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Free-Standing Ambulatory Surgery Centers and Hospital Surgery Volume

This paper examines the association of free-standing ambulatory surgery centers (ASCs) with hospital surgery volume, using data from the 2002 Medicare Online Survey Certification and Reporting System and the American Hospital Association Annual Surveys of Hospitals. From 1993 to 2001, the number of ASCs per 100,000 population in metropolitan statistical areas (MSAs) increased by 150%. During the same period, hospital outpatient surgeries increased 28%, while inpatient surgeries decreased by 4.5%. MSA and year fixed-effects regression analyses suggest that an increase of one ASC per 100,000 people was associated with a 4.3% reduction in hospital outpatient surgical volume, but was not associated with inpatient surgical volume.

The number of Medicare-certified free-standing ambulatory surgery centers (ASCs) has grown rapidly, from approximately 400 in 1983 to more than 3,300 in 2001 (Winter 2003). ASCs provide relatively uncomplicated surgical procedures in a nonhospital setting, and typically specialize in one or two procedures related to ophthalmology, gastroenterology, or orthopedics (Casalino, Devers, and Brewster 2003; Winter 2003). Herzlinger (2004) has referred to ASCs as an example of "focused factories" that are models of highly specialized and efficient delivery of health care.

ASCs tend to be physician-owned or owned jointly by physicians and other investors; over the period 1985–2003, hospital-physician joint ventures appear to be rare. The profusion of ASCs has been controversial, with the same concerns about self-referral by physician-owners, patient selection, and competition with community hospitals that have arisen with specialty hospitals and free-standing imaging centers (Mitchell 2005; Guterman 2006; Stensland and Winter 2006; Greenwald et al. 2006).

Critics have argued that physician-owned ASCs may present a conflict of interest leading to the provision of unnecessary surgeries and procedures (Casalino, Devers, and Brewster 2003; Mitchell and Sass 1995). Others have argued that ASCs draw profitable patients away from community hospitals, making it difficult for those hospitals to provide uncompensated care and unremunerative services. Devers, Brewster, and Casalino (2003) have suggested that ASCs may be part of a return to the medical arms race in which

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Inquiry 44: 200–210 (Summer 2007). © 2007 Excellus Health Plan, Inc.
0046-9580/07/4402-0200
www.inquiryjournal.org

providers attract patients with services and amenities rather than price.

The growth of ASCs has been much more rapid than that of specialty hospitals, but there has been remarkably little empirical research on the effects of ASCs on health care markets. The existing work has documented the growth of such facilities and provided case studies of their impact on hospitals, but no generalizable research has addressed the effects of ASCs. This study begins to fill that void by examining the association of the growth of ASCs with outpatient and inpatient surgery volume in community hospitals. Our empirical analysis uses a balanced 1993–2001 metropolitan statistical area (MSA) level panel data set constructed from the 2002 Medicare Online Survey Certification and Reporting System and the 1993–2001 American Hospital Association Annual Surveys of Hospitals. Over this period, hospital ambulatory surgeries nationwide increased 28%, while inpatient surgeries decreased 4.3%. However, at least some of the procedures provided in ASCs appear to have been substitutes for procedures in hospital settings. Our MSA and year fixed-effects regression results suggest that one additional ASC per 100,000 population was associated with a 4.3% reduction in hospital outpatient surgery volume, but was not associated with hospital inpatient surgical volume.

Background

Kozak, McCarthy, and Pokras (1999) document the eightfold increase in ambulatory procedures over the 16-year period, from 3 million operations in 1980 to 27 million in 1995. They attribute the growth in ambulatory surgery in part to advances in surgical techniques and anesthesia. The surgical changes, including laparoscopic and laser techniques, have made surgery easier on patients by reducing surgical trauma, pain, and post-operative nausea, and by allowing patients to return more quickly to their normal lives (Lumsdon, Anderson, and Burke 1992). The improvements in anesthesiology have lessened headaches and post-operative nausea (Detmer and Gelijns 1994). As a result, the demand for ambulatory surgical procedures increased and patients who otherwise might have lived with their minor symptoms or have been poor candidates for more invasive procedures now may receive ambulatory procedures.

In addition, the growth of managed care and changes in Medicare payment systems changed the incentives to use ambulatory surgical settings. Arguably, managed care plans' attention to the price of services, as well as location and quality, have led to an insistence that relatively minor procedures be performed on an ambulatory basis. However, there is little evidence documenting managed care plans' preference for ambulatory settings. However, Case, Johantgen, and Steiner (2001) examined the use of ambulatory settings for mastectomies in five states during the first half of the 1990s. Controlling for available clinical and hospital characteristics, they found that those women with insurance coverage other than health maintenance organizations (HMOs) were 29% less likely to receive an outpatient mastectomy than were HMO enrollees.

The Medicare program moved to the prospective payment system (PPS) in the mid-1980s and implicitly provided incentives to move procedures to the outpatient setting. Sloan, Morrisey, and Valvona (1988) reported dramatic reductions in the provision of "little ticket" inpatient tests and procedures after the advent of the PPS. Moreover, Medicare expanded its coverage in the 1980s to include more procedures provided in an ambulatory setting, and often has paid more for ambulatory-based services than for inpatient ones.

Winter (2003) reported that the number of Medicare-certified ASCs grew from just over 400 in 1983 to more than 3,300 in 2001. In 2000, 17% of Medicare-paid ambulatory surgical procedures were performed in ASCs, compared to 24% in physician's offices and 59% in hospital outpatient departments. The Medicare Payment Advisory Commission (MedPAC) (2004) noted that over the period 1998–2002, nearly all ASCs (94%) were for-profit and located in large metropolitan areas (88%). On average, they were equipped with 2.5 operating rooms. The vast majority (99%) of ASCs were free-standing facilities that

were distinct from outpatient surgery departments or ambulatory surgical entities owned by hospitals or jointly owned by hospitals with surgeons. Medicare requires ASCs to be licensed by the states in which they operate in order to be Medicare-certified providers (Casalino, Devers, and Brewster 2003).

Many ASCs specialize in one or two types of relatively uncomplicated services. The MedPAC (2004) reported that among Medicare-paid surgeries and procedures in 2001, ophthalmology, gastroenterology, and orthopedic surgery/procedures were among the most frequently performed in the 750 high-volume Medicare-certified ASCs. However, only about 20% of ASC revenue came from Medicare patients. Among the high-volume Medicare ASCs, 43% provided general surgical services, while 34% specialized in ophthalmology and 18% specialized in gastroenterology. There is no information currently available on specialty areas and total surgery or procedure volume of ASCs.

Although ASCs are assumed to be a lower-cost alternative to hospital outpatient surgery facilities because of specialization, they sometimes are paid more generously by Medicare, as already noted. ASCs were paid higher Medicare facility fees than hospital outpatient units in eight of the 10 surgical procedure categories that account for the highest share of Medicare payments to ASCs (Winter 2003). The MedPAC (2004) has argued that some of the higher payments were the result of payment groupings of services that were defined too broadly and of the use of old data on costs. It also noted that the Medicare Modernization Act eliminated payment updates for ASCs for 2005 through 2009, and had ordered a new payment system to be implemented sometime between 2006 and 2008. The differences in Medicare payment rates for ASCs and hospital outpatient surgery departments appear to have created incentives for ASCs to perform selectively certain types of more profitable surgeries or procedures, at least among Medicare beneficiaries. A shift of profitable surgical procedures from a hospital to an ASC setting potentially could limit a hospital's ability to provide charitable care to communities.

Surgeons are paid the same professional fees by Medicare for services regardless of the delivery setting. Thus, surgeons who have an ownership interest in an ASC can earn a return on equity in the facility in addition to their professional fees. This return on equity may create some incentive for surgeons to steer patients away from community hospital outpatient facilities to ASCs where they have an ownership interest. Although federal laws ("Stark I" and "Stark II" provisions) prohibit physicians from referring their patients to facilities in which the physicians have an ownership interest, ASCs are exempted from these federal laws (Iglehart 2005).

The introduction of ASCs into hospital markets has been controversial. For example, Hyland (2003) reported in the *Baltimore Business Journal* the controversy in Maryland over ASCs, quoting a policy analyst for the state's health care commission: "Since outpatient surgery tends to be profitable, [hospitals] would like to keep it to themselves." In court cases in Hammond, La., Aberdeen, S.D., and Rome, N.Y., ASCs have alleged that local hospitals used exclusive contracts with insurers to deprive the ASCs of business or have closed the hospital medical staff to new members to limit ASCs' access to surgeons (Lynk and Longley 2002; Leaner 2003). In 2004, some 25 states had certificate of need (CON) provisions applying to ASCs (Morrisey 2005). CON applications for ASCs are often contentious. Casalino, Devers, and Brewster (2003) have argued that the development of ASCs in their case studies was associated with the absence of CON and the presence of large, single-specialty physician groups. In contrast, Conover and Sloan (1998) found no effect of CON on the diffusion of ambulatory surgery units. While it is generally believed that ASCs compete with hospital outpatient facilities, other than the case studies by Lynk and Longley (2002) and Casalino, Devers, and Brewster (2003), there is no empirical work in this area.

Conceptual Overview

The theory underlying the effects of ASCs on community hospitals is straightforward. Hos-

pitals are assumed to generally compete with each other in the delivery of both inpatient and outpatient surgical procedures. This competition is traditionally assumed to be along dimensions of services, quality, and amenities provided to patients and their physicians. With the advent of aggressive managed care in the late-1980s, hospitals also began to compete on the basis of the price of services (Morrisey 2001). Thus, in a reasonably functioning private health care market, the entry of a new ASC is expected to draw ambulatory surgeries away from community hospitals if the ASC offers lower prices, greater convenience, and/or higher quality to privately insured patients. In a managed care setting, one can envision local managed care plans negotiating over price and service conditions and entering into a contract with the new ASC.

In an administered price system like Medicare, a new entrant is unable to compete on a direct price basis. However, it still can compete by offering better quality, location, and services to surgeons and beneficiaries. Moreover, if Winter (2003) is correct, many Medicare payments for similar services are higher if provided in an ASC. Under these conditions, one would expect that Medicare ambulatory surgeries would be shifted from hospitals to newly established ASCs.

Thus, under both the reasonably price-competitive private market and the administered Medicare program, one would expect that the entry of new ASCs would result in reduced volume of outpatient surgery in community hospitals. In contrast, the Devers, Brewster, and Casalino (2003) argument of a renewed medical arms race might suggest an increase in both hospital outpatient and ASC surgeries as providers compete more intensely on service and amenity bases, implying unmet demand and/or unnecessary surgical provision.

In addition, there is good evidence that hospital prices are higher when the hospital market is more concentrated (Morrisey 2001). Recent work by the Government Accountability Office (GAO 2005) indicated that hospitals in the least competitive markets had prices that were 18% higher than average, while those in more competitive markets had prices 11% below average. This suggests that ASCs will draw more ambulatory surgeries from community hospitals in markets where the hospital market is more highly concentrated.

Finally, the comparative advantage of managed care plans is their ability to selectively contract, trading volume for an acceptable mix of price, services, and quality. If so, in markets with greater managed care penetration, one might expect health plans to focus more aggressively on the efficiency of their health care providers. The "focused factory" notion of highly efficient ASCs then suggests that ASCs will draw more ambulatory surgeries from hospitals in markets with greater managed care penetration.

Data and Methods

We test the ASC competition, hospital concentration, and managed care penetration hypotheses using four secondary data sources. The two main data sources are the 2002 Medicare Online Survey Certification and Reporting System (OSCAR) and the 1993–2001 American Hospital Association (AHA) Annual Surveys of Hospitals. The OSCAR provides information on all Medicare-certified free-standing ASCs in operation during 2001, excluding ASCs jointly owned by hospitals. Hereafter, ASCs refers to Medicare-certified free-standing ASCs.[1]

Relevant information from the OSCAR includes the opening dates and the county and state location of ASCs. The AHA survey files provide information on outpatient and inpatient surgery volumes as well as the number of hospital admissions and an identifier of hospital system membership. On the annual survey, an outpatient surgery is "a scheduled service provided to patients who do not remain in the hospital overnight….outpatient surgery may be performed in operating suites also used for inpatient surgery, specially designated surgical suites for outpatient surgery, or procedure rooms within an outpatient care facility" (AHA 2002, p. 193). Two other data sources include a health maintenance organization enrollment file that reports the number of HMO enrollees at the county level from 1993 to

2001, and the Area Resource Files (ARFs), which compile county-level information such as the supply of physicians, population estimates, and demographic and economic characteristics from 1993 and the period 1995–2003.[2] We used multiple year ARFs to construct a longitudinal database.

We defined the relevant hospital market at the MSA level based upon the 2001 designations because very few ASCs exist outside MSAs, and MSAs have been used as the basis of urban health care markets in the past (Morrisey, Sloan, and Valvona 1988; GAO 2005). We aggregated all county-level data to the MSA level and constructed a 1993–2001 MSA-level balanced panel data set by merging ASC data with HMO penetration, AHA survey, and ARF data. There were a total of 322 MSAs in the United States in 2001, but the final panel data set included only 317 MSAs each year because HMO penetration data were not available for five MSAs.

The empirical model was estimated using an ordinary least squares (OLS) regression with MSA and year fixed effects. The MSA fixed effects control for any MSA-specific time-invariant variables such as disease prevalence. The year fixed effects control for time trends in surgeries that may be correlated with changes in ASC presence. Thus, the analytic strategy was to purge the unobserved and potentially confounded cross-sectional heterogeneity by relying on the within-MSA variation for estimation. Our main model has the following specification:

$$\begin{aligned} ln(\mathrm{VOLUME}it) = \beta_0 &+ \beta_1 \mathrm{ASC}it \\ &+ \beta_2\, \mathrm{HHI}it + \beta_3\, \mathrm{HMO}it \\ &+ \beta_4\, Zit + \mu i + \sigma t + \varepsilon it \end{aligned}$$

where log-transformed outpatient, inpatient, and total surgeries (VOLUME) in MSA i in year t is a function of the number of ASCs per 100,000 population (ASC), the community hospital concentration (HHI), the HMO penetration rate (HMO), and other market characteristic conditions (Z) as well as MSA (μ) and year (σ) fixed effects. Standard errors were adjusted via Huber robust standard errors correction (White 1980). In alternative specifications, one-year lagged right-hand side variables were used in place of contemporaneous values as a check for potential lagged market responses and reverse causality.

We would have preferred to have the prices or volumes of ambulatory surgeries provided in total or by type of surgery for ASCs, but these data were not available from the OSCAR. The ASC data also suffer from not incorporating information on mergers and closures. This appears to be a relatively minor problem. The MedPAC (2004) reports that while there was an average of 58 ASC mergers and/or closures per year between 1997 and 2002, there were 279 new ASCs that opened each year. We address the implications of the missing information on ASCs in the discussion section.

Hospital concentration was measured by the Herfindahl-Hirschman Index (HHI) from the AHA survey data on admissions in community hospitals. The HHI is defined as the sum of the squared admission market shares of all community hospitals in an MSA. As the index value increases, admissions are concentrated in fewer and/or larger hospitals. To avoid underestimating market concentration by failing to account for the rapid development of hospital systems, we treated hospitals belonging to one hospital system within an MSA as one single hospital when calculating the HHI.

HMO penetration was used as a proxy of managed care penetration. Recent research suggests that greater penetration by HMOs is associated with lower employer-sponsored health insurance premiums, while greater penetration by preferred provider organizations (PPOs) is not (Bamezai et al. 1999; Morrisey, Jensen, and Gabel 2003). Thus, we focused only on HMO penetration in this study. HMO penetration is more likely to capture the extent of aggressive selective contracting with an emphasis on efficient providers. We calculated HMO penetration as a ratio of the total number of HMO enrollees to the total population in each MSA.

The additional MSA-level covariates (Z), all constructed from the ARFs, included specialty surgeons per 10,000 population (those specializing in colon/rectal surgery,

Table 1. Mean statistics of the MSA panel data, 1993–2001

	1993	1994	1995	1996	1997	1998	1999	2000	2001	Mean
Outpatient surgery volume	33,101	34,325	34,940	36,429	38,090	39,986	40,628	42,174	42,565	38,026
Inpatient surgery volume	27,612	26,464	26,183	25,808	25,657	26,381	25,762	26,289	26,416	26,286
ASCs per 100,000 population	.740	.836	.921	1.080	1.216	1.344	1.473	1.577	1.685	1.208
Hospital concentration (HHI)	.388	.396	.434	.411	.425	.437	.442	.449	.449	.426
HMO penetration	.127	.138	.147	.165	.182	.194	.201	.196	.190	.171
No. specialty surgeons[a] per 10,000 population	5.288	5.296	5.477	5.518	5.649	5.677	5.548	5.615	5.638	5.523
No. nonfederal physicians per 10,000 population	24.612	24.627	26.205	26.867	27.561	28.088	28.723	28.682	28.801	27.130
Per capita income in \$10,000s (2001 \$)	2.304	2.326	2.369	2.457	2.522	2.567	2.713	2.743	2.734	2.526
Unemployment rate	.067	.061	.056	.054	.050	.046	.043	.042	.048	.052
Proportion of population > 64 years	.126	.127	.127	.127	.127	.128	.128	.126	.126	.127
Total population per MSA in 100,000s	6.334	6.404	6.452	6.522	6.581	6.655	6.715	6.936	7.030	6.625

Notes: MSA = metropolitan statistical area; ASC = ambulatory surgery center; HMO = health maintenance organization; HHI = Herfindahl-Hirschman index. The sample for all years was 317 MSAs; the mean sample was 2,853 MSA-years.
[a] Surgery specialties include: colon/rectal surgery, general surgery, neurological surgery, obstetrics-gynecology subspecialties, ophthalmology, orthopedic surgery, otolaryngology, plastic surgery, thoracic surgery, and urology.

general surgery, neurological surgery, obstetrics-gynecology subspecialties, ophthalmology, orthopedic surgery, otolaryngology, plastic surgery, thoracic surgery, and urology), nonfederal physicians per 10,000 population, per capita income, unemployment rates among those age 16 years or older, the proportion of population over age 64, and total MSA-level population in 100,000s.

Results

Table 1 shows the summary statistics of the panel data of 317 MSAs in nine years (or 2,853 MSA-years). In spite of any substitution that may have occurred between hospital outpatient surgical units and free-standing ASCs, the volume of hospital outpatient surgeries increased from 10.5 million (33,101 $\times$ 317) in 1993 to 13.5 million (42,565 $\times$ 317) in 2001, an increase of over 28%. In contrast, inpatient surgical volume declined over the period: from approximately 8.8 million surgeries in 1992 to 8.4 million surgeries in 2001, a decrease of 4.5%. The trends of hospital surgery volume are also shown in Figure 1.

During the same period, the number of ASCs was increasing rapidly. Figure 2 puts this increase in some perspective by reporting the number of such facilities per 100,000 population. The number of ASCs in the 317 MSAs increased by more than 150%. For example, an MSA with a population of one million in 2001 typically would have had nearly 17 ASCs; the same MSA in 1993 likely would have had only seven ASCs.

Table 2 contains the estimated models of outpatient and inpatient hospital surgery volumes. (Because the estimates of the main models were similar in magnitude, direction, and significance to those of the one-year lagged models, we only discuss results of the main model.) An increase in ASCs per 100,000 population was associated with a statistically significant reduction in hospital outpatient surgeries ($p < .01$), but it had only a small and statistically insignificant effect on inpatient procedures. One additional ASC per 100,000 population was estimated to reduce metropolitanwide hospital outpatient surgeries by 4.3% ($exp(-.044)$–1).[3] Evaluated at the mean, the estimated marginal impact of

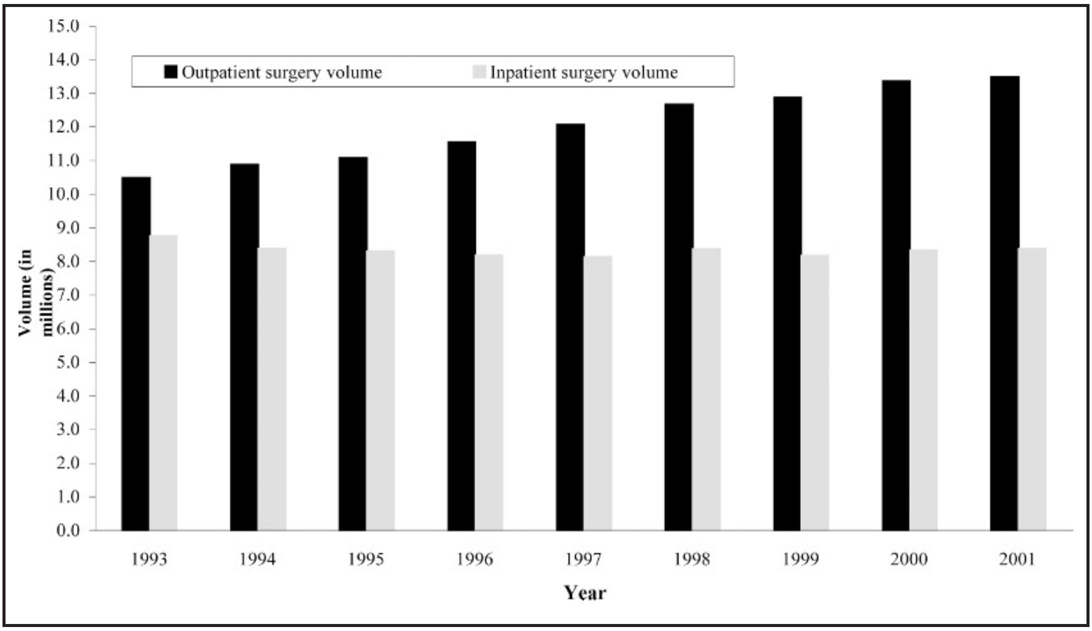

Figure 1. Total hospital surgery volume in 317 MSAs

an additional ASC per 100,000 implies a reduction of more than 1,644 hospital-based outpatient surgeries per MSA per year (or 521,194 among the 317 MSAs studied).

As hypothesized, MSAs with greater hospital concentration had fewer surgeries, both outpatient and inpatient (both $p < .01$). However, these effects were relatively small. On average, the HHI increased from .388 to .449 over the nine-year period of study. This increase of .061 in the HHI was associated with a 1.8% decrease in hospital outpatient surgeries and a 1.3% decrease in inpatient surgeries. Evaluated at the means, these two estimates imply a total reduction of 703 outpatient surgeries and 489 inpatient surgeries for an average MSA.

In contrast, the hypotheses related to HMO penetration were not supported. The estimated coefficients were not statistically significant on HMO penetration, although the parameter estimates did suggest fewer hospital outpatient and inpatient surgeries in the presence of greater penetration. This may reflect the lack of a managed care effect on surgery volumes or may reflect the potential endogeneity of the HMO penetration rate.

