	Pathology: Quantitative D-Dimer	-7	0.368
38510	Biopsy or excision of lymph node(s)	14	0.096
67028	Intravitreal injection of a pharmacologic agent	-24	0.06
82570	Pathology; Measurement of Creatinine	0	0.028
58563	Surgical hysteroscopy with electrosurgical ablation of endometrium	-24	0.022
63047	Laminectomy	2	0.019
37607	Ligation or banding of angioaccess arteriovenous fistula	2	0.015
73718	Magnetic resonance imaging, lower extremity other than joint; without contrast	-12	0.014
75635	Computed tomographic angiography with contrast	-10	0.014
43259	Esophagogastroduodenoscopy, flexible, transoral	-10	0.013

Table A4: Synthetic Control Weights and Time Shifts for Botox Case

Notes: This table details the synthetic control time shifts and weights used for the Botox case. The control units are other types of outpatient care, described in detail in Appendix C.2. The time shift describes the number of months the control unit must be shifted to align with the treated unit in the pre-whistleblowing period. Positive values mean the control unit is shifted forward in time, and negative months mean the control is shifted back in time. For example, a time shift of +2 means that the control unit in October, 2005 serves as a control for the treated unit in December, 2005.

Inpatient				
DRG V-24	MS-DRG V-25 $$	Descriptor	Time Shift (Months)	Synthetic Control Weight
462	945, 946	Rehabilitation	47	0.431
533, 534	037,038,039	Extracranial Procedures	3	0.049
524	69	Transient Ischemia	5	0.045
518	250, 251	Percutaneous cardio procedures w/o coronary artery stent	17	0.045
535	222, 223	Cardiac defibrilator implant with cardiac catheterization	-5	0.037
519, 520	471,472,473	Cervical spinal fusion	-12	0.035
155,156,567,568	326, 327, 328	Stomach, esophagealm and duodenal procedures	-58	0.03
515	226, 227	Cardiac defibrillator implant w/o cardiac catheterization	21	0.029
523	896, 897	Alcohol/drug abuse or dependence w/o rehabilitation therapy	-58	0.026
496	453, 454, 455	Combined anterior/posterior spinal fusion	-58	0.025

Table A5: Synthetic Control Weights and Time Shifts for Kyphoplasty Case

Outpatient

•			
CPT Code Range	Surgical Category	Time Shift(Months)	Weight
20000, 20005	Incision and Drainage	0	0.158
22900-22999	Abdomen	0	0.115
21920-21936	Back or Flank	0	0.096
21501-21899	Neck or Thorax	0	0.079
26990-27299	Pelvis or Hip	0	0.077
21010-21499	Head	0	0.076
27301-27599	Femur or Knee	0	0.061
27600-27899	Leg or Ankle	0	0.058
29000-29799	Casts	11	0.051
25000-25999	Forearm or Wrist	11	0.048

Notes: This table details the synthetic control time shifts and weights used for the Kyphoplasty case. The top panel describes the controls for inpatient spending, which are groups of other inpatient DRGs. The bottom panel describes the controls for outpatient spending, which are other CPT code ranges of surgery on the musculoskeletal system. These controls are described in detail in Appendix C.3. The time shift describes the number of months the control unit must be shifted to align with the treated unit in the pre-whistleblowing period. Positive values mean the control unit is shifted forward in time, and negative months mean the control is shifted back in time. For example, a time shift of +3 means that the control unit in September, 2005 serves as a control for the treated unit in December, 2005.