Turning briefly to the other variables in the model, the number of specialty surgeons per 10,000 population was associated with more surgeries of all types ($p < .01$). This may reflect surgeon-induced demand, but more likely reflects underlying health status that attracts more surgeons and more surgeries (Escarce 1992). There was no effect of the number of physicians per 10,000 population on surgery volumes. Metropolitan areas with larger populations had higher demands for both outpatient and inpatient surgeries ($p < .01$). The time dummies were consistent with the increasing trend in outpatient surgeries and the declining trend in inpatient surgeries.

Discussion

This study is the first to examine in any nationally representative way the effects of ambulatory surgery centers on hospital surgical volume. It found that, on average, one additional ASC per 100,000 population in a metropolitan area was associated with 4.3% fewer hospital outpatient surgeries each year. ASCs had essentially no effect on hospital inpatient procedures. Greater hospital concentration in an MSA was associated with both fewer outpatient and fewer inpatient surgeries, but these effects were relatively small. Greater HMO penetration was found

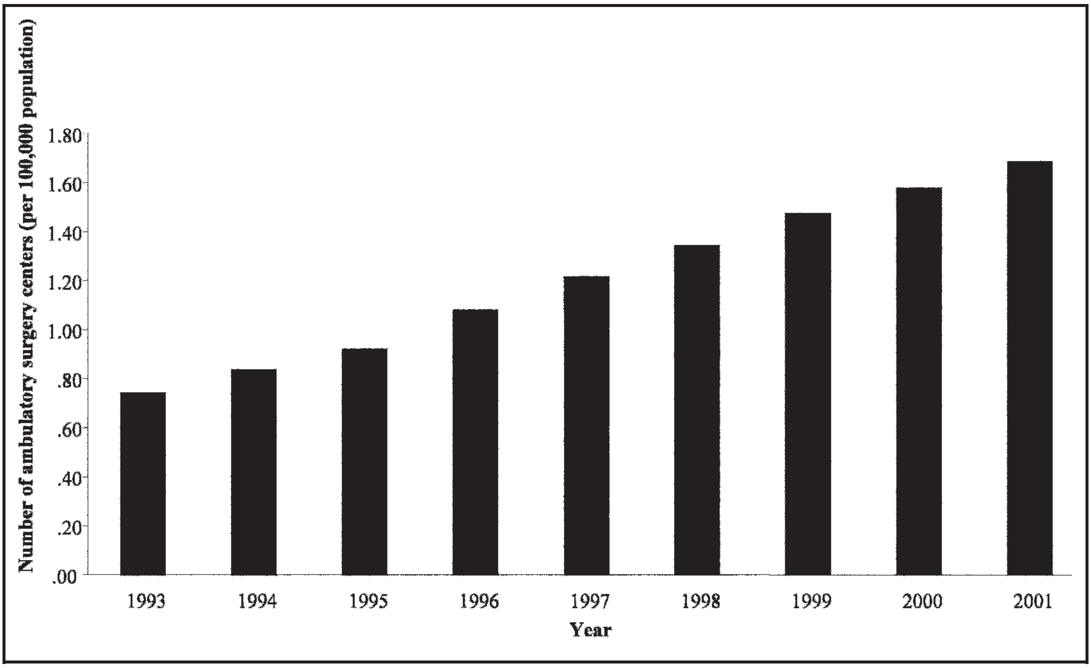

Figure 2. Average number of ambulatory surgery centers per 100,000 population, per MSA

to have little impact on the trend in hospital surgical volume. The strength of these findings lies in the use of the panel data and the fixed-effects model that controls for unobservable time-invariant differences across MSAs and over time.

However, this study has several limitations. First, one would have liked to look directly at the effects of the relative prices of particular types of surgeries in ASCs and in hospital-based facilities for both private sector and Medicare payers. This would have allowed us to draw some direct inference about the extent to which price competition in the private sector has caused hospital outpatient volume to increase less rapidly. In particular, relative price data would permit an analysis of the extent to which the shift in outpatient surgeries to ASCs stems from more generous payment rates set by Medicare. The lack of statistically meaningful coefficients on the share of the population age 65 and older in our models was consistent with MedPAC (2004) data suggesting that Medicare accounts for a relatively small share of ASC business. However, our finding is hardly definitive.

Second, it would have been useful to have information on the specialties and surgical volumes of ASCs. This would have allowed us to examine whether hospitals are particularly affected by, for instance, ASCs devoted to orthopedic procedures relative to ophthalmologic procedures. As it is, without measures of the volume of procedures provided in ASCs, we were able to estimate only the effect of an "average" new facility providing an "average" mix of surgical procedures.

Third, information on the number of ASC-provided surgeries combined with hospital ambulatory surgery data would have allowed us to investigate the effects of the introduction of ASCs on the communitywide surgical volume. This would have let us examine whether ASCs contribute to a renewed medical arms race as Devers, Brewster, and Casalino (2003) have suggested, and/or the extent to which ASCs reflect advances in surgical technique and an expansion of services to new cohorts of patients.

A fourth limitation of our ASC data is that we only knew the opening dates of those ASCs that existed in 2001. Thus, we do not know other ASCs that may have existed and subsequently closed before 2001 (but were operating for some of the years during the nine-year period of the study). Nor do we know of any ASC mergers that may have

Table 2. Effects of ASCs on hospital outpatient and inpatient surgical volume

Dependent variable: log-transformed surgery volume	Outpatient surgery	Inpatient surgery
ASCs per 100,000 population	−4.419*** (1.023)	.068 (.490)
Hospital concentration (HHI)	−.306*** (.083)	−.212*** (.072)
HMO penetration	−.022 (.131)	−.141 (.109)
No. specialty surgeons per 10,000 population	.024*** (.007)	.032*** (.010)
No. nonfederal physicians per 10,000 population	.005 (.004)	.004 (.006)
Per capita income in $10,000s (2001 $)	−.023 (.034)	−.092*** (.030)
Unemployment rate	.361 (.584)	−.470 (.578)
Proportion of population age > 64 years	1.099 (1.677)	1.271 (1.764)
Total population per MSA in 100,000s	.024** (.006)	.036*** (.007)
Year 1994	.033*** (.016)	−.031** (.015)
Year 1995	.068*** (.020)	−.024 (.018)
Year 1996	.120*** (.023)	−.034 (.023)
Year 1997	.183*** (.028)	−.034 (.028)
Year 1998	.227*** (.035)	−.007 (.034)
Year 1999	.249*** (.039)	−.009 (.038)
Year 2000	.279*** (.043)	.006 (.042)
Year 2001	.284*** (.045)	.031 (.043)
Number of observations (MSA-years)	317 × 9 = 2,853	

Note: Standard errors (in parentheses) were adjusted for Huber standard errors correction. MSA = metropolitan statistical area; ASC = ambulatory surgery center; HMO = health maintenance organization; HHI = Herfindahl-Hirschman index.
*Statistical significance at 10%.
**Statistical significance at 5%.
***Statistical significance at 1%.

occurred during the period. This may yield biased parameter estimates. However, while the direction of bias depends on many factors, random measurement error in the number of ASCs in the market tends to bias the coefficient toward zero. On the other hand, if there were significant numbers of ASCs that were missing from our data, that would have over-estimated the actual average impact of ASCs on community hospital surgical volumes.

Finally, there are the usual limitations of using the MSA as a measure of the market, the Herfindahl-Hirschman Index as a measure of competition, and the HMO penetration rate as a managed care penetration rate. While commonly used, the MSA may overstate the size of the relevant market particularly in large urban areas, potentially understating the extent of ASC-hospital competition in some regions of the MSA and overstating it in others. The Herfindahl-Hirschman Index has the advantage of reflecting both the number of hospital providers and the relative dominance of larger facilities. Its disadvantage is that it combines both factors. We re-estimated our models using the number of hospitals in the MSA as a sensitivity analysis. The results were consistent with those presented here. The limitation with the HMO penetration measure is twofold. It fails to include other forms of managed care and it is unable to account for the aggressiveness of the selective contracting that historically has been the comparative advantage enjoyed by managed care organizations.

Nonetheless, this study suggests that ASCs are meaningful competitors to hospitals; markets with more ASCs per unit population had fewer hospital outpatient surgeries. From the perspective of patient empowerment, consumer-directed health plans, and a desire for choices on the part of consumers, this finding can be viewed as good news. It suggests that consumers can find options from which to obtain minor surgical procedures, and that these providers may be able to compete on the basis of price as well as quality and convenience.

The results also can be viewed as consistent with those who see ASCs as focused factories. In a reasonable, competitive ambulatory surgery market, one would expect specialized,

highly efficient providers to draw patients away from other, less efficient providers. The results suggest that ASCs have been able to draw patients from community hospitals. From a related perspective, the findings suggest that those concerned about hospital competition need to consider more formally alternatives to hospitals, at least as they consider ambulatory procedures.

From other perspectives, one may be less sanguine about the findings. If it is the case, as MedPAC (2004) reported, that ASCs receive higher payments than hospitals do for many identical procedures, then these findings may indicate that the locus for minor surgical procedures has shifted for reasons that have nothing to do necessarily with efficiency or competition on a level playing field. The findings may highlight only the inefficiency of the Medicare payment system. Finally, in as much as ASCs are overwhelmingly physician-owned and exempt from Stark I and II federal laws, the apparent shift from hospital-based to free-standing ambulatory surgery may reflect substantial self-referral, with all the attendant controversy about financial self-interest, specialization, and quality of care.

ASCs appear to be significant players in the ambulatory surgery market. As a result, much more effort needs to be expended on obtaining data on ASCs, and on understanding ASCs' effects on prices and quality of surgical care, on private sector and Medicare expenditures, and on local markets for hospital care.

Notes

Earlier versions of this paper were presented at the University of Alabama at Birmingham Lister Hill Center for Health Policy, the 2005 AcademyHealth meetings, and the 2006 ISPOR Asia-Pacific conference. We thank participants, Kathy Swartz, and two anonymous reviewers for useful comments. In addition, we thank Kathleen Dalton for providing access to the free-standing ambulatory surgery center data, and Laurence Baker for access to the HMO data used in this study. Remaining errors are our own.

1 It is worth noting that the data appear to have very few hospital-physician joint ASCs during the period 1993-2001. The 2001 AHA Annual Survey showed that only 44 hospitals in the 317 MSAs reported having an ambulatory surgery joint venture. This is consistent with the MedPAC (2004) data as well.

2 We thank Lawrence Baker for providing the HMO data. These data were derived from Group Health Association of America and InterStudy surveys and were adjusted to distribute an HMO's total enrollment across the counties in which HMOs provided services based upon the county's population (Baker 1997).

3 Table 2 reports the actual coefficient estimates and standard errors. However, discussion of the magnitude of dichotomous variables in the text incorporates the Halvorson-Palmquist correction for logged dependent variables. See Kennedy (2003) for a discussion.

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Does competition from ambulatory surgical centers affect hospital surgical output?

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Courtemanche, C. and Plotzke, M. R. (2010) ―Does Competition from Ambulatory Surgical Centers Affect Hospital Surgical Output?" *Journal of Health Economics*, 29(5), 765-773.

Abstract:
This paper estimates the effect of ambulatory surgical centers (ASCs) on hospital surgical volume using hospital and year fixed effects models with several robustness checks. We show that ASC entry only appears to influence a hospital's outpatient surgical volume if the facilities are within a few miles of each other. Even then, the average reduction in hospital volume is only 2–4%, which is not nearly large enough to offset the new procedures performed by an entering ASC. The effect is, however, stronger for large ASCs and the first ASCs to enter a market. Additionally, we find no evidence that entering ASCs reduce a hospital's inpatient surgical volume.
JEL classification: I11
Keywords: Ambulatory surgical center, Hospital competition, Physician-ownership, Hospital profit

Article:

1. Introduction

Many studies have examined how hospitals compete on price and non-price dimensions (i.e. Zwanziger and Mooney, 2005; Abraham et al., 2007). However, when defining hospital markets, these studies have assumed that hospitals only compete with other hospitals. The impact of ambulatory surgical centers (ASCs), which also provide some services offered by hospitals, on the competitive environment of hospital markets has rarely been considered.

ASCs are small healthcare facilities that predominately offer outpatient surgeries and certain high-tech diagnostic tests. ASCs are typically for-profit facilities located in urban areas (MedPAC, 2005). The number of Medicare certified ASCs has grown from 2,462 in 1997 to 4,700 in 2006, with roughly 1.7% of facilities exiting annually during that time (MedPAC, 2005, 2009). Outpatient surgeries are increasingly performed at ASCs rather than hospitals; in 2006 ASCs provided an estimated 42.8% of all outpatient surgeries in the United States (Cullen et al., 2009). ASCs are appealing to physicians and patients since they offer nicer amenities than hospitals and may cost less than hospitals due to specialization.

ASCs have been criticized, however, for potentially reducing the volume of high revenue services from hospitals' outpatient departments, hindering their ability to subsidize less profitable services such as uncompensated care (Higgins, 2005; Kelly, 2003a,b; Casalino et al., 2003). For example, one hospital administrator claimed that in 2005 only 31% of his hospital's revenue came from outpatient services, compared to 52% 5 years earlier (Feldstein, 2006). The administrator cited a nearby ASC that specialized in orthopedic surgery as a primary reason for the decline.[2] Since physicians who treat patients at an ASC are generally partial owners of that facility, ASCs allegedly ―have an unfair edge in referrals from physicians with a financial interest" (Kelly, 2003a,b). Physician-owners of ASCs may cherry pick by treating their high revenue-low cost patients at facilities they own and their low revenue-high cost patients at hospitals (Abelson, 2004; Gawande, 2009).

We contribute to the debate over ASC-hospital competition by examining the impacts of ASC entry into a hospital's market on the hospital's outpatient and inpatient surgical volume. We estimate hospital and year fixed effects models with a detailed set of hospital- and area-level controls, computing ASC presence in a hospital's market using both fixed and variable radius market definitions. As robustness checks, we estimate models including MSA-by-year effects, hospital-specific time trends, and future ASC presence, as well as instrumental variable models that use lagged ASC presence as an instrument for current ASC presence. We find that an additional ASC in a hospital's market reduces the hospital's annual outpatient surgical volume only if the facilities are very close to each other – less than 4 miles apart – and even then the average reduction is a modest 2–4%. This magnitude is not nearly large enough to offset the additional procedures performed at the typical ASC. The effect is somewhat more substantial, however, if the entering ASC is large or an early entrant: an ASC with three of more operating rooms reduces outpatient volume by about 7%, while the first ASC in a market reduces outpatient volume by 5–6%. We find no evidence that ASC entry lowers a hospital's inpatient surgical volume.

The rest of this paper proceeds as follows. Section 2 discusses the relevant literature, while Section 3 describes the data. In Section 4, we attempt to determine the approximate size of the market in which ASCs and hospitals compete. Using these results to guide our choice of market definitions, in Section 5 we estimate the average effect of ASCs in a hospital's market on the hospital's outpatient and inpatient surgical volume. In Section 6, we test for heterogeneity in the effect on the basis of the size of the ASCs and the number of pre-existing ASCs in the market. Section 7 concludes.

2. Literature review

To date, few authors have examined the effect of ASCs on hospital output. Lynk and Longley (2002) present two case studies where the entry of ASCs into rural hospitals' markets led the hospitals to perform dramatically fewer outpatient surgeries. Bian and Morrisey (2007) extend this type of research to a national sample. Using MSA-level panel data from 1993 to 2001, they find an additional ASC per 100,000 individuals is associated with a 4.3% decrease in hospital outpatient surgeries but no statistically significant change in hospital inpatient surgeries. Their model includes MSA and year fixed effects as well as controls for hospital concentration, HMO penetration, number of specialty surgeons, number of non-federal physicians, per capita income, unemployment rate, total population, and the proportion of the population age 65 years or older.

Our paper builds on the analysis of Bian and Morrisey in three ways. First, we directly examine how ASC presence in a hospital's market affects that hospital's output. It is not clear how Bian and Morrisey's estimated MSA-level associations could measure that relationship, as the typical market in which ASCs and hospitals compete is likely much smaller than an entire MSA. Also, defining markets using MSA borders may misclassify the markets of hospitals located close to a border. We conduct a hospital-level instead of MSA-level analysis, defining hospital markets using both fixed and variable radius techniques that approximate the size of a typical market.

Second, we perform numerous robustness checks to investigate omitted variable bias and reverse causality. Omitted variable bias is a potential concern in Bian and Morrisey's model, as an increase in demand for outpatient services over time not captured by the control variables could lead to both ASC entry and an increase in hospital outpatient surgical volume. Reverse causality is also possible, as an increase in the number of outpatient surgeries performed by a hospital may encourage the entry of ASCs.

Third, we test for heterogeneity in the effect of ASC entry on hospital outpatient surgical volume based on ASC size and the number of ASCs already in the market. Large ASCs serve more patients than small ASCs and therefore likely cause more substantial reductions in hospital volume. The effect of the first ASC to enter a market may be stronger than the effect of an additional ASC once the market is saturated, at which point ASCs compete with other ASCs in addition to hospitals.

Researchers have also examined other aspects of ASCs besides their effect on hospital volume. Wynn et al. (2004) found that older and unhealthier patients (who are more costly to treat) are more likely to be treated at a hospital than at an ASC. Winter (2003) shows the average risk score (a measure of the cost of treating a patient based on factors such as age and comorbidities) of patients is higher at hospital outpatient departments than at ASCs. Gabel et al. (2008) show that physicians are more likely to treat well-insured patients at their ASC and send Medicaid patients to hospitals. Plotzke and Courtemanche (forthcoming) analyze a sample of Medicare patients and find that a 10% increase in a patient's profitability is associated with a 1–2 percentage point increase in the probability that the patient is treated at an ASC instead of a hospital. They find, however, that profitability is only one of many factors that affect surgery location decisions, with patient health and procedure complexity being potentially more important.[3] Most recently, Hollingsworth et al. (2010) used Florida data to show that physicians with an ownership stake in an ASC performed significantly more surgeries than other physicians. The authors pointed to financial incentives as a possible explanation.

3. Data

Our empirical analysis utilizes data from two main sources. First, we use the Centers for Medicare & Medicaid Services (CMS), Provider of Services (POS) files from 1999 to 2004 for information on every ASC in the U.S. certified to treat Medicare patients.[4] We obtain the entry date, geographic location, and services offered by ASCs from the POS files, allowing us to compute the number of ASCs in any given area in all years up to 2004.[5] We determine the latitudes and longitudes for the ASCs by using their street address and geocoding software from www.geocode.com.

Next, we use the 1997 through 2004 AHA annual surveys for information on a hospital's geographic location, ownership, teaching status, facility size, services offered, staffing arrangements, and number of outpatient and inpatient surgeries performed. The AHA survey includes the latitude and longitude of most hospitals, and we compute any missing information using the geocoding software. We then compute the distance between every pair of healthcare facilities in the sample using the ―great circle" distance formula. To minimize differences between urban and rural hospital markets, we only examine hospitals located in urban areas.

We next match the hospitals in the sample to each of the ASCs in their markets. Several different market definitions have been used in the hospital competition literature.[6] The easiest approach is to define markets according to geopolitical boundaries, such as Metropolitan Statistical Areas (MSAs) or counties. However, this likely leads to markets that are too small or too large, while also inaccurately describing the markets of hospitals located near a border. Another possibility is to define market boundaries using a fixed radius. This method assigns the same fixed radius to all hospitals in the sample and assumes that the radius around each hospital represents the hospital's market. This definition may also provide an inaccurate description of the market since different hospitals have different market sizes. Gresenz et al. (2004) accounted for this problem by constructing a variable radius measure for hospital markets. The authors calculate the actual radii from which hospitals in nine states admit 75% of their inpatients and also the radii from which those hospitals admit 90% of their inpatients. They then calculate the predicted radii for the remaining hospitals in the 1997 AHA survey.[7]

We utilize both the variable and fixed radius approaches. We begin with the 75% variable radius market definition of Gresenz et al. (2004). Since the average 75% variable radius in our sample is 11.5 miles, we also use an 11.5 mile fixed radius to examine the robustness of our results.[8] After creating these markets, we split them into thirds to examine how the effects of ASCs differ by their distance from a hospital. It is possible that inpatient market sizes may be too large for outpatient surgeries, or that ASC versus hospital competition occurs in a smaller area than hospital versus hospital competition. Using the 75% variable radius definition, we determine the number of ASCs within the first, second, and third thirds of that radius. For instance, if a hospital admits 75% of its inpatients within 15 miles of the hospital, we compute the number of ASCs that are less than 5 miles, between 5 and 10 miles, and between 10 and 15 miles away from that hospital. With the 11.5 miles fixed radius definition, we compute the number of ASCs that are less than 3.83 miles away from a hospital, between 3.83 and 7.67 miles away, and between 7.67 and 11.5 miles away.

Table 1
Summary statistics: sample means and standard deviations (in parentheses).

	Variable radius	Fixed radius
Annual number of outpatient surgeries [Hospital]	5623.108	5634.279
	(5172.217)	(5149.231)
Annual number of inpatient surgeries [Hospital]	3609.085	3631.386
	(3511.217)	(3527.543)
Number of ASCs within 1/3 of the radius [Market]	2.164	2.225
	(3.556)	(3.195)
Number of ASCs between 1/3 and 2/3 of the radius [Market]	1.939	2.541
	(4.587)	(4.697)
Number of ASCs beyond 2/3 of the radius [Market]	1.989	3.137
	(4.484)	(5.795)
Small hospital [Hospital]	0.168	0.171
	(0.374)	(0.377)
Private hospital [Hospital]	0.148	0.154
	(0.356)	(0.361)
Public hospital [Hospital]	0.131	0.129
	(0.338)	(0.335)
Teaching hospital [Hospital]	0.203	0.205
	(0.402)	(0.403)
Separate location for outpatient surgery [Hospital]	0.375	0.374
	(0.484)	(0.484)
Number of operating rooms [Hospital]	10.761	10.811
	(8.867)	(8.900)
Full time physicians and dentists [Hospital]	21.950	22.031
	(85.327)	(85.682)
Herfindahl Hirschman Index [Market]	0.464	0.385
	(0.329)	(0.313)
Number of hospitals [Market]	9.123	11.872
	(13.461)	(14.555)
Total population over 65 (100,000) [County]	1.134	1.131
	(1.849)	(1.839)
Total population (100,000) [County]	10.154	10.145
	(18.130)	(18.057)
Percentage without health insurance [County]	13.722	13.741
	(4.401)	(4.407)
Unemployment rate [County]	4.925	4.939
	(1.826)	(1.820)
Percentage living in poverty [County]	11.951	11.970
	(4.579)	(4.582)
Log of median income [County]	10.654	10.655
	(0.215)	(0.215)

Table 2
Estimated Effects on ln(outpatient surgeries).

	Variable radius	Fixed radius
Number of ASCs within 1/3 of the radius	**−0.031**	**−0.027**
	(0.006)* **	**(0.006)*** **
Number of ASCs between 1/3 and 2/3 of the radius	0.001	−0.005
	(0.005)	(0.005)
Number of ASCs beyond 2/3 of the radius	−0.008	0.006
	(0.006)	(0.004)
Small hospital	−0.062	−0.064
	(0.036)	(0.036)
Private hospital	0.054	0.054
	(0.046)	(0.046)
Public hospital	0.008	0.005
	(0.059)	(0.061)
Teaching hospital	0.045	0.040
	(0.024)	(0.024)
Separate location for outpatient surgery	−0.002	−0.002
	(0.013)	(0.013)
Number of operating Rooms	**0.016**	**0.015**
	(0.002)* **	**(0.002)*** **
Full time physicians and dentists	−0.00008	−0.00002
	(0.00012)	(0.00010)
Herfindahl Hirschman Index	−0.057	0.029
	(0.079)	(0.076)
Number of hospitals	**−0.008**	−0.001
	**(0.004)* **	(0.003)
Total population over 65 (100,000)	0.227	0.209
	(0.263)	(0.267)
Total population over 65 (100,000) squared	−0.017	−0.004
	(0.027)	(0.027)
Total population (100,000)	−0.003	−0.002
	(0.026)	(0.027)
Total population (100,000) squared	0.0001	0.0001
	(0.0003)	(0.0003)
Percentage without health insurance	0.028	0.047
	(0.033)	(0.032)
Unemployment rate	**0.025**	**0.025**
	(0.007)* **	**(0.007)*** **
Percentage living in poverty	−0.004	−0.005
	(0.006)	(0.006)
Log of median income	0.189	0.186
	(0.191)	(0.197)
Observations	13322	13405
R^2	0.921	0.921

Standard errors in parentheses are heteroskedasticity-robust and clustered at the hospital-level.
Hospital and year fixed effects are included in all regressions.
* Indicates significant at the 5% level.
** Indicates significant at the 1% level.
*** Indicates significant at the 0.1% level.

We utilize a wide range of hospital-level, market-level, and county-level variables as controls. Our hospital-level controls include the number of operating rooms and full time physicians as well as dummy variables for whether the hospital is small (has less than 100 beds); is non-profit, for-profit, or public; is a teaching hospital (as defined by having at least 20 residents); and has an additional facility (besides the main hospital) where it provides outpatient surgery. Our market-level variables are the total number of hospitals and the Herfindahl Hirschman Index (HHI).[9] Our county-level controls consist of demographic characteristics (total population and the population that is age 65 or older) from the Area Resource Files produced by Quality Resource Systems Inc., economic characteristics (unemployment rate, percentage living in poverty, and log of median income) from the Bureau of Labor Statistics, and the percentage of people without health insurance from the U.S. Census Bureau.[10]

Table 1 reports the variables' summary statistics using both the 75% variable radius and 11.5 mile fixed radius market definitions. In brackets, we report whether a variable is hospital-level, market-level, or county-level. The fixed radius sample consists of 13,405 observations from 2349 hospitals, while the variable radius sample consists of 13,322 observations from 2243 hospitals.[11] The average hospital performs approximately 5600 outpatient and 3600 inpatient surgeries per year. Using the variable radius, the average hospital's market contains 6.1 ASCs: 2.2 in the closest third of the radius, 1.9 in the middle third, and 2.0 in the farthest third.

Using the fixed radius, 7.8 ASCs are in the average hospital's market: 2.2 less than 3.83 miles away, 2.5 between 3.83 and 7.67 miles away, and 3.1 between 7.67 and 11.5 miles away.

4. Market size

We begin the empirical analysis by attempting to determine the approximate size of the market in which hospitals and ASCs compete. We regress the natural log of hospital outpatient surgeries (ln(OS)) on the number of ASCs in the first third (ASC1), second third (ASC2), and third third (ASC3) of the market, as well as the set of controls (Controls) and hospital and year fixed effects (α and ω).[12] In unreported regressions, we find that splitting the market radius into more than three pieces does not reveal additional information, and also that the results are similar using the total number of ASC operating rooms in the market instead of the number of ASCs. The regression equation is

$$[\ln(OS)_{it}] = \beta_0 + \beta_1 ASC1_{it} + \beta_2 ASC2_{it} + \beta_3 ASC3_{it} + \beta_4 \, Controls_{it} + \alpha_i + \omega_t + \varepsilon_{it} \quad (1)$$

where subscripts *i* and *t* indicate hospital and year. We take the log of surgeries following Bian and Morrisey (2007); this gives the coefficients an approximate percentage interpretation.[13] Controls includes the set of control variables described in Section 3, plus the squares of population and population 65 and over. We estimate (1) using both the 75% variable radius and the 11.5 miles fixed radius market definitions. Since 11.5 miles is the average of the 75% variable radii for the hospitals in the sample, the coefficient estimates for the market-level variables in the two regressions are somewhat comparable. We compute heteroskedasticity-robust standard errors corrected for clustering at the hospital-level.

Table 2 reports the results. In both regressions, an increase in the number of ASCs within 1/3 of the radius is associated with a statistically significant but modest reduction in hospital outpatient volume. An additional ASC within 1/3 of the 75% radius reduces the hospital's outpatient surgeries by approximately 3.1 %, while an additional ASC within 3.83 miles reduces the hospital's outpatient surgeries by 2.7%. However, we find no evidence in either regression of an association between ASCs in the second and third thirds of the market and hospital output even though the coefficients are precisely estimated.

When examining ASC versus hospital competition, the appropriate market size therefore appears to be small relative to the market sizes typically used when studying competition in a hospital's inpatient market (e.g. Rogowski et al., 2007; Dafny, 2005). Outpatient surgeries are generally simpler than inpatient surgeries, so patients may not need to travel as far to receive adequate care. Given the results from this section, in Sections 5 and 6 we define markets using 1/3 of the 75% variable radius and a 3.83 miles fixed radius.

Only two of the control variables – number of operating rooms and unemployment rate – are significant in both regressions, while number of hospitals in the market is also significant in the variable radius regression. We suspect that the other controls are not significant in these fixed effects models because of a lack of variation in these variables over time during our sample period. Fortunately, there is ample variation over time in the number of ASCs (MedPAC, 2005). The independent variables together explain over 90% of the variation in outpatient surgeries, largely due to the explanatory power of the hospital and year fixed effects.

5. Average effects

5.1. Models

Defining markets using both 1/3 of the 75% variable radius and a 3.83 miles fixed radius, we next estimate the average effects of additional ASCs in a hospital's market on the hospital's outpatient and inpatient surgical volume. While it is less likely that ASC entry would affect inpatient volume than outpatient volume, a connection is possible. Hospitals that lose outpatient surgeries to an ASC may use excess capacity to treat more inpatients. Alternatively, an entering ASC may treat some patients on an outpatient basis who previously would have been treated on an inpatient basis at a hospital.

Our baseline regression equation is

$$Y_{it} = \beta_0 + \beta_1 \text{ASC1}_{it} + \beta_2 \text{Controls}_{it} + \alpha_i + \omega_t + \varepsilon_{it} \quad (2)$$

where Y is either ln(outpatient surgeries) or ln(inpatient surgeries). We also estimate the model without controls in order to assess the sensitivity of $\hat{\beta}_1$ to their inclusion.

The fixed effects estimator is unbiased if there are no unobserved variables that change over time that are correlated with the error term during any time period. That is, the error term must be strictly exogenous. With respect to $\hat{\beta}_1$, our controls should capture some of the potential sources of omitted variable bias, such as age and income. As discussed in Section 2, however, potential endogeneity concerns remain. The controls may not capture all time-varying factors that affect demand for healthcare services, and changes in demand could determine both ASC entry and changes in hospital output. Reverse causality is also possible, as physicians may observe an increase in a hospital's outpatient surgical volume and decide to open an ASC. We conduct a number of robustness checks to examine these concerns.

First, we add MSA-by-year effects to the model by interacting each of the year fixed effects with each of a set of MSA fixed effects. The inclusion of MSA-by-year effects restricts identification of the parameters of interest to variation between hospitals in the same MSA over time.[14] To illustrate, suppose an ASC opens in the markets of two hospitals in the Boston MSA but not in the markets of the other hospitals in the MSA. If demand for healthcare services has been growing faster in the Boston MSA than in other parts of the country, the baseline fixed effects estimator may be biased upward, and adding MSA-by-year effects would eliminate this bias.

We next replace the MSA-by-year effects with hospital-specific linear time trends, created by interacting year with each of the hospital fixed effects.[15] Controlling for unobservable time-variant MSA characteristics may not remove all sources of bias, as there is heterogeneity within MSAs. For instance, some areas of an MSA are wealthier than others, which may impact hospital outpatient surgical volume as well as ASC entry patterns. If secular trends in demand or other unobservable characteristics of a hospital or its market are biasing the baseline fixed effects estimator, including hospital trends will affect the results. A limitation of this approach is that changes over time in the unobservable variables are assumed to be linear; including hospital trends may not impact the results if changes in the sources of omitted variable bias are sufficiently non-linear.

While including MSA-by-year effects or hospital trends can reduce or eliminate omitted variable bias, they do not solve the problem of reverse causality. We therefore next estimate (2) including as an additional regressor the number of ASCs in the market at the end of the following year. If the lead of the number of ASCs is correlated with the dependent variable conditional on the current number of ASCs, this would provide evidence of reverse causality.

We next estimate instrumental variable models using lagged ASC presence as an instrument for current ASC presence. If reverse causality is a problem, using lagged number of ASCs as an instrument for current number of ASCs should impact the results. We estimate two-stage least-squares fixed effects models of the following form:

$$\text{ASC1}_{it} = \gamma_0 + \gamma_1 \text{ASC1}_{i,t-j} + \gamma_2 \text{Controls}_{it} + \mu_i + \sigma_t + \varepsilon_{it} \quad (3)$$

$$Y_{it} = \beta_0 + \beta_1 \overline{\text{ASC1}}_{it} + \beta_2 \text{Controls}_{it} + \alpha_i + \omega_t + \varepsilon_{it} \quad (4)$$

where u_i and σ_t are the first-stage hospital and year effects, ε_{it} is the first-stage error term, j is the number of years before the cur-rent year (j = 1, 2,. .., 10), and the other terms are defined as in (2).[16] We present the results when j = 1 and j = 10; results using the lag lengths in between these are similar. The identifying assumption in the model is that, conditional on the controls, lagged ASC presence is only correlated with hospital output and profit through its effect on contemporaneous ASC presence. This assumption would be violated (for at least some of the shorter lag lengths) if the effects of ASC entry are gradual or temporary. To test the validity of the

exclusion restriction, we estimated the baseline model (2) including up to five annual lags of the number of ASCs in addition to the number of contemporaneous ASCs. The lags in all cases were highly insignificant, suggesting that the effects of ASCs occur relatively quickly.[17]

5.2. Results

Tables 3 and 4 report the results for outpatient and inpatient surgeries. Panel A of each table uses 1/3 of the 75% variable radius, while Panel B uses the 3.83 miles fixed radius. The first column reports the results from the regression excluding the controls, while the second column displays the results from the baseline model in Eq. (2), which includes the controls. The third column adds the MSA-by-year effects and the fourth replaces the MSA-by-year effects with the hospital trends. The fifth column reports the estimates from the baseline model, but including the lead of the number of ASCs. The sixth and seventh columns use number of ASCs in *t*-1 and *t*-10, respectively, as instruments for current number of ASCs. The first and second rows of each panel report the coefficient estimates and standard errors for the number of ASCs and, when applicable, the lead of ASCs. For the instrumental variable models, the third row reports the F-statistic from the test of the null hypothesis that the instrument does not belong in the first-stage model.

Table 3
Estimated Effect of ASCs on ln(Outpatient Surgeries).

		No controls	Baseline	MSA-by-year	Hospital trends	Lead of ASCs	IV: ASCs in *t-1*	IV: ASCs in *t-10*
Panel A: variable radius	Number of ASCs	**−0.029** (0.006)***	**−0.032** (0.006)***	**−0.023** (0.007)***	**−0.029** (0.007)***	**−0.038** (0.008)***	**−0.035** (0.006)***	**−0.024** (0.010)*
	Lead of number of ASCs	–	–	–	–	0.006 (0.008)	–	–
	First-stage *F*-statistic	–	–	–	–	–	2998.87	156.51
Panel B: fixed radius	Number of ASCs	**−0.028** (0.006)***	**−0.027** (0.006)***	**−0.022** (0.008)**	**−0.022** (0.008)**	**−0.031** (0.009)***	**−0.026** (0.006)***	**−0.028** (0.012)*
	Lead of number of ASCs	–	–	–	–	0.005 (0.009)	–	–
	First-stage *F*-statistic	–	–	–	–	–	3197.71	119.09

Standard errors in parentheses are heteroskedasticity-robust and clustered at the hospital-level.
Hospital and year fixed effects and the controls from Table 3 are included in all regressions.
*** Indicates significant at the 0.1% level.
** Indicates significant at the 1% level.
* Indicates significant at the 5% level.

Table 3 shows that ASC entry is associated with a reduction in hospital outpatient surgical volume. In the baseline regression, an additional ASC reduces outpatient volume by approximately 3.2% using the variable radius and 2.7% using the fixed radius. Results are similar excluding the controls; adding MSA-by-year effects, hospital trends, or the lead of ASCs; and using short or long lags of ASC presence as an instrument for current ASC presence. Number of ASCs is significant in all 14 regressions, and the estimated effects range from 2.2% to 3.8%. We find no evidence of omitted variable bias or reverse causality, as none of the estimates from the robustness checks are statistically distinguishable from the base-line estimates, and the lead of ASCs is highly insignificant.

Table 4
Estimated effect of ASCs on ln(inpatient surgeries).

		No controls	Baseline	MSA-by-year	Hospital trends	Lead of ASCs	IV: ASCs in *t-1*	IV: ASCs in *t-10*
Panel A: variable radius	Number of ASCs	0.004 (0.003)	0.003 (0.003)	0.001 (0.005)	−0.001 (0.005)	0.002 (0.005)	0.003 (0.004)	−0.010 (0.007)
	Lead of number of ASCs	–	–	–	–	0.001 (0.006)	–	–
	First-stage *F*-statistic	–	–	–	–	–	2998.87	156.51
Panel B: fixed radius	Number of ASCs	0.005 (0.004)	0.006 (0.004)	0.008 (0.005)	0.004 (0.006)	−0.001 (0.006)	0.004 (0.005)	−0.016 (0.010)
	Lead of number of ASCs	–	–	–	–	0.008 (0.007)	–	–
	First-stage *F*-statistic	–	–	–	–	–	3197.71	119.09

See notes for Table 4.

Table 4 presents the results for inpatient volume. Number of ASCs is not statistically significant in any of the 14 regressions, even though the coefficients are precisely estimated. We again find no evidence that the baseline fixed effects estimator suffers from omitted variable bias or reverse causality, as the estimated effects in columns (3)–(7) are statistically indistinguishable from those in column (2), and the lead of ASCs in column (5) is statistically insignificant. The finding that ASC entry has no effect on a hospital's inpatient surgical volume is not surprising given that ASCs provide only outpatient surgeries.

In all, an additional ASC is associated with a 2–4% reduction in the average hospital's outpatient surgical volume but no statistically or economically significant change in inpatient volume. While this effect is non-trivial, it is not large enough to suggest that competition from ASCs poses a serious threat to the viability of the typical hospital. To illustrate, our baseline estimates imply that a 10% increase in the number of ASCs in a hospital's market at the sample mean (2.164 ASCs using the variable radius, 2.225 using the fixed radius) would reduce a hospital's outpatient volume by just 0.6–0.7%, and that the existence of ASCs has caused hospital outpatient volume to be just 6–7% lower than it would have been otherwise. These effects are economically meaningful but less severe than one might suspect given the anecdotes discussed in Section 1. For instance, recall the hospital whose share of revenues coming from outpatient procedures fell from 52% to 31% after the entry of a nearby ASC (Feldstein, 2006). If revenues from other sources were constant, then outpatient revenues must have fallen by 40% – an order of magnitude greater than the effect estimated in this paper. The impact on this hospital was therefore either an exceptional case or due largely to other factors besides the entry of the ASC.

We can also use these calculations to relate our estimates to those of Bian and Morrisey (2007). Bian and Morrisey's estimated impact is 4.3% and their sample mean for ASCs per 100,000 residents is 1.208, implying that the existence of ASCs has caused hospital volume to be 5.2% less than it would have been otherwise. This is slightly less than but similar to our estimates of 6–7% from the preceding paragraph. We caution against a direct comparison since the two papers estimate different parameters: Bian and Morrisey estimate the impact of ASCs per 100,000 residents in an MSA on outpatient surgeries performed by all hospitals in the MSA while we estimate the impact of the number of ASCs in a hospital's market on outpatient surgeries performed by that hospital. That said, the two papers appear to be in agreement about the order of magnitude of the aggregate effect. Our results, though, emphasize that ASC entry in an MSA will have very different effects on the hospitals in that MSA depending on their distance from the new ASC.

5.3. Does the decrease in hospital volume offset the increase in ASC volume?

Given our results, an important question is whether the loss in hospital volume fully offsets the increase in ASC volume. The offset is likely somewhat less than one-to-one, as some procedures performed at a new ASC would otherwise be performed in physician offices or other ASCs as opposed to hospitals. However, if the offset is substantially less than one-to-one, this would provide indirect evidence that ASC entry increases a market's overall outpatient surgery volume. Such an increase in overall market volume could occur for three distinct reasons. First, ASCs provide greater convenience, comfort, and ease of scheduling than hospitals, which could increase the volume of surgeries on the margin in a welfare-enhancing way. Next, the opportunity to earn additional income from the facility fee could lead physician-owners of ASCs to induce demand, consistent with Hollingsworth et al.'s (2010) finding that ASC ownership leads physicians to perform more surgeries.[18] Finally, HOPDs faced with declining profits may induce demand to recoup some of the losses.[19]

Unfortunately, we are unable to directly estimate the relationship between a market's ASC volume and a market's hospital outpatient volume because our data do not include the number of surgeries performed by each ASC. We therefore calculate an approximation of this relationship using the following formula. We define OFFSET as the proportion of an entering ASC's outpatient volume lost by hospitals, $dY_H/dASC$ as the marginal effect of the number of ASCs in the market on the number of outpatient surgeries performed annually by the average hospital in the market, Y_{ASC} as the number of surgeries performed at the average ASC, and M as the number of hospitals' markets in which the average ASC is located. Therefore,

$$OFFSET = \frac{dY_H/\,dASC * M}{Y_{ASC}} \qquad (5)$$

We estimate $dY_H/dASC$ using regression equation (2) with the variable radius market definition and the level instead of the log of hospital surgeries as the dependent variable, obtaining the coefficient estimate −134 (standard error 47).[20] As sensitivity analyses, we also utilize as alternative values for $dY_H/dASC$ this point estimate plus or minus one or two standard errors (−40, −87, −181, and −228). We use three values for M: the

number of hospitals' markets in which the average ASC in our sample is located in all years (5.5), in the year in which this number was the lowest (5.1 in 2004), and in the year in which it was the highest (5.9 in 1997).

Since our data do not contain information on the number of surgeries performed by ASCs, we calibrate Y_{ASC} as follows. We are not aware of any national estimates of the number of surgeries performed by the average ASC, but during 2002 ASCs in Indiana and Pennsylvania performed an average of 3494 and 3953 surgeries, respectively (Indiana State Department of Health, 2003; Pennsylvania Health Care Cost Containment Council, 2003). We also develop our own national estimate by dividing the number of surgeries performed at ASCs in the U.S. in 2006 (14.9 million; Cullen et al., 2009) by the number of ASCs in the U.S. in 2006 (4700; MedPAC, 2009), obtaining 3170. We set Y_{ASC} equal to each of the values 3494, 3953, and 3170.

Together, there are 45 possible parameter combinations. We report the results for each combination in Appendix Table 1. *OFFSET* ranges from 0.052 to 0.424, with a median of 0.211, mean of 0.210, and standard deviation of 0.108. Importantly, *OFFSET* is well below 1 even using the most extreme parameter values. For no combination of parameters do we find that the loss in hospital volume offsets even half of ASC volume. It therefore appears that only a portion of ASC surgical volume comes from hospitals. The remaining portion comes from surgeries previously performed in other outpatient settings or not performed at all. Future research should explicitly measure the increase in a market's surgical volume following ASC entry and also examine the extent to which the increase reflects welfare-enhancing procedures as opposed to ASC or hospital inducement.

6. Heterogeneity

Even if the average effect of ASC entry on a hospital's outpatient volume is modest, as suggested in Section 5, the possibility remains that the effect is more substantial for certain types of ASCs in certain types of markets. In this section, we explore potential heterogeneity in the effect based on the size of the ASC and the number of ASCs already in the market.

Table 5
Estimated effects of ASCs with 1, 2, and 3 or more operating rooms on ln(output surgeries).

	Variable radius	Fixed radius
Number of ASCs with 1 operating room	−0.002	−0.005
	(0.009)	(0.008)
Number of ASCs with 2 operating rooms	**−0.034**	−0.017
	(0.010)***	(0.010)
Number of ASCs With 3 or more operating rooms	**−0.066**	**−0.073**
	(0.009)***	**(0.011)*****

See notes for Table 4.

First, we estimate a model that includes three independent variables of interest: the number of "small" ASCs (one operating room), the number of "medium-sized" ASCs (two operating rooms), and the number of "large" ASCs (three or more operating rooms). We choose these divisions because approximately one-third of the ASCs in our sample fall into each of the three categories. The regression equation is

$$\ln(OS_{it}) = \beta_0 + \beta_1 \, ASC1S_{it} + \beta_2 ASC1M_{it} + \beta_3 ASC1L_{it} + \beta_4 Controls_{it} + \alpha_i + \omega_t + \varepsilon_{it} \quad (6)$$

where ASC1*S* is the number of small ASCs in the first third of the 75% variable or 11.5 miles fixed radius markets, ASC1*M* is the number of medium-sized ASCs, and ASC1*L* is the number of large ASCs.

Table 5 reports the results. In both the variable and fixed radius regressions, small ASCs have essentially no effect on outpatient volume. The effect of medium-sized ASCs is significant using the variable radius but not the fixed radius market definition. The magnitude of the effect is modest in both regressions, as an additional medium-sized ASC reduces hospital outpatient volume by about 3% using the variable radius and about 2% using the fixed radius. The effect of large ASCs is more substantial: an additional large ASC reduces hospital outpatient volume by a statistically significant 7% in both regressions. Therefore, while the average effect of

ASCs appears to be modest, large ASCs have an effect that is considerably stronger than the average. Nonetheless, even the impact of large ASCs is not as devastating as the anecdotal evidence might suggest.

We next examine whether the first ASCs to enter a market have a different effect on outpatient volume than later entrants. Later entrants may have a weaker effect because they compete not only with hospitals for patients but also with the other ASCs. We estimate a model that includes as variables of interest both the number of ASCs in the market and the square of the number of ASCs.21 This allows their marginal effect to change across the distribution. Our regression equation is

$$\ln(OS_{it}) = \beta_0 + \beta_1 ASC1_{it} + \beta_1 ASC1_{it}^2 + \beta_4 Controls_{it} + \alpha_i + \omega_t + \varepsilon_{it} \quad (7)$$

In Figs. 1 and 2, we plot the marginal effect of ASCs on the log of hospital outpatient output for up to the 99th percentile of the ASC1 distribution in the sample. The coefficient estimates are reported at the bottom of the figures. Fig. 1 defines markets using 1/3 of the 75% variable radius; the 99th percentile is 18 ASCs. The first ASC in the market reduces hospital outpatient volume by about 6%. The marginal effect gradually decreases across the distribution, eventually reaching about 2% by the 17th ASC. Fig. 1 uses the 3.83 miles fixed radius market definition; the 99th percentile is 14 ASCs. The first ASC reduces volume by about 5%, and the marginal effect again gradually decreases across the distribution, eventually reaching about 2%. The evidence therefore suggests that if an ASC enters a market with no pre-existing ASCs, its effect on a hospital's outpatient output is likely to be stronger than the average effect reported in Section 5, but still not strong enough to pose a serious threat to hospital viability.

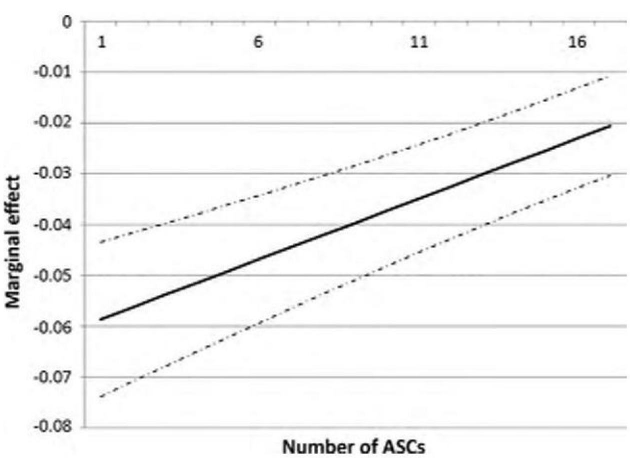

Fig. 1. Marginal effect of additional ASCs on ln(outpatient surgeries) – variable radius. Dashed lines represent 95% confidence intervals. Coefficient estimates and standard errors (in parentheses) for ASC variables: ASCs −0.061 (0.008); ASCs^2 0.0012 (0.0002).

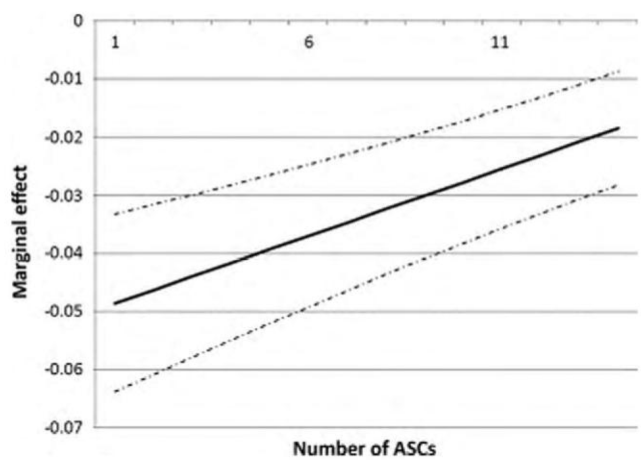

Fig. 2. Marginal effect of additional ASCs on ln(outpatient surgeries) – fixed radius. Dashed lines represent 95% confidence intervals. Coefficient estimates and standard errors (in parentheses) for ASC variables: ASCs −0.050 (0.008); ASCs^2 0.0012 (0.0002).

In unreported regressions, we also combined the two tests for heterogeneity in this section by estimating models including the number of small, medium, and large ASCs as well as their squares. These results indicate that if the first ASC in a market also happens to be large, the decline in hospital outpatient volume is about 9%.

7. Conclusion

This paper estimates the impact of ASC entry in a hospital's market on the hospital's outpatient and inpatient surgical volume. We begin by showing that ASC entry only appears to affect a hospital's outpatient surgical volume if the ASC is within 1/3 of the distance from which hospitals admit 75% of their patients, which is on average less than four miles. Even then, the average reduction in volume is a modest 2-4%, which implies that hospitals' lost volume accounts for only a fraction of the procedures performed at the typical ASC. The effect, however, is stronger if the entering ASC has three or more operating rooms or is an early entrant into the market. The estimated effect on inpatient volume is small and statistically insignificant. In all, the evidence suggests that the effect of ASCs on the productivity of hospitals is in most cases non-trivial but far from

devastating. It seems unlikely that the estimated effects would lead to substantial reductions in the provision of uncompensated care, although future research should test this hypothesis more directly.

An understanding of the net effect of ASCs on social welfare is needed to evaluate the appropriateness of policies that govern ASCs, such as CON laws. ASCs lead to welfare gains for the physicians who profit from them, the patients for whom surgeries are more convenient, and the insurance companies for whom surgeries are potentially cheaper. However, ASCs may lead to welfare losses for hospitals, which in turn may lead to welfare losses for low-income patients for whom charity care is no longer available. Effects on outcomes and utilization should also be considered. ASCs could improve outcomes because of their specialization, or worsen outcomes because of limited treatment capability if complications arise. They could also increase the quantity of outpatient surgeries performed in ways that are either welfare-enhancing or wasteful. Further research is needed to fully understand the complex and multi-faceted effect of ASCs on social welfare.

Appendix A.

Table A1
Estimates for percentage of surgeries ASCs perform that were previously performed at hospitals (*OFFSET*).

$dY_H/dASC$	*M*	Y_{ASC}	*OFFSET*
−134	5.5	3494	0.211
−134	5.5	3953	0.186
−134	5.5	3170	0.232
−134	5.1	3494	0.196
−134	5.1	3953	0.173
−134	5.1	3170	0.216
−134	5.9	3494	0.226
−134	5.9	3953	0.200
−134	5.9	3170	0.249
−40	5.5	3494	0.063
−40	5.5	3953	0.056
−40	5.5	3170	0.069
−40	5.1	3494	0.058
−40	5.1	3953	0.052
−40	5.1	3170	0.064
−40	5.9	3494	0.068
−40	5.9	3953	0.060
−40	5.9	3170	0.074
−87	5.5	3494	0.137
−87	5.5	3953	0.121
−87	5.5	3170	0.151
−87	5.1	3494	0.127
−87	5.1	3953	0.112
−87	5.1	3170	0.140
−87	5.9	3494	0.147
−87	5.9	3953	0.130
−87	5.9	3170	0.162
−181	5.5	3494	0.285
−181	5.5	3953	0.252
−181	5.5	3170	0.314
−181	5.1	3494	0.264
−181	5.1	3953	0.234
−181	5.1	3170	0.291
−181	5.9	3494	0.306
−181	5.9	3953	0.270
−181	5.9	3170	0.337
−228	5.5	3494	0.359
−228	5.5	3953	0.317
−228	5.5	3170	0.396
−228	5.1	3494	0.333
−228	5.1	3953	0.294
−228	5.1	3170	0.367
−228	5.9	3494	0.385
−228	5.9	3953	0.340
−228	5.9	3170	0.424

Notes:

2 Because of the perceived financial threat, some hospitals have attempted to limit the competition they face from ASCs in a number of ways including seeking exclusive contracts with health insurance providers (Casalino et al., 2003).

3 A related literature examines the impact of specialty hospitals on general hospitals. Barro et al. (2006) show that markets with specialty hospitals are associated with lower expenditures for cardiac care without significant changes in mortality. However, they and Greenwald et al. (2006) find that specialty hospitals treat healthier patients than general hospitals. In a study prepared for the AHA, McManis Consulting (2005) found hospitals in Wichita and Oklahoma City that shut down community medical education programs because of reductions in profits due to competition from specialty hospitals.
4 We use the end of year POS from 1999 through 2001 and the second quarter POS from 2002 through 2004. CMS was not able to provide the end of year POS for the years 2002 through 2004. Additionally, we examine services offered to exclude any ASCs that focus exclusively on cosmetic surgery.
5 We construct measures of ASC presence in the years before 1999 using the entry dates from the 1999 file. We therefore have no record of ASCs that existed before 1999. This should not be a major problem since, as mentioned earlier, shows that only a small number of ASC's exit each year.
6 Garnick et al. (1987) present more detailed explanations of these market definitions.
7 Wong et al. (2005) explored how using different market definitions impacted the estimated effect of competition between hospitals on a hospital's total operating expenses. Using seven different market definitions, they found as a hospital market became more competitive the hospital costs in that market decreased, implying that the sign of their estimate did not depend on market definition.
8 In unreported regressions, we find no evidence that ASCs located beyond these boundaries impact hospitals, so it seems unlikely that our markets are too small.
9 The HHI for each hospital is the sum of the squared market shares of admissions for all of the hospitals in a hospital's market.
10 For the percentage uninsured variable, we use the U.S. Census Bureau's Small Area Health Insurance estimates. This information is only available in 2000 and 2001, so we use the 2000 estimates for 1997 through 1999 and the 2001 estimates for 2002 through 2004.
11 We include only hospitals that perform at least 20 outpatient and inpatient surgeries in each year and have outpatient and inpatient department operating margins between —1 and 1. Only hospitals classified in the AHA survey as not-for-profit, for-profit, and nonfederal government were included. Also, only hospitals with a service code description in the AHA survey of general medical and surgical were included. Finally, since Gresenz, Rogowski, and Escarce only constructed the variable radius of a hospital market for those hospitals that completed the 1997 AHA survey, we do not include hospitals that entered after 1997.
12 We define the number of ASCs in a given year as the number of ASCs in operation at the end of the preceding year. Results (available upon request) are almost identical using the number of ASCs in operation at the end of the current year.
13 Data limitations prevent us from examining the impact of ASCs on specific hospital outpatient service lines, though this presents a fruitful avenue for future research.
14 The fixed radius sample consists of 2349 hospitals in 327 MSAs, while the variable radius sample consists of 2243 hospitals in 325 MSAs.
15 We do not interact each of the year fixed effects with each of the hospital fixed effects, as that would lead to perfect collinearity.
16 We use the Stata module xtivreg2 by Schaffer (2008).
17 In unreported regressions (available upon request), we also consider a different instrument: a binary variable indicating whether CON laws governed ASCs in the state in the preceding year. However, the instrument is weak according to the criteria of Staiger and Stock (1997), likely because there were only five changes in state CON law status during our sample period. (Alabama passed an ASC CON law in 1998, while Missouri, Nebraska, New Jersey, and Ohio repealed their ASC CON laws in 2000,1999,1999, and 1997, respectively.) Accordingly, the estimates are too imprecise to be useful, and they are statistically indistinguishable from the estimates from the other regressions.
18 Alternatively, earning income from the facility fee could reduce the number of surgeries physicians perform if the income effect dominates the substitution effect.
19 See McGuire (2000, pp. 503–520) for a review of the literature on physician-induced demand.
20 Our conclusion is not sensitive to the use of the other specifications or the fixed radius market definition.
21 Higher-order terms, such as number of ASCs to the third power, are insignificant.

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ANNALS OF HEALTH CARE | **MAY 11, 2015 ISSUE**

OVERKILL

An avalanche of unnecessary medical care is harming patients physically and financially. What can we do about it?

BY ATUL GAWANDE

Millions of Americans get tests, drugs, and operations that won't make them better, may cause harm, and cost billions.

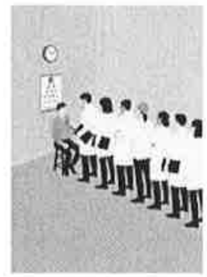

ILLUSTRATION BY ANNA PARINI

It was lunchtime before my afternoon surgery clinic, which meant that I was at my desk, eating a ham-and-cheese sandwich and clicking through medical articles. Among those which caught my eye: a British case report on the first 3-D-printed hip implanted in a human being, a Canadian analysis of the rising volume of emergency-room visits by children who have ingested magnets, and a Colorado study finding that the percentage of fatal motor-vehicle accidents involving marijuana had doubled since its commercial distribution became legal. The one that got me thinking, however, was a study of more than a million Medicare patients. It suggested that a huge proportion had received care that was simply a waste.

The researchers called it "low-value care." But, really, it was no-value care. They studied how often people received one of twenty-six tests or treatments that scientific and professional organizations have consistently determined to have no benefit or to be outright harmful. Their list included doing an EEG for an uncomplicated headache (EEGs are for diagnosing seizure disorders, not headaches), or doing a CT or MRI scan for low-back pain in patients without any signs of a neurological problem (studies consistently show that scanning such patients adds nothing except cost), or putting a coronary-artery stent in patients with stable cardiac disease (the likelihood of a heart attack or death after five years is unaffected by the stent). In just a single year, the researchers reported, twenty-five to forty-two per cent of Medicare patients received at least one of the twenty-six useless tests and treatments.

Could pointless medical care really be that widespread? Six years ago, I wrote an article for this magazine, titled "The Cost Conundrum," which explored the problem of unnecessary care in McAllen, Texas, a community with some of the highest per-capita costs for Medicare in the nation. But was McAllen an anomaly or did it represent an emerging norm? In 2010, the Institute of Medicine issued a report stating that waste accounted for thirty per cent of health-care spending, or some seven hundred and fifty billion dollars a year, which was more than our nation's entire budget for K-12 education. The report found that higher prices,

administrative expenses, and fraud accounted for almost half of this waste. Bigger than any of those, however, was the amount spent on unnecessary health-care services. Now a far more detailed study confirmed that such waste was pervasive.

I decided to do a crude check. I am a general surgeon with a specialty in tumors of the thyroid and other endocrine organs. In my clinic that afternoon, I saw eight new patients with records complete enough that I could review their past medical history in detail. One saw me about a hernia, one about a fatty lump growing in her arm, one about a hormone-secreting mass in her chest, and five about thyroid cancer.

To my surprise, it appeared that seven of those eight had received unnecessary care. Two of the patients had been given high-cost diagnostic tests of no value. One was sent for an MRI after an ultrasound and a biopsy of a neck lump proved suspicious for thyroid cancer. (An MRI does not image thyroid cancer nearly as well as the ultrasound the patient had already had.) The other received a new, expensive, and, in her circumstances, irrelevant type of genetic testing. A third patient had undergone surgery for a lump that was bothering him, but whatever the surgeon removed it wasn't the lump—the patient still had it after the operation. Four patients had undergone inappropriate arthroscopic knee surgery for chronic joint damage. (Arthroscopy can repair certain types of acute tears to the cartilage of the knee. But years of research, including randomized trials, have shown that the operation is of no help for chronic arthritis- or age-related damage.)

Virtually every family in the country, the research indicates, has been subject to overtesting and overtreatment in one form or another. The costs appear to take thousands of dollars out of the paychecks of every household each year. Researchers have come to refer to financial as well as physical "toxicities" of inappropriate care—including reduced spending on food, clothing, education, and shelter. Millions of people are receiving drugs that aren't helping them, operations that aren't going to make them better, and scans and tests that do nothing beneficial for them, and often cause harm.

Why does this fact barely seem to register publicly? Well, as a doctor, I am far more concerned about doing too little than doing too much. It's the scan, the test, the operation that I *should* have done that sticks with me—sometimes for years. More than a decade ago, I saw a young woman in the emergency room who had severe pelvic pain. A standard X-ray showed nothing. I examined her and found signs of pelvic inflammatory disease, which is most often caused by sexually transmitted diseases. She insisted that she hadn't been sexually active, but I didn't listen. If I had, I might have ordered a pelvic CT scan or even recommended exploratory surgery to investigate further. We didn't do that until later, by which time the real source of her symptoms, a twisted loop of bowel in her pelvis, had turned gangrenous, requiring surgery. By contrast, I can't remember anyone I sent for an unnecessary CT scan or operated on for questionable reasons a decade ago. There's nothing less memorable.

"The goddesses want some young dudes."

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It is different, however, when I think about my experience as a patient or a family member. I can readily recall a disturbing number of instances of unnecessary care. My mother once fainted in the Kroger's grocery store in our Ohio home town. Emergency workers transported her to a hospital eighty miles away, in Columbus, where doctors did an ultrasound of her carotid arteries and a cardiac catheterization, too, neither of which is recommended as part of the diagnostic workup for someone who's had a fainting episode, and neither of which revealed anything significant. Only then did someone sit down with her and take a proper history; it revealed that she'd had dizziness, likely from dehydration and lack of food, which caused her to pass out.

I began asking people if they or their family had been subject to what they thought was unnecessary testing or treatment. Almost everyone had a story to tell. Some were appalling.

My friend Bruce told me what happened when his eighty-two-year-old father developed fainting episodes. His doctors did a carotid ultrasound and a cardiac catheterization. The tests showed severe atherosclerotic blockages in three coronary arteries and both carotid arteries. The news didn't come as a shock. He had smoked two packs of cigarettes a day since the age of seventeen, and in his retirement years was paying the price, with chronic lung disease, an aortic-aneurysm repair at sixty-five, a pacemaker at seventy-four, and kidney failure at seventy-nine, requiring dialysis three days a week. The doctors recommended doing a three-vessel cardiac-bypass operation as soon as possible, followed, a week or two later, by surgery to open up one of his carotid arteries. The father deferred the decision-making to the son, who researched hospitals and found a team with a great reputation and lots of experience. The team told him that the combined procedures posed clear risks to his father—for instance, his chance of a stroke would be around fifteen per cent—but that the procedures had become very routine, and the doctors were confident that they were far more likely to be successful than not.

It didn't occur to Bruce until later to question what the doctors meant by "successful." The blockages weren't causing his father's fainting episodes or any other impairments to his life. The operation would not make him feel better. Instead, "success" to the doctors meant reducing his future risk of a stroke. How long would it take for the future benefit to outweigh the immediate risk of surgery? The doctors didn't say, but carotid surgery in a patient like Bruce's father reduces stroke risk by about one percentage point per year. Therefore, it would take fifteen years before the benefit of the operation would exceed the fifteen-per-cent risk of the operation. And he had a life expectancy far shorter than that—very likely just two or three years. The potential benefits of the procedures were dwarfed by their risks.

Bruce's father had a stroke during the cardiac surgery. "For me, I'm kicking myself," Bruce now says. "Because I remember who he was before he went into the operating room, and I'm thinking, Why did I green-light an eighty-something-year-old, very diseased man to have a major operation like this? I'm looking in his eyes and they're like stones. There's no life in his eyes. There's no recognition. He's like the living dead."

A week later, Bruce's father recovered his ability to talk, although much of what he said didn't make sense. But he had at least survived. "We're going to put this one in the win column," Bruce recalls the surgeon saying.

"I said, 'Are you fucking kidding me?' "

His dad had to move into a nursing home. "He was only half there mentally," Bruce said. Nine months later, his father died. That is what low-value health care can be like.

I'm a fan of the radio show "Car Talk" (which ceased taping in 2012 but still airs in reruns), and a regular concern of callers who sought the comic but genuine advice of its repair-shop-owning hosts, Tom and Ray Magliozzi, was whether they were getting snookered by car mechanics into repairs they didn't need.

"There's no question we have considerable up-selling in the industry," Ray told me when I reached him by phone. "Quickie-lube places are the worst for this. I won't name names, but they tend to have the word 'lube' in them." He let out that *nyuk-nyuk-nyuk* laugh he has. "You can't make money on a $29.95 oil change. So they try to sell you on a lot of stuff. First level, they sell you something you don't need but at least doesn't hurt. Second level, they do some real damage mucking around."

Even reputable professionals with the best intentions tend toward overkill, he said. To illustrate the point, he, too, had a medical story to tell. Eight months earlier, he'd torn a meniscus in his knee doing lunges. "Doing lunges is probably something a sixty-five-year-old should not be doing to begin with," he admitted. He was referred to an orthopedic surgeon to discuss whether to do physical therapy or surgery. "Very good guy. Very unassuming. I had no reason not to trust the guy. But I also know he's a surgeon. So he's going to present surgery to me."

Sure enough, the surgeon recommended arthroscopic knee surgery. "This is going to fix it," Ray recalled him saying. "In by nine, out by noon."

Ray went for a second opinion, to a physical therapist, who, of course, favored physical therapy, just as the surgeon favored surgery. Ray chose physical therapy.

"How'd it turn out?" I asked.

"Amazingly well," he said. "I feel pretty darn good right now."

"What did the surgeon say when you told him you weren't going to do the surgery?"

"He said, 'No problem, go to P.T., and when that doesn't work we can schedule the surgery,' " Ray recalled. "Who knows? Maybe I will end up having to go back. He wasn't trying to pull the wool over my eyes. But he believed."

What Ray recommended to his car-owning listeners was the approach that he adopted as a patient—caveat emptor. He did his research. He made informed choices. He tried to be a virtuous patient.

The virtuous patient is up against long odds, however. One major problem is what economists call information asymmetry. In 1963, Kenneth Arrow, who went on to win the Nobel Prize in Economics, demonstrated the severe disadvantages that buyers have when they know less about a good than the seller does. His prime example was health care. Doctors generally know more about the value of a given medical treatment than patients, who have little ability to determine the quality of the advice they are getting. Doctors, therefore, are in a powerful position. We can recommend care of little or no value because it enhances our incomes, because it's our habit, or because we genuinely but incorrectly believe in it, and patients will tend to follow our recommendations.

Another powerful force toward unnecessary care emerged years after Arrow's paper: the phenomenon of overtesting, which is a by-product of all the new technologies we have for peering into the human body. It has been hard for patients and doctors to recognize that tests and scans can be harmful. Why not take a look and see if anything is abnormal? People are discovering why not. The United States is a country of three hundred million people who annually undergo around fifteen million nuclear medicine scans, a hundred million CT and MRI scans, and almost ten billion laboratory tests. Often, these are fishing expeditions, and since no one is perfectly normal you tend to find a lot of fish. If you look closely and often enough, almost everyone will have a little nodule that can't be completely explained, a lab result that is a bit off, a heart tracing that doesn't look quite right.

Excessive testing is a problem for a number of reasons. For one thing, some diagnostic studies are harmful in themselves—we're doing so many CT scans and other forms of imaging that rely on radiation that they are believed to be increasing the population's cancer rates. These direct risks are often greater than we account for.

What's more, the value of any test depends on how likely you are to be having a significant problem in the first place. If you have crushing chest pain and shortness

of breath, you start with a high likelihood of having a serious heart condition, and an electrocardiogram has significant value. A heart tracing that doesn't look quite right usually means trouble. But, if you have no signs or symptoms of heart trouble, an electrocardiogram adds no useful information; a heart tracing that doesn't look quite right is mostly noise. Experts recommend against doing electrocardiograms on healthy people, but millions are done each year, anyway.

Resolving the uncertainty of non-normal results can lead to procedures that have costs of their own. You get an EKG. The heart tracing is not completely normal, and a follow-up procedure is recommended. Perhaps it's a twenty-four-hour heart-rhythm monitor or an echocardiogram or a stress test or a cardiac catheterization; perhaps you end up with all of them before everyone is assured that everything is all right. Meanwhile, we've added thousands of dollars in costs and, sometimes, physical risks, not to mention worry and days of missed work.

Overtesting has also created a new, unanticipated problem: overdiagnosis. This isn't misdiagnosis—the erroneous diagnosis of a disease. This is the correct diagnosis of a disease that is never going to bother you in your lifetime. We've long assumed that if we screen a healthy population for diseases like cancer or coronary-artery disease, and catch those diseases early, we'll be able to treat them before they get dangerously advanced, and save lives in large numbers. But it hasn't turned out that way. For instance, cancer screening with mammography, ultrasound, and blood testing has dramatically increased the detection of breast, thyroid, and prostate cancer during the past quarter century. We're treating hundreds of thousands more people each year for these diseases than we ever have. Yet only a tiny reduction in death, if any, has resulted.

My last patient in clinic that day, Mrs. E., a woman in her fifties, had been found to have a thyroid lump. A surgeon removed it, and a biopsy was done. The lump was benign. But, under the microscope, the pathologist found a pinpoint "microcarcinoma" next to it, just five millimetres in size. Anything with the term "carcinoma" in it is bound to be alarming—"carcinoma" means cancer, however "micro" it might be. So when the surgeon told Mrs. E. that a cancer had been found in her thyroid, which was not exactly wrong, she believed he'd saved her life, which was not exactly right. More than a third of the population turns out to have these tiny cancers in their thyroid, but fewer than one in a hundred thousand people die from thyroid cancer a year. Only the rare microcarcinoma develops the capacity to behave like a dangerous, invasive cancer. (Indeed, some experts argue that we should stop calling them "cancers" at all.) That's why expert guidelines recommend no further treatment when microcarcinomas are found.

Nonetheless, it's difficult to do nothing. The patient's surgeon ordered a series of ultrasounds, every few months, to monitor the remainder of her thyroid. When the imaging revealed another five-millimetre

nodule, he recommended removing the rest of her thyroid, out of an abundance of caution. The patient was seeing me only because the surgeon had to cancel her operation, owing to his own medical issues. She simply wanted me to fill in for the job—but it was a job, I advised her, that didn't need doing in the first place. The surgery posed a greater risk of causing harm than any microcarcinoma we might find, I explained. There was a risk of vocal-cord paralysis and life-threatening bleeding. Removing the thyroid would require that she take a daily hormone-replacement pill for the rest of her life. We were better off just checking her nodules in a year and acting only if there was significant enlargement.

H. Gilbert Welch, a Dartmouth Medical School professor, is an expert on overdiagnosis, and in his excellent new book, "Less Medicine, More Health," he explains the phenomenon this way: we've assumed, he says, that cancers are all like rabbits that you want to catch before they escape the barnyard pen. But some are more like birds—the most aggressive cancers have already taken flight before you can discover them, which is why some people still die from cancer, despite early detection. And lots are more like turtles. They aren't going anywhere. Removing them won't make any difference.

We've learned these lessons the hard way. Over the past two decades, we've tripled the number of thyroid cancers we detect and remove in the United States, but we haven't reduced the death rate at all. In South Korea, widespread ultrasound screening has led to a fifteen-fold increase in detection of small thyroid cancers. Thyroid cancer is now the No. 1 cancer diagnosed and treated in that country. But, as Welch points out, the death rate hasn't dropped one iota there, either. (Meanwhile, the number of people with permanent complications from thyroid surgery has skyrocketed.) It's all over-diagnosis. We're just catching turtles.

Every cancer has a different ratio of rabbits, turtles, and birds, which makes the story enormously complicated. A recent review concludes that, depending on the organ involved, anywhere from fifteen to seventy-five per cent of cancers found are indolent tumors—turtles—that have stopped growing or are growing too slowly to be life-threatening. Cervical and colon cancers are rarely indolent; screening and early treatment have been associated with a notable reduction in deaths from those cancers. Prostate and breast cancers are more like thyroid cancers. Imaging tends to uncover a substantial reservoir of indolent disease and relatively few rabbit-like cancers that are life-threatening but treatable.

We now have a vast and costly health-care industry devoted to finding and responding to turtles. Our ever more sensitive technologies turn up more and more abnormalities—cancers, clogged arteries, damaged-looking knees and backs—that aren't actually causing problems and never will. And then we doctors try to fix them, even though the result is often more harm than good.

The forces that have led to a global epidemic of overtesting, overdiagnosis, and overtreatment are easy to grasp. Doctors get paid for doing more, not less. We're more afraid of doing too little than of doing too much. And patients often feel the same way. They're likely to be grateful for the extra test done in the name of "being thorough"—and then for the procedure to address what's found. Mrs. E. was such a patient.

Mrs. E. had a turtle. She would have been better off if we'd never monitored her thyroid in the first place. But, now that we'd found something abnormal, she couldn't imagine just keeping an eye on it. She wanted to take her chances with surgery.

The main way we've tried to stop unnecessary treatments has been through policing by insurers: they could refuse to pay for anything that looked like inappropriate care, whether it was an emergency-room visit, an MRI scan, or an operation. And it worked. During the nineteen-nineties, the "Mother, may I?" strategy flattened health-care costs. But it also provoked a backlash. Faceless corporate bureaucrats second-guessing medical decisions from afar created an infuriating amount of hassle for physicians and patients trying to orchestrate necessary care—and sometimes led to outrageous mistakes. Insurance executives were accused of killing people. Facing a public outcry, they backed off, and health-care costs resumed their climb. A decade and a half later, however, more interesting approaches have emerged.

Consider the case of Michael Taylor. A six-foot-tall, fifty-five-year-old optician from Ogden, Utah, Taylor threw his back out a year ago, while pulling weeds from his lawn. When he tried to straighten up, pain bolted from his lower back through his hips and down both thighs. He made his stooped way up his front-porch steps, into his house, and called his wife, Sandy, at work.

"For him to call meant it was *really* bad," she said later.

Taylor was a stoic guy who had had back issues for a long time. By his early thirties, he had already undergone two spine operations: the fusion of a vertebra in his neck, which was fractured in a car accident, and the removal of a ruptured disk in his lower back that had damaged a nerve root, causing a foot drop—his left foot slapped when he walked. He'd had periodic trouble with back spasms ever since. For the most part, he managed them through stretches and exercise. He had been a martial artist since the age of thirteen—he'd earned a third-degree black belt—and retained tremendous flexibility. He could still do splits. Occasionally, if an attack was bad, he saw a pain specialist and got a spinal injection of steroids, which usually worked for a while. This episode, however, was worse than any before.

"He could hardly walk," Sandy said. He tried sleeping in a recliner and waiting out the pain. But it didn't go away. He called his primary-care physician, who ordered an MRI. It showed degenerative disk disease in his lumbar spine—a bulge or

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narrowing of disk space between two of the vertebrae in his lower back. The doctor prescribed muscle relaxants and pain medications, and said that Taylor might need spinal surgery. She referred him to a local neurosurgeon.

Taylor put off making the appointment. He did his lower-back stretches and range-of-motion exercises, and worked on losing weight. These measures helped a little, but he still couldn't sleep in his bed or manage more than a shuffling walk. After four weeks with no improvement, he finally went to see the surgeon, who recommended fusing Taylor's spine where his disk was bulging. Taylor would lose some mobility—his days of spinning kicks were over—and success was not guaranteed, but the doctor thought that it was the best option.

"He said the surgery would be, like, a fifty-fifty thing," Taylor recalled. "Half of people would see great success. The other half would see little or no difference. And there'd be a few who find it makes the pain worse." There was also the matter of cost. The vision center he managed was in a Walmart superstore, and the co-payments and deductibles with the company insurance plan were substantial. His bills were likely to run past a thousand dollars.

But Taylor had heard about a program that Walmart had launched for employees undergoing spine, heart, or transplant procedures. Employees would have no out-of-pocket costs at all if they got the procedure at one of six chosen "centers of excellence": the Cleveland Clinic; the Mayo Clinic; Virginia Mason Medical Center, in Washington; Scott and White Memorial Hospital, in Texas; Geisinger Medical Center, in Pennsylvania; and Mercy Hospital Springfield, in Missouri. Taylor learned that the designated spine center for his region was Virginia Mason, in Seattle. He used to live in Washington, and the back surgery he'd had when he was younger was at the same hospital. He trusted the place, and it had a good reputation. He decided to proceed.

The program connected him to the hospital, and its staff took care of everything from there. They set up his appointments and arranged the travel for him and his wife. All expenses were covered, even their food and hotel costs.

"They flew us from Salt Lake City and picked us up at the airport in a town car," Taylor said. He said he felt like royalty.

Walmart wasn't providing this benefit out of the goodness of its corporate heart, of course. It was hoping that employees would get better surgical results, sure, but also that the company would save money. Spine, heart, and transplant procedures are among the most expensive in medicine, running from tens of thousands to hundreds of thousands of dollars. Nationwide, we spend more money on spinal

fusions, for instance, than on any other operation—thirteen billion dollars in 2011. And if there are complications the costs of the procedure go up further. The medical and disability costs can be enormous, especially if an employee is left permanently unable to return to work. These six centers had notably low complication rates and provided Walmart a fixed, package price.

Two years into the program, an unexpected pattern is emerging: the biggest savings and improvements in care are coming from avoiding procedures that shouldn't be done in the first place. Before the participating hospitals operate, their doctors conduct their own evaluation. And, according to Sally Welborn, the senior vice-president for benefits at Walmart, those doctors are finding that around thirty per cent of the spinal procedures that employees were told they needed are inappropriate. Dr. Charles Nussbaum, until recently the head of neurosurgery at Virginia Mason Medical Center, confirmed that large numbers of the patients sent to his hospital for spine surgery do not meet its criteria.

Michael Taylor was one of those patients. Disk disease like the kind seen on his MRI is exceedingly common. Studies of adults with no back pain find that half or more have degenerative disk disease on imaging. Disk disease is a turtle—an abnormality that generally causes no harm. It's different when a diseased disk compresses the spinal cord or nerve root enough to cause specific symptoms, such as pain or weakness along the affected nerve's territory, typically the leg or the arm. In those situations, surgery is proved to be more effective than nonsurgical treatment. For someone without such symptoms, though, there is no evidence that surgery helps to reduce pain or to prevent problems. One study found that between 1997 and 2005 national health-care expenditures for back-pain patients increased by nearly two-thirds, yet population surveys revealed no improvement in the level of back pain reported by patients.

There are gray-zone cases, but Taylor's case was straightforward. Nussbaum said that Taylor's MRI showed no disk abnormality compressing his spinal cord or nerve root. He had no new leg or foot weakness. His pain went down both legs and not past the knee, which didn't fit with disk disease. The symptoms were consistent with muscle spasms or chronic nerve sensitivity resulting from his previous injuries. Fusing Taylor's spine—locking two vertebrae together with bolts and screws—wouldn't fix these problems. At best, it would stop him from bending where it hurt, but that was like wiring a person's jaw shut because his tooth hurts when he chews. Fusing the spine also increases the load on the disks above and below the level of fusion, making future back problems significantly more likely. And that's if things go well. Nussbaum recommended against the surgery.

This was not what Taylor's wife wanted to hear. Had they come all this way for nothing? "I got kind of angry," Sandy told me later. She wanted his back problem solved.

"The first rule of miming is you don't talk He did, too. But he was relieved to hear that

about miming."

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he wouldn't have to undergo another back operation. Nussbaum's explanations made sense to him, and he had never liked the idea of having his spine fused. Moreover, unlike most places, the Virginia Mason spine center had him seen not only by a surgeon but also by a rehabilitation-medicine specialist, who suggested a nonsurgical approach: a spinal injection that afternoon, continued back exercises, and a medication specifically for neuropathic pain—chronic nerve sensitivity.

"Within a couple of weeks, I was literally pain free," Taylor said. It was six months after his visit to Seattle, and he could do things he hadn't been able to do in decades.

"I was just amazed," Sandy said. "The longer it's been, the better he is."

If an insurer had simply decreed Taylor's back surgery to be unnecessary, and denied coverage, the Taylors would have been outraged. But the worst part is that he would not have got better. It isn't enough to eliminate unnecessary care. It has to be replaced with necessary care. And that is the hidden harm: unnecessary care often crowds out necessary care, particularly when the necessary care is less remunerative. Walmart, of all places, is showing one way to take action against no-value care—rewarding the doctors and systems that do a better job and the patients who seek them out.

Six years ago, in "The Cost Conundrum," I compared McAllen with another Texas border town, El Paso. They had the same demographics—the same levels of severe poverty, poor health, illegal immigration—but El Paso had half the per-capita Medicare costs and the same or better results. The difference was that McAllen's doctors were ordering more of almost everything—diagnostic testing, hospital admissions, procedures. Medicare patients in McAllen received forty per cent more surgery, almost twice as many bladder scopes and heart studies, and two to three times as many pacemakers, cardiac bypass operations, carotid endarterectomies, and coronary stents. Per-capita spending on home-health services was five times higher than in El Paso and more than half of what many American communities spent on all health care. The amount of unnecessary care appeared to be huge.

What explained this? Our piecework payment system—rewarding doctors for the quantity of care provided, regardless of the results—was a key factor. The system gives ample reward for overtreatment and no reward for eliminating it. But these inducements applied everywhere. Why did McAllen succumb to them more than other medical communities did? Doctors there described a profit-maximizing medical culture. Specialists not only made money from the services they provided; many also owned stakes in home-health-care agencies, surgery and imaging centers,

and the local for-profit hospital, which brought them even bigger returns from health-care overuse.

The test of health-care reform, I wrote, was whether McAllen or El Paso would become the new norm. Would McAllen's costs come down or El Paso's go up? Now that it has been five years since the passage of the Affordable Care Act, I thought I'd find out. I returned to the economist Jonathan Skinner, of the Dartmouth Institute for Health Policy and Clinical Practice, who had provided the earlier analysis of the Medicare data, and worked with him to get a sense of what recent data reveal. As it turns out, the cost of a Medicare patient has flattened across the country, El Paso included. U.S. health-care inflation is the lowest it has been in more than fifty years. Most startling of all, McAllen has been changing its ways. Between 2009 and 2012, its costs dropped almost three thousand dollars per Medicare recipient. Skinner projects the total savings to taxpayers to have reached almost half a *billion* dollars by the end of 2014. The hope of reform had been to simply "bend the curve." This was savings on an unprecedented scale.

Skinner showed me the details. In-patient hospital visits dropped by about ten per cent—and physicians reduced the mad amounts of home-health-care spending by nearly forty per cent. McAllen's spending on ambulance rides—previously the highest in the country—dropped by almost forty per cent, too.

I followed up with doctors there to find out how this had happened. I started with Lester Dyke, a cardiac surgeon who was one of many doctors troubled by what they were seeing, but the only one to let me quote him by name in my McAllen piece. ("Medicine has become a pig trough here," he had told me. "We took a wrong turn when doctors stopped being doctors and became businessmen.") After it was published, television crews descended on the town. Texas newspapers did follow-up investigations.

"The reaction here was fierce, just a tremendous amount of finger-pointing and yelling and screaming," Dyke recently told me. The piece infuriated the local medical community, which felt unfairly singled out. And Dyke paid a steep price: "I became persona non grata overnight." Colleagues said that he would be to blame if they lost money. Cardiologists stopped sending him patients. "My cases went down by ninety per cent," he told me. He had to give up his practice at Doctors Hospital at Renaissance, the for-profit hospital, after it became clear that he wasn't welcome there, but he was able to continue doing some surgery at two other hospitals. When I talked to Dyke in the first months afterward, he'd sounded low. The few friends who voiced support didn't want to be seen in public with him. He thought he might be forced to retire.

Yet he insisted that he had no regrets. Two of his children went into medicine, and in a medical-ethics class his son was assigned the article. The professor asked whether he was related to the Dr. Dyke quoted in it.

"Yes, I am," he said proudly. "That's my crazy dad."

"I don't think you often get a chance in life to stand up to all the badness," Dyke told me.

"Is this the wine you selected at random?"

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With time, the anger of colleagues subsided. Many of them resumed sending him patients. Within a couple of years, he was back to an annual caseload of three hundred open-heart operations. Meanwhile, it got harder for McAllen physicians to ignore the evidence about unnecessary care. Several federal prosecutions cracked down on outright fraud. Seven doctors agreed to a twenty-eight-million-dollar settlement for taking illegal kickbacks when they referred their patients to specialty medical services. An ambulance-company owner was indicted for reporting six hundred and twenty-one ambulance rides that allegedly never happened. Four clinic operators were sent to jail for billing more than thirteen thousand visits and procedures under the name of a physician with dementia. The prosecutions involved only a tiny fraction of the medical community. But Dyke thought it led doctors to say to themselves, "Hey, we're under the magnifying glass. We need to make sure we're doing things strictly by the book."

Jose Peña, an internist, was a board member at Doctors Hospital at Renaissance in 2009. When we spoke recently, he didn't hesitate to tell me the immediate reaction his colleagues had to what I'd written. "We hated you," he said. The story "put us in a spotlight, in a bad way," but, he added, "in a good way at the same time." They hadn't known that they were one of the most expensive communities in the country, he maintained. They knew there were problems, "but we did not know the magnitude." His hospital did its own analysis of the data and reluctantly came to the same conclusion that the article did: inappropriate and unnecessary care was a serious problem.

The major overuse of home-health-care services proved particularly embarrassing. "We didn't know that home health was a thousand dollars a month" for each patient, Peña said. People in the medical community had never paid attention to how much of it they were ordering or how little of it was really needed. He led monthly staff meetings with more than four hundred local physicians and began encouraging them to be more mindful about signing home-health-care orders. Within a year, home-health-care agencies started going out of business.

But more interesting was how broad and enduring the cost decline has been. E.R. visits, hospital admissions, tests, and procedures all fell from the Texas stratosphere. And, years after the attention and embarrassment had passed, the costs continued to fall. Bad publicity, a few prosecutions, and some stiffened regulatory requirements here and there couldn't explain that. I probed for months, talking to

local doctors and poring over data. And I've come to think that a major reason for the change may be a collection of primary-care doctors who don't even seem to recognize the impact of what they've been doing.

Armando Osio is a sixty-three-year-old family physician in McAllen. In 2009, when the article came out, he did not own part of an imaging center or sleep-testing center or hospital or any other medical money-making venture. He didn't have any procedures or tests that he made big money from. He was just a primary-care doctor doing what primary-care doctors do—seeing patient after patient every twenty to thirty minutes, for about sixty dollars a visit. That's what Medicare paid; private insurance paid more, and Medicaid or the uninsured paid less. He earned nothing like the income of the specialists that I'd written about.

Then, later that year, officials at a large medical group called WellMed contacted Osio. They wanted to establish a practice in McAllen, catering to Medicare patients, and asked whether he'd join them. WellMed had contracted with Medicare H.M.O. plans to control their costs. Its pitch to clinicians was that, if a doctor improved the quality of care, this would save on costs, and WellMed would share those savings with the doctor in the form of bonuses. That meant Osio would have to see fewer patients, for longer visits, but WellMed assured him that, if he could show measurable quality improvements, he'd actually make more money.

Osio was skeptical, but he agreed to see some of WellMed's patients. When he was in training, he'd been interested in geriatrics and preventive medicine. In practice, he hadn't had time to use those skills. Now he could. With WellMed's help, Osio brought on a physician assistant and other staff to help with less complex patients. He focussed on the sicker, often poorer patients, and he found that his work became more satisfying. With the bonuses for higher patient satisfaction, reducing hospital admissions, and lowering cardiology costs, his income went up. This was the way he wanted to practice—being rewarded for doing right rather than for the disheartening business of churning through more and more people. Within a year, he'd switched his practice so that he was seeing almost entirely WellMed patients.

He gave me an example of one. That day, he'd seen an elderly man who had taken a bad spill two or three weeks earlier, resulting in a contused kidney and a compression fracture of his lower spine. After a couple of days in the hospital, he'd been sent home. But the pain remained unmanageable. He called Osio's office seeking help.

If the man had called five years ago, a receptionist would have told him that the schedule was full for days and sent him to an emergency room. There, he would have waited hours, been seen by someone who didn't know his story, been given a repeat CT or MRI, and then likely have been kept for another hospital stay. Once the doctors were sure that the situation wasn't dangerous, he would finally have been sent home, with pain medicine and instructions to see his primary-care doctor.

Cost: a few thousand dollars.

Now when the man called, the receptionist slotted him to see Osio that afternoon. The doctor examined him and, being familiar with his case, determined that he had no worsening signs requiring imaging. He counselled patience and offered reassurance, gave him pain medication, and sent him home, with a plan for his nurse to check on him the next day. Cost: at most, a hundred dollars. And the patient got swifter, better care.

"Hi. I'm Murphy."

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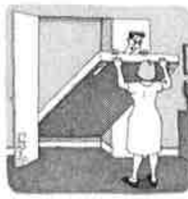

I spoke to Carlos Hernandez, an internist and the president of WellMed. He explained that the medical group was founded twenty-five years ago, in San Antonio, by a geriatrician who believed that what the oldest and sickest most needed in our hyper-specialized medical system was slower, more dedicated primary care. "Our philosophy is that the primary-care physician and patient should become the hub of the entire health-care-delivery system," Hernandez said. He viewed the primary-care doctor as a kind of contractor for patients, reining in pointless testing, procedures, and emergency-room visits, coördinating treatment, and helping to find specialists who practice thoughtfully and effectively. Our technology- and specialty-intensive health system has resisted this kind of role, but countries that have higher proportions of general practitioners have better medical outcomes, better patient experiences, and, according to a European study, lower cost growth. WellMed found insurers who saw these advantages and were willing to pay for this model of care. Today, WellMed has more than a hundred clinics, fifteen hundred primary-care doctors, and around a quarter of a million patients across Texas and Florida.

There's a reason that WellMed focussed on these two states. They are among the nation's most expensive states for Medicare and are less well-supplied with primary care. An independent 2011 analysis of the company's Texas clinics found that, although the patient population they drew from tended to be less healthy than the over-all Medicare population (being older and having higher rates of diabetes and chronic lung disease, for instance), their death rates were half of the Texas average.

This last part puzzled me. I had started to recognize how unnecessary care could crowd out necessary care—but enough that dedicated primary care could cut death rates in half? That seemed hard to believe. As I learned more about how Dr. Osio's practice had changed, though, I began to grasp how it could happen.

He told me, for instance, about a new patient he'd seen, a sixty-five-year-old man with diabetes. His blood-sugar level was dangerously high, at a level that can signify a full-blown diabetic crisis, with severe dehydration, rising acid levels in the blood, and a risk of death. The man didn't look ill, though. His vital signs were normal.

Osio ordered a urine test, which confirmed that the man was not in crisis. That was, in a way, a bad sign. It meant that his diabetes was so out of control that his body had developed a tolerance to big spikes in blood sugar. Unchecked, his diabetes would eventually cause something terrible—kidney failure, a heart attack, blindness, or the kind of wound-healing problem that leads to amputation.

Previously, Osio would not have had the time or the resources to do much for the man. So he would have sent him to the hospital. The staff there would have done a battery of tests to confirm what Osio already knew—that his blood sugar was way too high. They would have admitted him, given him insulin, and brought his blood sugar down to normal. And that would have been about it. The thousands of dollars spent on the hospital admission would have masked a galling reality: no one was addressing the man's core medical problem, which was that he had a chronic and deadly disease that remained dangerously out of control.

But now WellMed gave Osio bonuses if his patients' diabetes was under better control, and helped him to develop a system for achieving this. Osio spent three-quarters of an hour with the man, going over his pill bottles and getting him to explain what he understood about his condition and how to treat it. The man was a blue-collar worker with limited schooling, and Osio discovered that he had some critical misunderstandings. For instance, although he checked his blood-sugar level every day, he wrongly believed that if the level was normal he didn't need to take his medicine. No, Osio told him; his diabetes medication was like his blood-pressure medication—he should never skip a dose unless the home measurements were too low.

Osio explained what diabetes is, how dangerous it can be, how insulin works. Then he turned the man over to an office nurse who had taken classes to become certified as a diabetes educator. She spent another forty-five minutes having him practice how to draw up and take his insulin, and how to track his sugar levels in a logbook. She set a plan to call him every other day for a week and then, if necessary, bring him back for another review. This would continue until his disease was demonstrably under control. After that, she'd check on him once a month by phone, and Osio would see him every three to four months. The nurse gave him her direct phone number. If he had any problems or questions, she told him, "*Llámame*"—call me.

Step by deliberate step, Osio and his team were replacing unnecessary care with the care that people needed. Since 2009, in Hidalgo County, where McAllen is situated, WellMed has contracted with physicians taking care of around fourteen thousand Medicare patients. According to its data, the local WellMed practices have achieved the same results as WellMed has elsewhere: large reductions in overuse of care and better outcomes for patients. Indeed, for the past two years, the top-ranked primary-care doctor out of WellMed's fifteen hundred—according to a wide range of quality measures, such as the percentage of patients with well-controlled blood pressure and diabetes, rates of emergency-room visits and

hospital readmissions, and levels of patient satisfaction—has been a McAllen physician.

I spoke to that doctor, Omar Gomez. He said that he'd set about building a strong team around his patients, and that team included specialists such as cardiologists and surgeons. He encouraged his patients to shift to the ones who, he noticed, didn't subject them to no-value care. He sat with the specialists, and, he said, "I told them, 'If my patient *needs* a cardiac cath—by all means, do it. But if they don't, then don't do it. That's the only thing I ask.' "

"Believe me when I tell you that I'm not that honest."

MARCH 5, 2001

The passage of the Affordable Care Act, in 2010, created opportunities for physicians to practice this kind of dedicated care. The law allows any group of physicians with five thousand or more Medicare patients to contract directly with the government as an "accountable-care organization," and to receive up to sixty per cent of any savings they produce. In McAllen, two primary-care groups, with a total of nearly thirteen thousand patients, formed to take advantage of the deal. One, as it happens, was led by Jose Peña, the Doctors Hospital at Renaissance internist. Two years later, Medicare reported that Peña's team had markedly improved control of its patients' diabetes; patients also had dramatically lower emergency-room visits and hospital admissions. And the two McAllen accountable-care organizations together managed to save Medicare a total of twenty-six million dollars. About sixty per cent of that went back to the groups. It wasn't all profit—achieving the results had meant installing expensive data-tracking systems and hiring extra staff. But even after overhead doctors in one group took home almost eight hundred thousand dollars each (some of which they shared with their mid-level staff). It was proving to be a very attractive way to practice.

McAllen, in large part because of changes led by primary-care doctors, has gone from a cautionary tale to something more hopeful. Nationwide, the picture is changing almost as fast. Just five years after the passage of health-care reform, twenty per cent of Medicare payments are being made to physicians who have enrolled in alternative-payment programs, whether through accountable-care organizations like those in McAllen or by accepting Walmart-like packaged-price care—known as bundled payment—for spine surgery, joint surgery, and other high-cost procedures. If government targets are met, these numbers will reach thirty per cent of Medicare payments by 2016. A growing number of businesses are also extending the centers-of-excellence approach to their employees, including Boeing, Kohl's, Lowe's, and PepsiCo. And a nonprofit in California, the Pacific Business Group on Health, now offers to provide a similar network to any health-care purchaser in the country.

Could a backlash arrive and halt the trend? It's a concern. No one has yet invented a payment system that cannot be gamed. If doctors are rewarded for practicing more conservative medicine, some could end up stinting on care. What if Virginia Mason turns away a back-pain patient who should have gone to surgery? What if Dr. Osio fails to send a heart patient to the emergency room when he should have? What if I recommend not operating on a tiny tumor, saying that it is just a turtle, and it turns out to be a rabbit that bounds out of control?

Proponents point out that people can sue if they think they've been harmed, and doctors' groups can lose their contracts for low-quality scores, which are posted on the Web. But not all quality can be measured. It's possible that we will calibrate things wrongly, and skate past the point where conservative care becomes inadequate care. Then outrage over the billions of dollars in unnecessary stents and surgeries and scans will become outrage over necessary stents and surgeries and scans that were not performed.

Right now, we're so wildly over the boundary line in the other direction that it's hard to see how we could accept leaving health care the way it is. Waste is not just consuming a third of health-care spending; it's costing people's lives. As long as a more thoughtful, more measured style of medicine keeps improving outcomes, change should be easy to cheer for. Still, when it's your turn to sit across from a doctor, in the white glare of a clinic, with your back aching, or your head throbbing, or a scan showing some small possible abnormality, what are you going to fear more—the prospect of doing too little or of doing too much?

Mrs. E., my patient with a five-millimetre thyroid nodule that I recommended leaving alone, feared doing too little. So one morning I took her to the operating room, opened her neck, and, in the course of an hour, removed her thyroid gland from its delicate nest of arteries and veins and critical nerves. Given that the surgery posed a greater likelihood of harm than of benefit, some people would argue that I shouldn't have done it. I took her thyroid out because the idea of tracking a cancer over time filled her with dread, as it does many people. A decade from now, that may change. The idea that we are overdiagnosing and overtreating many diseases, including cancer, will surely become less contentious. That will make it easier to calm people's worries. But the worries cannot be dismissed. Right now, even doctors are still coming to terms with the evidence.

Other people of a more consumerist bent will be troubled not that I gave her the choice but that she paid virtually none of the expenses incurred by it. The nature of her insurance coverage guaranteed that. Her employer had offered her two options. One was a plan with a high deductible and a medical savings account that would have made her pay a substantial portion of the many-thousand-dollar operation. And this might have made her think harder about proceeding (or, at least, encouraged her to find someone cheaper). But, like many people, she didn't want to be in that situation. So she chose the second option, which provided full coverage for cases like this one. She found it difficult enough to weigh her fears of the cancer

against her fears of the operation—with its risks of life-threatening bleeding and voice damage—without having to put finances into the equation.

Two hours after the surgery, Mrs. E.'s nurse called me urgently to see her in the recovery room. Her neck was swelling rapidly; she was bleeding. We rushed her back to the operating room and reopened her neck before accumulating blood cut off her airway. A small pumping artery had opened up in a thin band of muscle I'd cauterized. I tied the vessel off, washed the blood away, and took her back to the recovery room.

"That one looks like a fluorescent light."

AUGUST 24, 2009

I saw her in my office a few weeks later, and was relieved to see she'd suffered no permanent harm. The black and blue of her neck was fading. Her voice was normal. And she hadn't needed the pain medication I'd prescribed. I arranged for a blood test to check the level of her thyroid hormone, which she now had to take by pill for the rest of her life. Then I showed her the pathology report. She did have a thyroid cancer, a microcarcinoma about the size of this "O," with no signs of unusual invasion or spread. I wished we had a better word for this than "cancer"—because what she had was not a danger to her life, and would almost certainly never have bothered her if it had not been caught on a scan.

All the same, she thanked me profusely for relieving her anxiety. I couldn't help reflect on how that anxiety had been created. The medical system had done what it so often does: performed tests, unnecessarily, to reveal problems that aren't quite problems to then be fixed, unnecessarily, at great expense and no little risk. Meanwhile, we avoid taking adequate care of the biggest problems that people face—problems like diabetes, high blood pressure, or any number of less technologically intensive conditions. An entire health-care system has been devoted to this game. Yet we're finally seeing evidence that the system can change—even in the most expensive places for health care in the country. ♦

Atul Gawande, a surgeon and public-health researcher, became a *New Yorker* staff writer in 1998.

Otolaryngology–Head and Neck Surgery (2009) 141, 701-709

ORIGINAL RESEARCH–GENERAL OTOLARYNGOLOGY

Comparing quality at an ambulatory surgery center and a hospital-based facility: Preliminary findings

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No sponsorships or competing interests have been disclosed for this article.

ABSTRACT

OBJECTIVE: To measure the quality of outpatient surgery in an ambulatory surgery center (ASC) compared to a hospital-based facility (HBF) in a multidimensional manner.
STUDY DESIGN: Cross-sectional survey based on chart review.
SETTING: Pediatric academic health center.
SUBJECTS AND METHODS: A total of 486 cases were reviewed. Procedures were performed at either an ASC (n = 275) or an HBF (n = 211). Cases comprised four procedure types: ventilation tube insertion (ASC, n = 126; HBF, n = 108), dental rehabilitation (ASC, n = 89; HBF, n = 58), adenotonsillectomy (ASC, n = 37; HBF, n = 34), and ventilation tube insertion/adenoidectomy (ASC, n = 23; HBF, n = 11). Measures were developed for five categories: safety, patient-centeredness, timeliness, efficiency, and equitability. Performance was compared between facilities.
RESULTS: The ASC had no unexpected safety events (0/275) compared to nine events (9/211) at the HBF. Tonsil bleed rates were 0 percent (0/37) at the ASC compared to 5.9 percent (2/34) at the HBF. Patient satisfaction was similar between facilities (ASC, n = 64; HBF, n = 35). Differences in timeliness approached 30 percent. A total of 77 percent of ASC cases finished within the scheduled time compared to 38 percent at the HBF. Total charges were 12 to 23 percent less at the ASC. Patients treated at the ASC generally lived in wealthier neighborhoods.
CONCLUSION: Performance at the ASC generally exceeded that at the HBF. Future research should investigate how perioperative processes result in these quality differences. Health policy implications are discussed.

Today's healthcare environment continues to be plagued by "layers of processes and handoffs that patients and families find bewildering and clinicians view as wasteful."[1] As the healthcare industry responds to public demand for higher quality while facing scarce resources, innovative delivery models that provide high-quality, low-cost care are increasingly needed. Ambulatory surgery centers (ASC), which take advantage of economies of scale and low-cost organizational structures, have been described as such a model.[2]

One explanation for the quality advantage of ASCs is their bias toward being high-volume centers. A well documented relationship exists between quality and surgical volume.[3] In rotator cuff surgery, for example, higher volume has been linked to decreased length of stay, higher rates of routine patient discharges, and shorter mean operating room times.[4] ASCs are also cost effective. Plastic surgery cases performed at an ASC resulted in higher contribution margin per case minute compared with those performed at a hospital-based facility (HBF).[2] This quality advantage has resulted in more procedures being shifted to ASCs. For example, ambulatory cases represented four to 13 percent of lumbar spine surgery from 1994 to 1996, whereas that percentage increased to nine to 17 percent from 1997 to 2000.[5] According to the American Association for Accreditation of Ambulatory Surgery Facilities (AAAASF), 23 unanticipated deaths occurred out of 1,414,418 outpatient procedures performed.[6] A recent review of pediatric otolaryngology outpatient procedures performed at an ASC revealed an unexpected outcome rate of 0.2 percent, with no deaths.[7]

Current quality studies typically investigate one aspect of quality (eg, safety) while ignoring others. In 2001, the Institute of Medicine defined quality as "the degree to which health services for individuals and populations increase the likelihood of desired health outcomes, and are consistent with current professional knowledge".[1] Quality was further described as being multidimensional. These dimensions include care that is safe, effective, patient-centered, timely, efficient, and equitable.[1] Quality studies should address each of these dimensions to avoid dangerous tradeoffs. For instance, a service that is timely and efficient because it cuts corners may not be safe.

The purpose of this study was to measure the quality of outpatient surgery in an ASC compared to an HBF. By measuring quality in a multidimensional manner, a more complete understanding can be developed of how organizational structure affects quality.

Received March 26, 2009; revised August 12, 2009; accepted September 9, 2009.

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doi:10.1016/j.otohns.2009.09.002

METHODS

Case Selection

An institution-owned database was retrospectively reviewed from October 1, 2008, to October 31, 2008. This database consisted of all surgical procedures performed at a pediatric academic health center for that time period. Procedures were either performed at an HBF or an ASC; both facilities are owned by the same institution. The four most common procedures performed at the ASC were compared to the same procedures at the HBF. These procedures were myringotomy with insertion of pressure equalizing tubes (PET), dental rehabilitation (Dental Rehab), adenotonsillectomy (T&A), and adenoidectomy/myringotomy with insertion of pressure equalizing tubes (PET/Ad). Only outpatient procedures were included. Procedures that were scheduled as inpatient, outpatient-admit, or 23-hour observation were excluded. Combination procedures were also excluded. The study was approved by the Institutional Review Board at Cincinnati Children's Hospital Medical Center.

Facility Description

The HBF is a full-service, not-for-profit, pediatric academic medical center. In 2007, the HBF performed 23,069 outpatient surgical procedures and 5892 inpatient procedures.[8] Twenty-three operating rooms are available. The HBF is located in an urban setting and is a worldwide tertiary referral center for complex conditions.

The ASC is located at a pediatric medical facility consisting of a 24-hour pediatric emergency room, outpatient specialty clinics, imaging and laboratory services, and eight operating rooms. The ASC performs only outpatient surgical procedures and a small number of overnight procedures.

Quality Measures

Using the Institute of Medicine's multidimensional definition of quality, a variety of measures was developed. Table 1 provides the definition, measurement tool, and measure for each dimension of quality. These measures were selected based on existing institutional resources that facilitated data collection and analysis. Although additional measures for each dimension would have certainly yielded a more robust comparison, it was felt that the selected measures provided enough information to make valuable inferences about quality differences between facilities. Safety was measured by extracting data from the surgical safety database, an institution-owned database. Safety measures included unplanned trips to the operating room, unplanned admissions, and unplanned visits to the emergency room. Results were reviewed by senior faculty for appropriateness before inclusion. Effectiveness was not measured in this study. Because the same surgeons operated at each facility, it was felt that any deficiencies in effectiveness would be equally distributed between facilities. Patient-centeredness was measured using the Children's Hospital Ambulatory Surgery Questionnaire, a 17-question survey addressing specific aspects of the patient's experience. Patients were interviewed via telephone by a contracted agency. Questionnaire data were collected from July 1, 2008, to October 31, 2008. Only surveys for included cases (PET, Dental Rehab, T&A, PET/Ad) were used. Timeliness was measured using an electronic operating room management system (Epic, Madison, WI) that records specific time points during the patient's surgery experience. These time points were used to construct clinically relevant time periods. Additional timeliness measures included percentage of cases starting within five minutes of scheduled start time (when scheduled as first case of the day), percentage of cases where the actual case duration did not exceed scheduled duration, and percentage of cases where the recovery room nurse was available at the patient's bedside upon arrival in the post operative care unit (PACU). The same management system (Epic) was used to measure efficiency. The institution's accounting system measures efficiency in terms of supplies, implants, and operational items. Supplies include items used directly for the case (suture, gauze, etc). No implants were used. Operational items are allocated in time increments (eg, charge/15 minutes in operating room [OR]) and are used to recover labor and overhead costs (OR equipment, maintenance, etc). Finally, equitability was evaluated by measuring the median household income by census tract (2000 census data) and geographic proximity to the delivery facility.[9]

RESULTS

Table 2 provides a description of cases performed at the ASC and the HBF. While the four most common procedures at the ASC comprised 48 percent of all cases performed there, these same procedures accounted for only 11 percent of cases at the HBF. Outpatient surgery comprised 99 percent of cases at the ASC compared to 68 percent of cases at the HBF. These results underscore the different environments present at the two facilities. Table 2 also reports the American Society of Anesthesiologists (ASA) classification by procedure. In general, the majority of patients were ASA 1 or ASA 2 at both facilities. The ASC had a slight bias toward ASA 1 patients compared to the HBF. This effect was statistically significant for PET and Dental Rehab ($P =$ 0.0003 and 0.01, respectively). Dental Rehab represented the largest discrepancy (73% were ASA 1 at the ASC; 48% were ASA 1 at the HBF). ASA 3 procedures were rare at both facilities.

Safety

The overall unexpected event rate was 4.2 percent (9/211) at the HBF. Five of these events were visits to the emergency room for dehydration and sore throat. Two patients were admitted for observation after treatment of postoperative tonsillar hemorrhage. One patient was admitted for observation with postoperative vomiting, and one patient with diabetes mellitus was admitted for blood glucose monitor-

Table 1
Dimensions of quality, definitions, and measures

Dimension	Definition (IOM)	Measurement tool	Measures
Safe	Avoiding injury to patients from care that is intended to help them	Surgical safety database	Unplanned trips to the operating room Unplanned admissions Unplanned visits to the emergency room
Effective	Providing services based on scientific knowledge to all who could benefit and refraining from providing services to those not likely to benefit	Not measured	Not measured
Patient-centered	Providing care that is respectful of and responsive to individual patient preferences, needs, and values, and ensuring that patient values guide all clinical decisions	Children's Hospital Ambulatory Questionnaire	17 Questions Addressing: Physical comfort Respect for patients' values, needs, and preferences Emotional support Access to care Information and education Transition and continuity Coordination and integration of care Overall and confidence in care
Timely	Reducing waits and sometimes harmful delays for both those who receive and those who give care	Electronic operating room management system	Clinically relevant time periods Enter time Registration time Wait for SDS SDS time Wait for OR Anesthesia time before OR OR time Transfer to PACU Nurse-to-bedside time Anesthesia time after OR Family wait to see child Recovery time Discharge time Total PACU time Leaving time Total time Percentage of cases starting on time Percentage of cases with actual case length not exceeding scheduled length Percentage of patients with zero wait for PACU nurse
Efficient	Avoiding waste, in particular, waste of equipment, supplies, ideas, and energy	Electronic operating room management system	Supply quantity Supply cost Supply charges Operational items Operational item charges Total charges
Equitable	Providing care that does not vary in quality because of personal characteristics such as sex, ethnicity, geographic location, and socioeconomic status	U.S. Census Bureau 2000 Census Data Mapping Software	Median household income by census tract Geographic proximity to delivery site

IOM, Institute of Medicine; *SDS,* same day surgery; *OR,* operating room; *PACU,* post operative care unit.
Measures were developed using the Institute of Medicine's definition of quality.

Table 2
Case description by facility

Procedure	ASC	HBF	Total
PET*	126	108	234
ASA 1	96 (76%)	60 (56%)	
ASA 2	28 (22%)	47 (43%)	
ASA 3	2 (2%)	1 (1%)	
Dental rehab†	89	58	147
ASA 1	65 (73%)	28 (48%)	
ASA 2	23 (26%)	23 (40%)	
ASA 3	1 (1%)	7 (12%)	
T&A‡	37	34	71
ASA 1	23 (62%)	16 (47%)	
ASA 2	14 (38%)	18 (53%)	
ASA 3	0 (0%)	0 (0%)	
PET/Ad§	23	11	34
ASA 1	12 (52%)	8 (73%)	
ASA 2	11 (48%)	3 (27%)	
ASA 3	0 (0%)	0 (0%)	
Subtotal	275 (48% of total)	211 (11% of total)	486
Total (OP/OP4H)	563	1274	1837
Total cases (all types)	569	1861	2430

ASC, ambulatory surgery center; *HBF,* hospital-based facility; *PET,* insertion pressure equalizing tubes; *Dental rehab,* dental rehabilitation; *T&A,* adenotonsillectomy; *PET/Ad,* insertion pressure equalizing tubes/adenoidectomy; *OP,* outpatient procedures; *OP4H,* 4 hour observation; *ASA,* American Society of Anesthesiologists.
P values represent the likelihood that the ASA class distribution occurred by chance.
*$P = 0.0003$.
†$P = 0.01$.
‡$P = 0.10$.
§$P = 0.22$.

ing. The tonsil bleed rate at the HBF was 5.9 percent (2/34) and 0 percent (0/37) at the ASC. No unexpected events occurred at the ASC.

Patient-centeredness

Results of the Children's Hospital Ambulatory Questionnaire demonstrated that patients generally had a positive experience at the ASC and HBF (Table 3). The overall experience was rated 9.6 at the ASC (scale from 0-10, 10 being the best) and 9.7 at the HBF. The scores were equally similar for all questions; they were generally positive and similar between facilities.

Timeliness

The time-period comparison revealed that procedures performed at the ASC were timelier than those performed at the HBF in nearly every measure for all procedure types (Fig 1). Additionally, the HBF generally had more variation than the ASC. For cases scheduled as the first case of the day, the ASC began on time in 89 percent of cases (n = 45 at both facilities) compared to only 69 percent at the HBF. The percentage of cases with a recovery nurse available upon arrival in the PACU was essentially equal (98% at ASC, n = 268; 94% at HBF, n = 207). Finally, the percentage of cases where the actual duration did not exceed the scheduled duration was dramatically better at the ASC (77%) compared to the HBF (38%).

Efficiency

The two principle measures used to evaluate efficiency were the supply quantity and the operational charges. In a fixed-fee reimbursement model, lower charges translate into increased profit margin for the institution. The ASC generally utilized fewer supplies and operational items for identical procedures (Table 4).

Equitability

In general, patients treated at the ASC came from wealthier census tracts than those treated at the HBF. The median household incomes by census tract for the ASC were $55,930 (PET), $44,388 (Dental Rehab), $51,410 (T&A), and $53,147 (PET/Ad), compared to $43,577 (PET), $42,039 (Dental Rehab), $40,500 (T&A), and $34,423 (PET/Ad) for the HBF. Figure 2 is a map showing the residence of all patients treated at the ASC (Fig 2A) and HBF (Fig 2B) in relation to the respective facility. At the HBF, a significant group of patients lived around the HBF, while no obvious geographical pattern was observed at the ASC.

Table 3
Children's Hospital Ambulatory Questionnaire (all procedures combined)

Question	Best/worst score	ASC, n = 64	HBF, n = 35	% with best score ASC/HBF
On a scale of 0-10, where 0 is the worst care possible and 10 is the best care possible, what number would you use to rate your child's care during this visit?	10/0	9.6	9.7	82/76
Did you have confidence and trust in the doctors treating your child?	1/3	1.0	1.0	98/97
Did you have confidence and trust in the nurses treating your child?	1/3	1.0	1.0	98/98
Did the anesthesia staff in the induction room do everything they could to put your child at ease?	1/3	1.3	1.3	92/95
How would you rate how well your child's pain was managed in the recovery room after his or her procedure?	1/5	1.4	1.4	65/71
How would you rate how well your child's pain was managed after leaving the hospital?	1/5	1.6	1.6	63/69
Would you say that your child's recovery room stay was, 1, a lot shorter than needed; 2, a little shorter than needed; 3, about right; 4, a little longer than needed; or 5, a lot longer than needed?	3/1, 5	3.0	2.8	84/84
How would you rate the courtesy of your child's doctors?	1/5	1.3	1.1	75/87
How would you rate the courtesy of your child's nurses?	1/5	1.2	1.1	83/87
Did the staff introduce themselves and explain their role to you and your child?	1/3	1.0	1.0	97/100
If your child's procedure did not start on time, did someone give you a reason for the delay? 1, Yes; 2, No; 3, Procedure started on time	3/2	2.9	2.7	N/A
When you had important questions to ask a nurse, did you get answers you could understand?	1/3	1.1	1.2	98/95
Before the procedure, did the surgeon answer your questions in a way you could understand?	1/3	1.1	1.0	92/100
Please rate how well the anesthesia staff helped you and your child understand the anesthesia process.	1/4	1.1	1.4	94/92
After your child's procedure, were the surgical results explained to you in a way that you could understand?	1/3	1.0	1.1	98/100
Did someone on the hospital staff teach you what you needed to know to care for your child at home?	1/3	1.0	1.1	97/95
Sometimes in the hospital, one doctor or nurse will say one thing and another will say something quite different. Did this happen during your child's stay?	3/1	2.9	2.8	89/87

Ten patients from each facility were contacted weekly via telephone by a contracted agency.

DISCUSSION

The purpose of this study was to use a multidimensional definition to measure the quality of outpatient surgery performed at an ASC compared to an HBF. While certain dimensions did not demonstrate significant differences (patient-centeredness), most of the dimensions revealed an advantage for the ASC over the HBF. The quality of outpatient surgery at the ASC was at least equal and in some cases superior to the HBF. These results confirm those found elsewhere.[2,4,7,10] This study was unique in the multidimensional manner in which quality was measured.

The results of the surgical safety database demonstrated differences between the two facilities. Nine unexpected events occurred at the HBF compared to none at the ASC. Upon further inspection, most of these events were visits to the emergency room for poor oral intake. Two tonsil bleeds occurred at the HBF (2/34, 5.9%), with zero (0/37, 0%) cases at the ASC. If the inclusion criteria were liberalized to include combination cases, two additional tonsil bleeds occurred at both the ASC and HBF. Therefore, the difference in tonsil bleed rates between facilities is likely not significant. Future data collections with larger sample sizes will elucidate these differences.

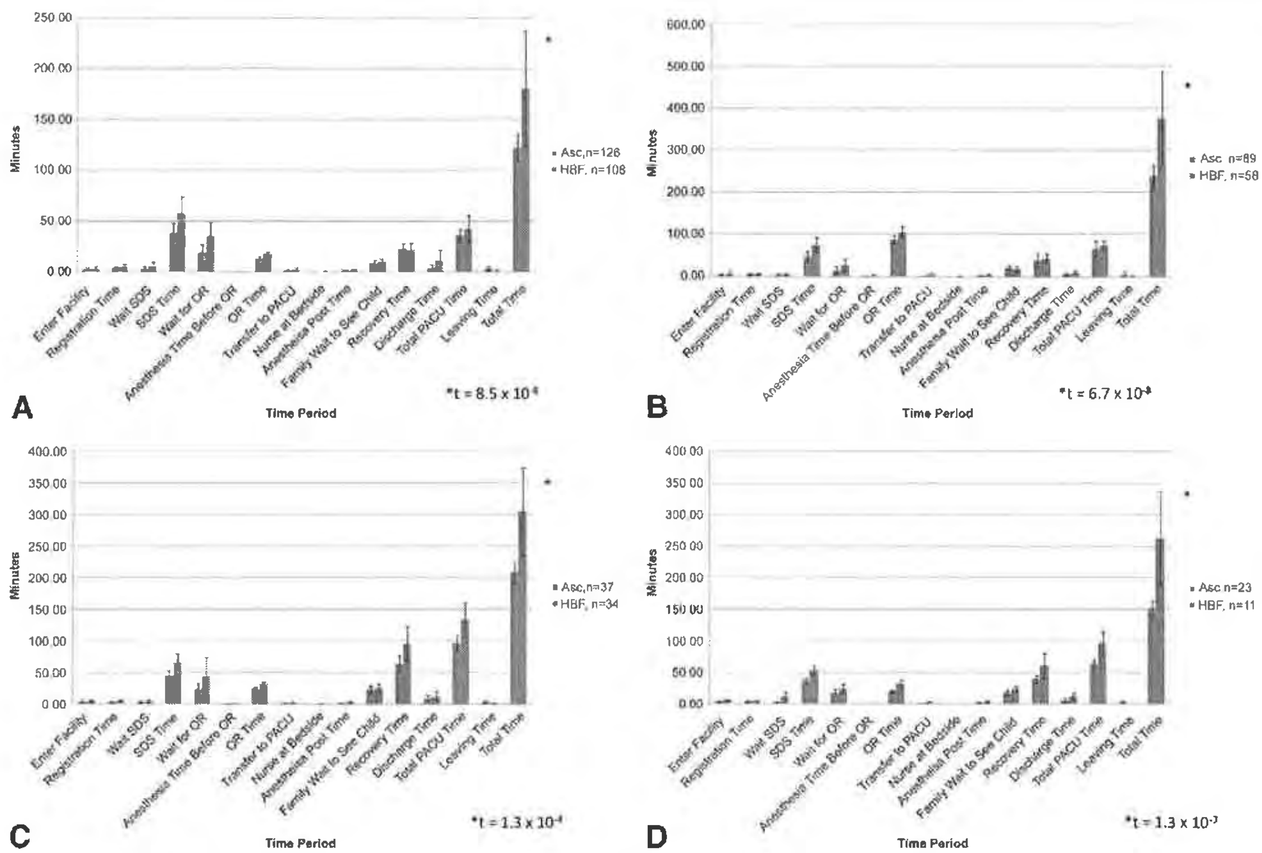

Figure 1 Time period comparison by location, ASC versus HBF: (A) PET; (B) dental rehab; (C) T&A; (D) PET/Ad. Student's t test applies to "total time."

Patient satisfaction surveys demonstrated that the experience was equally positive at both the ASC and the HBF. Gardner et al similarly found that, while patients at both types of facilities experienced significant preoperative anxiety, patients were generally satisfied with the care they received, regardless of location.[11] It is noteworthy that patients were equally pleased with each facility despite measurable differences in several quality dimensions. Literature

Table 4
Comparison of resource utilization by procedure and location

Procedure	Supply quantity	Supply cost ($)	Supply charge ($)	Operational items	Operational charges ($)	Total charges ($)
PET						
ASC	4.55	44.80	213.10	7.40	1457.25	1670.34
HBF	6.92	54.34	249.95	9.08	1672.78	1922.74
Dent rehab						
ASC	6.73	66.95	315.57	23.39	4029.68	4345.25
HBF	6.46	78.25	348.88	28.14	4708.84	5057.72
T&A						
ASC	4.89	72.25	341.76	13.78	2200.88	2542.64
HBF	7.32	82.79	391.59	18.00	2453.09	2844.68
PET/Ad						
ASC	8.91	102.39	484.30	10.57	1828.42	2312.72
HBF	10.73	126.45	574.09	14.91	2259.29	2833.38

ASC, ambulatory surgery center; *HBF,* hospital-based facility; *PET,* insertion pressure equalizing tubes; *Dental rehab,* dental rehabilitation; *T&A,* adenotonsillectomy; *PET/Ad,* insertion pressure equalizing tubes/adenoidectomy.
Supplies include items used (eg, gauze, suture, etc) for each procedure.

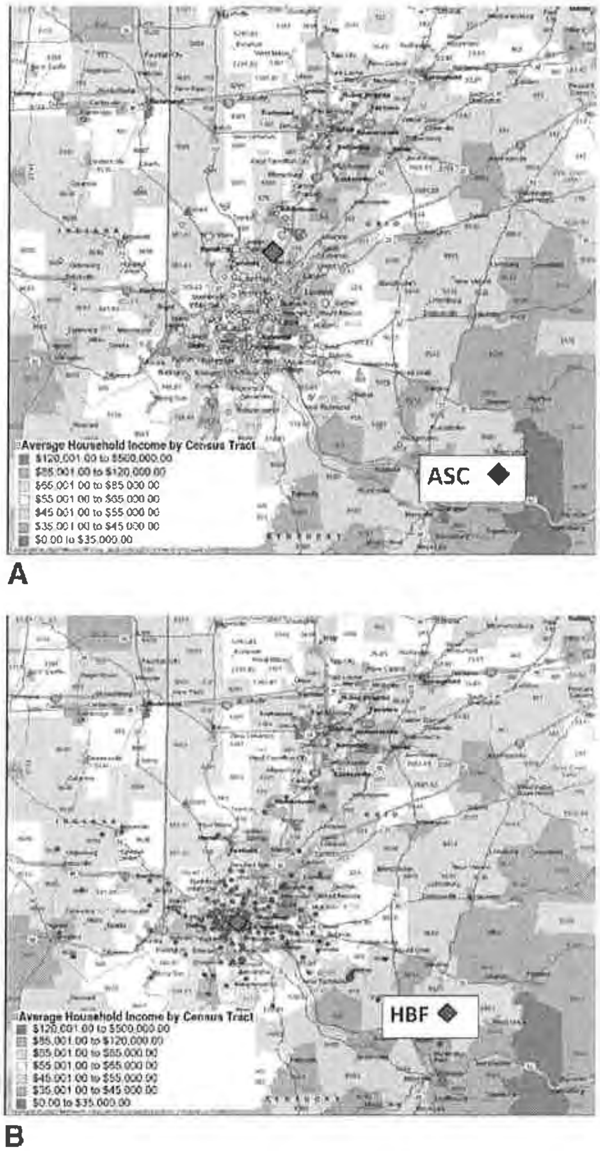

Figure 2 Proximity to facility by median household income: **(A)** ASC; **(B)** HBF. *Small circles*, 1 to 2 patients; *large circles*, 3 to 4 patients.

suggests that most patients lack the expertise to accurately judge the quality of healthcare services and therefore use surrogate markers (cleanliness, friendliness, etc) to make judgments about quality.[12]

The ASC appeared to outperform the HBF in timeliness. The ASC also demonstrated less variability than the HBF. The diverse and complicated nature of the HBF combines patients with diverse perioperative processes into one service location. This may adversely affect timeliness for low-complexity cases (PET, T&A) occurring in such an environment. Conversely, the ASC has a less diverse case mix, and thus perioperative processes are less varied. By geographically grouping cases with similar perioperative processes, the ASC efficiently utilizes human resources. Further investigation is warranted to gain a deeper understanding of how perioperative processes differ between facilities.

Dramatic differences were also observed in the percentage of cases where the actual case length did not exceed the scheduled length (77% vs 38%). In cases where the actual case length did exceed the scheduled length, the HBF also tended to have longer delays. For example, PETs performed at the HBF exceeded the scheduled length in 70 percent of cases, with an average delay of 6.3 minutes, compared to 17 percent of cases, with an average delay of 5.2 minutes, at the ASC. One explanation for this difference may be the presence of residents at the HBF. At the HBF, surgical residents are involved in most of the procedures, and many rotating residents participate in the anesthesia care. Currently, the ASC has almost no resident participation. As pressure increases to improve timeliness, academic centers will have to balance quality improvement efforts with their mission to train physicians.

Efficiency is a measure of how well resources are utilized. In the current study, supply quantity and operational items were used as measures of resource utilization. For nearly all procedures, the ASC performed the same procedures more efficiently than the HBF. These differences in resource utilization represent cost savings for the ASC and support other findings.[2]

The maps in Figure 2 demonstrate that patients treated at the ASC generally resided in higher income neighborhoods (census tracts) and were not restricted by location. Conversely, patients at the HBF tended to live in lower income areas surrounding the HBF. More research is needed to understand this effect. If ASCs truly represent a quality advantage over HBFs, and ASCs are placed geographically in affluent areas, then the patients of lower socioeconomic status could have reduced access to this higher quality care.

Limitations

There are several limitations to this study. It is likely that increased ASA classification is associated with poorer outcomes in areas such as timeliness, efficiency, and adverse events. In the current study, ASA 1 cases were more common at the ASC than ASA 2 cases for two procedures (PET, $P = 0.0003$; Dental Rehab, $P = 0.01$). While statistically significant, both classifications meet institutional criteria to be performed at either location. The impact of an ASA 1 case compared to an ASA 2 case on outcomes is felt to be low for the types of procedures studied. Nevertheless, future data collections will help answer this question. On the other hand, ASA 3 patients are felt to have sufficient comorbid disease to adversely affect outcomes, even for low-complexity procedures. For this reason, ASA 3 cases are not performed at the ASC unless special approval is obtained. The number of ASA 3 cases performed was extremely low for PET (2% at the ASC, 1% at the HBF), T&A (0% at both facilities), and PET/Ad (0% at both facilities). Interestingly, a difference in ASA 3 cases did exist for Dental Rehab (1% at the ASC; 12% at the HBF), and yet the quality outcomes

for this procedure followed the same trends as PET, T&A, and PET/Ad.

The sample size for this study is small, particularly for specific data subsets. While the small sample size may weaken the strength of the conclusions, the outcomes for procedures with small numbers (PET/Ad) did not differ from those with higher numbers (PET). As a preliminary study, sufficient data exist to suggest that true quality differences exist between facilities. Additionally, these results will help focus future data collections with larger numbers. Furthermore, the small sample size provided an opportunity to examine a larger, more inclusive number of measures in the quality comparison.

Another potential confounder in this study is the presence of residents at the HBF compared to the ASC. Figure 1 demonstrates, however, that the time during which residents participate in care (OR time) contributes insignificantly to overall differences in timeliness (total time). Therefore, at least some outcomes seem to be minimally affected by resident participation. From a practical standpoint, these results suggest that a very different quality experience characterizes these facilities, regardless of resident participation. This information is meaningful to providers, administrators, and patients when choosing a service facility. Finally, resident education may be limited if academic centers are held to the same quality standard as other institutions regarding value-based purchasing programs. Specifically, government programs that emphasize cost reduction and efficiency at the expense of resident training could undermine the quality of future generations of surgeons.

Health Policy Implications

Intense competition, increasing quality standards, and scarce resources have led many institutions to shift toward "service-line" strategies, allowing facilities to concentrate on what they do best. It makes sense, at least, for institutions to determine what types of organizational structure provide the best patient care. Aligning services with healthcare needs is not new. For example, Berry et al has stated that "when health care professionals consistently work below their level of expertise, scarce resources are wasted [and] care is more costly . . . Specialist physicians should do less of what generalist physicians can do, generalist physicians should do less of what nonphysician providers can do, and nonphysician providers should do less of what nonclinical staff can do."[13] The current study suggests that performing low complexity cases at an ASC may represent a better utilization of resources.

As efforts increase to make improvements in the Institute of Medicine's dimensions of quality, it becomes clear that organizational technologies are necessary for progress. Before the implementation of an electronic operating room management system, this type of quality measurement would have been impossible. Thus, the success of improvement efforts relies on an institution's "ability to simultaneously build upon several organizational technologies: clinical, social, information, and administrative technologies".[14]

Ample evidence suggests that academic centers operate with significant financial risk.[15-17] Highly specialized procedures are increasingly shifted to teaching hospitals,[18] and complex patients tend to be poorly reimbursed.[16] Many expect these trends to continue. While reimbursement polices certainly need to be adjusted, investing in a free standing ASC is one method for academic health centers to remain financially competitive.[19-20]

While access to the ASC in this study was not limited to patients with commercial insurance (identical insurance policies governed both facilities), many private ASCs do not accept government-funded insurance plans because of poor reimbursement. This study suggests that government programs supporting ASCs may be a wise use of resources, which could facilitate the growth of these facilities in areas besides wealthy neighborhoods.

ACKNOWLEDGEMENTS

The comments of Leonard Berry, PhD, and Andrew Friedrich, MD, are acknowledged and appreciated. Jareen Meinzen-Derr, PhD, MPH, assisted with statistical analysis.

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DISCLOSURES

Competing interests: None.

Sponsorships: None.

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ANNALS OF SURGERY
Vol. 230, No. 5, 721–727

Return Hospital Visits and Hospital Readmissions After Ambulatory Surgery

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Objective

To determine the overall and complication-related readmission rates within 30 days after ambulatory surgery at a major ambulatory surgical center.

Summary Background Data

Currently in North America, 65% of the surgical procedures are carried out in ambulatory settings. The safety of ambulatory surgery is well documented, with low rates of adverse events during or immediately after surgery. The consequences of ambulatory surgery during an extended period, however, have not been studied extensively.

Methods

Preoperative, intraoperative, and postoperative data were collected on 17,638 consecutive patients undergoing ambulatory surgery at a major ambulatory surgical center in Toronto, Ontario. With the use of the database of the Ontario Ministry of Health, the authors identified all return hospital visits and hospital readmissions occurring in Ontario within 30 days after the ambulatory surgery. Return visits were categorized as emergency room visits, ambulatory surgical unit admissions, or inpatient admissions. The readmissions were categorized as those resulting from surgical, medical, or anesthesia-related complications or those not related to the ambulatory surgery.

Results

One hundred ninety-three readmissions occurred within 30 days after ambulatory surgery (readmission rate 1.1%). Six patients returned to the emergency room, 178 patients were readmitted to the ambulatory surgical unit, and 9 patients were readmitted as inpatients. Twenty-five readmissions were the result of surgical complications, and one resulted from a medical complication (pulmonary embolism). The complication-related readmission rate was 0.15% (1 in 678 procedures). The complication rate was significantly higher among patients undergoing transurethral resection of bladder tumor (5.7%). No anesthesia-related readmissions or deaths were identified.

Conclusions

The rate of complication-related readmissions was extremely low (0.15%). This result further supports the view that ambulatory surgery is a safe practice.

The popularity of ambulatory surgery is continuously increasing because of cost saving and convenience. The low rate of adverse events or complications during the intraoperative or immediate postoperative periods further justifies the rapid growth of ambulatory surgery.[1–3] Most of the published literature, however, reflects the results of observations during the patients' stay in the ambulatory surgical unit (ASU) or within 48 to 72 hours after discharge.[2,4–7] To assess the overall safety of ambulatory surgery and its burden on health care, it is essential to extend the follow-up and observation of ambulatory surgical patients for a longer period, because surgery-related complications might occur more than 48 to 72 hours after surgery.

Only a limited number of published studies include large study populations and focus on ambulatory surgical patients after discharge during an extended observation period. In studies involving large patient populations, Natof[1] reported major complications within 2 weeks, and Warner et al[8] reported major complications and deaths within 1 month of ambulatory surgery. These studies were outcome surveys primarily based on mail-in questionnaires, phone interviews, and reviews of medical records identifying only major adverse events and deaths. Readmissions were not

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Accepted for publication May 10, 1999.

studied. Twersky et al[9] reported return hospital visits within 30 days of ambulatory surgery. However, because their study identified return visits occurring only in the same hospital, readmissions may have been missed if patients went to another hospital. Henderson et al,[10] using record linkage, reported emergency readmission rates within 28 days after day surgery; however, they did not determine whether the readmissions were related to the prior ambulatory surgery.[10] There are no available published results on complication-specific readmission rates in a large study population within an extended observation period after ambulatory surgery.

The objective of our study was to determine, by linking a large outpatient database at a major teaching hospital in Toronto to the database of the Ministry of Health in Ontario, how frequently ambulatory surgical patients required medical care in a hospital after their ambulatory surgery as a result of complications. We aimed to identify all hospital visits and admissions within 30 days after ambulatory surgery, whether they occurred in the same hospital or in a different health care facility.

METHODS

A total of 17,638 consecutive ambulatory surgical patients were enrolled into a prospective study during a 3-year period at the Toronto Western Hospital. The hospital's ethics committee approved the study. Because there was no alteration from standard patient care, no written consent was required from the patients.

Preoperative, intraoperative, and postoperative data were collected on each patient, using standardized information sheets. The patients' age, sex, American Society of Anesthesiology (ASA) physical status,[11] medical history, type and duration of surgery, type of anesthesia, physiologic variables, and medications given were recorded by the attending anesthesiologists on specifically designed standardized anesthesia records. The occurrence of intraoperative adverse events, such as cardiovascular, respiratory, intubation-related, fluid and metabolic, neurologic, and miscellaneous events, was also recorded on standardized intraoperative event sheets by the anesthesiologists.

The occurrence of postoperative adverse events, such as cardiovascular, respiratory, fluid, renal, metabolic, and neurologic events, excessive pain, bleeding, nausea and vomiting, dizziness, drowsiness, and miscellaneous events, in the postanesthesia care unit and the ASU was recorded on standardized event sheets by trained nursing staff.

Patients were discharged when they achieved a score of 9 or 10 on the Postanesthesia Discharge Scoring System.[12] Patient records and event sheets were systematically reviewed and checked for completeness and consistency on the next day by a research assistant and an experienced anesthesiologist.

After the completion of data entry, hospital visits and admissions within 30 days of the patients' ambulatory surgery were identified by using the Canadian Institute of Health Information inpatient and outpatient databases at the Ontario Ministry of Health. Patients were identified by their unique provincial health identification number. In Canada, the provincial governments are responsible for financing health care, including hospital and physician fees. To qualify for reimbursement for the provided care in Ontario, each patient's hospital visit or admission in the province must be reported to the Ontario Ministry of Health. Therefore, the use of these databases enabled us to identify all hospital visits and admissions of our patients occurring anywhere in Ontario. The information retrieved by the Ministry of Health contained the date of the visit or admission; the date of discharge; whether the patient was discharged alive; the admission category, such as elective, urgent, or emergency; the location and type of health care facility (inpatient or outpatient); the patient's diagnoses, coded according to the International Classification of Diseases, 9th revision; and the procedures completed on the patient during the patient's stay, coded according to the Canadian Classification of Diagnostic, Therapeutic and Surgical Procedures.

Based on the diagnoses and procedures in the Canadian Institute of Health Information files and our original patient files, we categorized the return hospital visits and admissions as emergency room (ER) visits, ASU admissions, or inpatient admissions. ER visits were further categorized as visits related to the previous ambulatory surgery (*e.g.*, bleeding, fever, pain, urinary retention) or visits unrelated to the previous ambulatory surgery. ASU and inpatient admissions were categorized as:

- Admissions resulting from surgical (*e.g.*, bleeding, fever), medical (*e.g.*, cardiovascular or pulmonary events), or anesthesia-related complications (*e.g.*, nausea, vomiting) related to the previous ambulatory surgery
- Admissions related to the previous ambulatory surgery but not resulting from complications (*e.g.*, stent removal after ureteral stent insertion)
- Admissions unrelated to the previous ambulatory surgery.

Rates of return hospital visits and admissions (readmission rates) due to complications or due to any reason are reported. Relative risks and 95% confidence intervals were calculated where appropriate. A p value <0.05 was considered significant. Because of the small number of events, multivariable analyses to identify independent risk factors for readmissions were not attempted.

RESULTS

Over a 3-year period, 17,638 patients underwent ambulatory surgery at the ASU of the Toronto Western Hospital (Tables 1, 2, and 3). Of those patients, 193 (1.1%) returned to the hospital within 30 days after their ambulatory surgery (Table 4). One hundred eighteen readmissions (61%) oc-

Table 1. PATIENT CHARACTERISTICS (n = 17368)

Age (years)	47 ± 21 (range 11–98)
Sex	
Female	11,826 (67.0%)
Male	5,812 (33.0%)
ASA Status	
I	9,194 (52.1%)
II	7,301 (41.4%)
III	1,143 (6.5%)
Preexisting Medical Conditions	
Hypertension	2,441 (13.8%)
Angina pectoris	751 (4.3%)
Myocardial infarction	449 (2.5%)
Dysrhythmia	471 (2.7%)
Valvular heart disease	302 (1.7%)
Congestive heart failure	144 (0.8%)
Smoking	2,508 (14.2%)
Asthma	1,003 (5.7%)
Chronic obstructive pulmonary disease	383 (2.2%)
Upper respiratory tract infection	95 (0.5%)
GE reflex	644 (3.7%)
Renal disease	204 (1.2%)
Diabetes mellitus	921 (5.2%)
Thyroid disease	790 (4.5%)
Obesity	2,799 (15.9%)
Arthritis	1,148 (6.5%)
Cerebrovascular accident or transient ischemic attack	234 (1.3%)
Seizure	118 (0.7%)
Peptic ulcer	139 (0.8%)
Hepatitis	138 (0.8%)
Sickle cell trait	92 (0.5%)
Substance abuse	88 (0.5%)
Anemia	46 (0.3%)
HIV-positive	17 (0.1%)

curred in the same hospital and 75 readmissions (39%) occurred at other institutions in the province. Of the 193 readmissions, 26 (13%) occurred as a result of complications (25 surgical and 1 medical), 38 (20%) were related to the previous ambulatory surgery but were not complications, and 129 (67%) were unrelated to the previous ambulatory surgery. Six patients (3%) returned to the ER, 178 (92%) were readmitted to the ASU, and 9 (5%) were readmitted as inpatients.

The complication-related readmission rate was 0.15%, or one complication in 678 procedures. No anesthesia-related complications or deaths were identified. Surgical or medical complications necessitating readmission followed nine types of surgical procedures (Table 5). Although the observed numbers were small, the surgical complication rate after transurethral resection of bladder tumor (TURBT; 5.7%) was significantly higher than that after other procedures. Complication-related readmissions also occurred after breast augmentation, breast biopsy, cystoscopy, Bartholin's cyst removal, dilatation and curettage for abortion, cornea and cataract surgery, and knee arthroscopy. The calculated rates for these procedures were not statistically different from the 0.15% overall complication-related readmission rate.

Of the 26 patients with return visits due to surgical or medical complications, 23 were treated in the same hospital and 3 at other institutions. Twelve of the 26 patients returned within the first 7 postoperative days. The patients with complications were older on the average (52 ± 20 years) and were more likely to have a higher ASA physical

Table 2. TYPE OF ANESTHESIA

Type	No. (%)
General anesthesia	10,110 (57.3)
Monitored anesthesia care	6,301 (35.7)
Local	586 (3.3)
Regional	484 (2.7)
Chronic pain block	157 (0.9)

Table 3. TYPE OF SURGERY

	Number (%)
Ophthalmology	**6372 (36.1)**
Cataract	4700 (26.6)
Strabismus	423 (2.4)
Cornea	423 (2.4)
Trabeculectomy	312 (1.8)
Other	514 (2.9)
Gynecology	**5959 (33.8)**
D&C	4948 (28.1)
Laparoscopy	740 (4.2)
Hysteroscopy	221 (1.3)
Biopsy/repair	50 (0.3)
Orthopedics	**3179 (18.0)**
Knee	1898 (10.8)
Shoulder	411 (2.3)
Hand, wrist	263 (1.5)
Ankle	220 (1.2)
Hardware removal	207 (1.2)
Hip and other	92 (0.5)
Elbow	88 (0.5)
Plastic Surgery	**633 (3.6)**
Hand	343 (1.9)
Skin and other	153 (0.9)
Face	96 (0.5)
Breast augmentation	41 (0.2)
Neurosurgery	**484 (2.7)**
Carpal tunnel	313 (1.8)
Nerve decompression, repair	171 (1.0)
General Surgery	**398 (2.3)**
Breast	221 (1.3)
Other	177 (1.0)
Urology	**232 (1.3)**
Bladder/prostate/kidney	174 (1.0)
Testicle/scrotum	29 (0.2)
Circumcision	29 (0.2)
ENT/Dental	**224 (1.3)**
ENT	208 (1.2)
Dental	16 (0.1)
Chronic Pain Block	**157 (0.9)**

Table 4. HOSPITAL VISITS AND ADMISSIONS WITHIN 30 DAYS OF AMBULATORY SURGERY

Hospital Visits and Admissions	Same Hospital	Other Institutions
Total	118	75
ER		
Related—surgical Cx	4	0
Not related	0	2
ASU		
Related—surgical Cx	16	2
Related—not Cx	30	7
Not related	62	61
Inpatient		
Related—surgical Cx	3	0
Related—medical Cx	0	1
Related—not Cx	1	0
Not related	2	2

Cx, complication; ER, emergency room; ASU, ambulatory surgical unit.

status (31%, 58%, and 12% of the patients with complications were in ASA class I, II, and III, respectively) than patients without complications.

Four of the 26 patients with complications were seen in the ER (Table 6). Three patients returned on the day after surgery: two because of urinary retention after urologic procedures (TURBT and cystoscopy), both requiring catheter insertion, and one because of pain after cataract surgery, requiring no immediate treatment. One patient returned to the ER 4 days after breast biopsy because of fever and wound dehiscence and was given antibiotics as treatment.

Of the 18 patients readmitted to the ASU because of surgical complications, 11 had undergone ophthalmologic surgery. They were readmitted for repair of iris prolapse, repositioning or exchange of dislocated lens implant after cataract surgery, division of anterior synechiae after corneal graft, or secondary corneal graft for leaking corneal wound after corneal implant (Table 7). Two patients returned for repeated abortion because no fetal tissue was removed at the original procedure, and two patients returned as a result of bleeding after abortion. Two patients returned after TURBT: one for stricture requiring catheter insertion and one for hematuria, which required cystoscopy to identify the source of bleeding. One patient returned because of a deflated breast implant after breast augmentation; the implant was replaced.

Four patients were admitted as inpatients because of complications within 30 days after their ambulatory surgery (Table 8). One patient was admitted as a result of wound infection and fever 3 days after Bartholin's cyst removal; antibiotics were given, and the patient was discharged the next day. Two patients were admitted because of extensive bleeding 6 and 17 days after dilatation and curettage for abortion; both patients were discharged after 2 days after volume replacement. A 44-year-old patient was admitted because of pulmonary embolism 20 days after knee arthroscopy; the patient was given anticoagulation therapy and discharged after 8 days.

One hundred sixty-seven of the 193 readmissions were not related to complications: 2 were ER visits, 160 were ASU admissions, and 5 were inpatient admissions. The two ER visits were not related to the original surgery and occurred in different hospitals (knee injury and lumbago). Thirty-seven of the non-complication-related ASU readmissions were for additional procedures, which were related to the original procedures but were not complications of them (*e.g.*, ultrasound fragmentation of stone after cystoscopy, stent removal after ureteral stent insertion, knee ligament repair after arthroscopy). The remaining 123 ASU procedures were scheduled elective procedures unrelated to the original ambulatory procedures. Of the five inpatient admissions, one was related to but was not a complication of the previous ambulatory procedure: nephrolithotomy was carried out, requiring a 5-day stay 29 days after the ambulatory cystoscopy. The other inpatient admissions were unrelated to the original ambulatory surgery: two were for repeated pain block for patients with chronic pain; one was for a patient with kidney cancer who had undergone ambulatory cataract removal; and one was a 1-day admission because of syncope, which occurred 23 days after cataract surgery in an 86-year-old patient.

Table 5. PROCEDURE-SPECIFIC RATES OF READMISSION DUE TO COMPLICATIONS

Procedure (no.)	No. of Readmissions for Complications (%)	Relative Risk (95% CI)	p Value
TURBT (53)	3 (5.7)*	43 (13–140)	<0.0001
Breast augmentation (41)	1 (2.4)	17 (0.9–172)	0.06
Bartholin's cyst removal, excision/repair (50)	1 (2.0)	14 (0.9–112)	0.07
Cystoscopy (66)	1 (1.5)	11 (0.7–93)	0.1
Cornea (423)	2 (0.5)	3.4 (0.8–14)	0.1
Breast surgery, general (221)	1 (0.5)	3.2 (0.4–23)	0.3
Cataract (4700)	10 (0.2)	1.7 (0.8–3.8)	0.2
D&C for abortion (4658)	6 (0.1)	0.8 (0.3–2.1)	0.7
Knee surgery (1881)	1 (0.05)	0.3 (0.1–2.5)	0.5

Relative risks are computed as comparison to all other types of procedures.
D&C, dilatation and curettage; TURBT, transurethral resection of bladder tumor.
* Significantly higher than in other procedures.

Table 6. CHARACTERISTICS OF PATIENTS RETURNING TO THE ER WITH COMPLICATIONS

Ambulatory Surgery	Complication and Treatment	Postop. Day	Age (yr)	Sex	ASA
Cataract removal	Pain, referral	1	54	M	2
TURBT	Urinary retention, catheter insertion	1	70	M	2
Cystoscopy	Urinary retention, catheter insertion	1	33	F	2
Breast biopsy	Fever, wound dehiscence, antibiotics given	4	40	F	1

ASA, American Society of Anesthesiology classification; POD, postoperative day at emergency room visit; TURBT, transurethral resection of bladder tumor.

DISCUSSION

We observed extremely low readmission rates after ambulatory surgery: 1.1% of the patients were readmitted, and only 0.15% of the patients were readmitted as a result of complications within 30 days after ambulatory surgery. These rates are lower than previously published rates. Natof[1] reported 106 major complications among 13,433 ambulatory surgical patients, a complication rate of 0.79%, within 2 weeks after their ambulatory surgery. Warner et al[8] found that 33 of 38,598 patients undergoing ambulatory surgery (*i.e.*, 0.09% of the patients) had major complications or died within 1 month after their ambulatory procedures. Heino et al[13] reported that 11.7% of their 500 ambulatory surgical patients visited a doctor within 1 month of their surgery, and 4.3% of them had wound problems. None of the above studies, however, reported what percentage of patients needed hospital admission. Henderson et al[10] identified emergency readmission rates of 0% to 2.3% within 28 days after ambulatory surgery. The frequency of readmissions depended on the type of surgery; however, the percentage of readmissions related to the previous ambulatory surgery was not specified. Our study showed that many readmissions were *not* related to the previous ambulatory surgery. Studies including smaller numbers of patients undergoing various surgical procedures also showed various rates (0.9% to 3.6%) of return hospital visits.[14–16]

Twersky et al[9] found that 187 return hospital visits (3.0%) occurred among 6243 ambulatory surgical patients within 30 days after their surgery. Eighty-two of those admissions resulted from surgical complications, a complication-related readmission rate of 1.3%. The authors may have underestimated their readmission rate, however, because they studied returns only to the same hospital. Even so, their overall readmission rate was threefold higher and their complication-related readmission rate was ninefold higher than the corresponding rates in our study. These differences between the studies could be explained by regional differences in the quality of surgical care, differences in the surgeons' attitude and judgment in the two regions about whether certain complications could be treated adequately in an office setting, or significant differences in the patient populations and the types of completed surgical procedures. The major difference in readmission rates between the facilities in these two studies indicates the need for every ambulatory surgical facility to study its own readmission rates due to surgical, medical, and anesthesia-related complications.

The fact that we did not find any deaths is comparable to the previously reported findings. Among the studies cited above, only Warner et al,[8] who had the largest patient population, reported deaths, and even their reported death rate was very low—4 in 38,598. The occurrence of only one medical complication (pulmonary embolism) in our study is also similar to previously published results.[8,9] The study by Warner et al asked whether the medical complications were just untimely events or the procedures and anesthetics were contributory. The complications occurred less often than would have been expected in the general population. This may result from the fact that patients scheduled for elective surgical procedures are usually healthier than the general population.

The absence of anesthesia-related readmissions in our patient population is also congruent with previously reported findings. The use of currently available anesthetics and anesthesia techniques results in a very low rate of adverse events, mostly nausea and vomiting. These adverse symptoms generally occur immediately or shortly after the end of the procedure, usually during the patients' stay in the postanesthesia care unit or ASU, and may lead to unantic-

Table 7. COMPLICATIONS REQUIRING READMISSION TO ASU

Complication	Number
Dislocated lens	6
Iris prolapse	3
Bleeding, hematuria	3
No fetal tissue	2
Leaking corneal wound after cornea graft	1
Anterior synechiae after cornea graft	1
Urethral stricture	1
Deflated breast implant	1

Table 8. PATIENTS WITH SURGICAL OR MEDICAL COMPLICATIONS REQUIRING INPATIENT HOSPITAL ADMISSIONS

Ambulatory Surgery	Complication and Treatment	POD	DOS (days)	Age (yr)	Sex	ASA
Bartholin's cyst removal	Fever, wound infection, antibiotics given	3	1	39	F	2
D&C for abortion	Delayed extensive bleed, volume replacement	6	2	33	F	2
D&C for abortion	Delayed extensive bleed, volume replacement	17	2	23	F	1
Knee arthroscopy	Pulmonary embolism, anticoagulation	20	8	44	M	2

ASA, American Society of Anesthesiology classification; D&C, dilatation and curettage; DOS, duration of stay; POD, postoperative day at readmission.

ipated admission.[17] Once these patients are discharged home, anesthesia-related symptoms do not cause readmission.

One type of procedure showed a higher-than-expected rate of hospital visits and readmissions. Of the 53 patients with TURBT, 3 returned to the hospital (5.7%). Twersky et al[9] showed a similar incidence among their urologic patients. This high return rate may be inherent among urologic patients, because they are at higher risk for multiple complications, such as hematuria, urinary retention, and infection. The relatively high return rate (1 in 41) after breast augmentation is also consistent with other published complication rates. Readmissions after breast augmentation result mainly from implant failure.[18]

The low return rate after cataract extraction and other types of eye surgery is also compatible with previously published rates.[19] These procedures are relatively short in duration (<1 hour); they are usually completed under monitored anesthesia care, resulting in a low rate of anesthesia-related symptoms; and they are usually less painful procedures, causing postoperative discomfort for only a limited time.

Compared with a previous report,[9] we found a surprisingly low readmission rate (0.1%) among patients undergoing dilatation and curettage for abortion. Similarly, the return rate due to infection and bleeding was extremely low among our patients. These differences could be the result of different techniques used by surgeons or a difference in the skills of surgeons.

The use of province-wide databases by the Ontario Ministry of Health ensures that all hospital readmissions were included in our study and makes it highly unlikely that any readmission of our patients was missed. The likelihood that a patient was admitted to a hospital outside Ontario is minimal but not impossible. It is also remarkable that 23 of the 26 complication-related readmissions (88%) occurred in the same hospital as the ambulatory surgery; therefore, using only the same hospital's records may result in only a moderate underestimation of complication-related readmission rates. However, the magnitude of this underestimation depends largely on the availability of similar surgical facilities in the same region.

In conclusion, our results give further support to the view that ambulatory surgery is a safe practice. We found an extremely low rate (0.15%) of complication-related hospital visits and readmissions within 30 days after ambulatory surgery. Only urologic patients undergoing TURBT had a significantly higher rate of complications (5.7%). The number and variety of surgical procedures performed in an ambulatory setting are continuously increasing; therefore, it is necessary to evaluate readmission rates after discharge for these procedures. These readmission rates may be useful as benchmarks for comparison against outcome reports in other surgical facilities.

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Cite this article as:
Elizabeth L. Munnich and Stephen T. Parente
Procedures Take Less Time At Ambulatory Surgery Centers, Keeping Costs Down And Ability To Meet Demand Up
Health Affairs, 33, no.5 (2014):764-769

doi: 10.1377/hlthaff.2013.1281

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DOI: 10.1377/hlthaff.2013.1281
HEALTH AFFAIRS 33,
NO. 5 (2014): 764–769

Procedures Take Less Time At Ambulatory Surgery Centers, Keeping Costs Down And Ability To Meet Demand Up

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ABSTRACT **During the past thirty years outpatient surgery has become an increasingly important part of medical care in the United States. The number of outpatient procedures has risen dramatically since 1981, and the majority of surgeries performed in the United States now take place in outpatient settings. Using data on procedure length, we show that ambulatory surgery centers (ASCs) provide a lower-cost alternative to hospitals as venues for outpatient surgeries. On average, procedures performed in ASCs take 31.8 fewer minutes than those performed in hospitals—a 25 percent difference relative to the mean procedure time. Given the rapid growth in the number of surgeries performed in ASCs in recent years, our findings suggest that ASCs provide an efficient way to meet future growth in demand for outpatient surgeries and can help fulfill the Affordable Care Act's goals of reducing costs while improving the quality of health care delivery.**

Technological developments in medicine have dramatically changed the provision of surgical care in the United States during the past thirty years. Advances in anesthesia and the development of laparoscopic surgery in the 1980s and 1990s made it possible for patients to be discharged the same day as their surgery, whereas previously they would have had to spend several days in the hospital recovering.[1,2] The introduction of the Medicare inpatient prospective payment system in 1983 created additional incentives for hospitals to shift patient care from inpatient to outpatient departments.[3]

Between 1981 and 2005 the number of outpatient surgeries nationwide—performed either in hospital outpatient departments or in freestanding ambulatory surgery centers (ASCs)—grew almost tenfold, from 3.7 million to over 32.0 million. Outpatient procedures represented over 60 percent of all surgeries in the United States in 2011, up from 19 percent in 1981.[4]

The expansion of health insurance coverage under the Affordable Care Act (ACA) presents opportunities to explore new ways to accommodate the increased demand for outpatient services. In addition, the ACA's goals of reducing the cost and improving the quality of health care delivery makes it increasingly important to find alternatives to existing methods of care delivery that cost less and are in more flexible settings.

ASCs are such an alternative to hospital outpatient departments. The number of ASCs has grown quickly to meet the rising demand for outpatient surgery services since the 1980s.[5] Whereas outpatient departments provide a range of complex services, including inpatient and emergency services, ASCs provide outpatient surgery exclusively. Since most ASCs focus on a limited number of services, they may provide higher-quality care at a lower cost than hospitals that offer a broad range of services.[6] Similar to retail clinics that meet primary care needs, ASCs offer convenient, relatively low-cost access to health care services.[7]

This article addresses the possibilities for ASCs

to generate substantial cost savings in outpatient surgery by presenting new evidence on the cost advantages of these centers relative to hospital outpatient departments. This is particularly important in light of the anticipated growth in demand for outpatient surgeries, in part as a result of the ACA.

Background On Ambulatory Surgery Centers

The number of outpatient surgeries has grown considerably in the United States since the early 1980s. Outpatient surgery volume across both hospital-based and freestanding facilities grew by 64 percent between 1996 and 2006, according to the National Survey of Ambulatory Surgery.[8]

Physicians receive the same payment for an outpatient procedure, regardless of whether it occurred in an ASC or a hospital. However, payments to facilities differ between settings. In general, reimbursements for outpatient procedures in hospitals are higher than those for procedures in ASCs, to account for the fact that compared to ASCs, hospitals must meet additional regulatory requirements and treat patients whose medical conditions are more complex.[9] However, there is little evidence about the extent of cost advantages of ASCs, since these facilities have not historically reported cost or volume data. In spite of the limited availability of information about ASC costs, the Centers for Medicare and Medicaid Services has adjusted the relative facility payments over time to reflect speculative cost differentials across the two types of outpatient surgery facilities.[10]

Changes in reimbursement levels for outpatient procedures have likely contributed to fluctuations in the number of ASCs in recent years. In 2000 Medicare's traditional cost-based reimbursement system for outpatient care in hospitals was replaced with the outpatient prospective payment system, which reimburses hospitals on a predetermined basis for what the service provided is expected to cost.

Noting the dramatic growth in outpatient surgeries performed in ASCs relative to hospitals around the same time, the Centers for Medicare and Medicaid Services subsequently made efforts to reduce ASCs' payments. The Medicare Prescription Drug, Improvement, and Modernization Act of 2003 froze ASCs' payment updates, and between 2008 and 2012 Medicare phased in a new system for ASCs' payments based on the outpatient prospective payment system.[9,11] The rates were set so that for any outpatient procedure, payments to ASCs would be no more than 59 percent of payments made to hospitals, phased in fully by 2012. This policy change reduced incentives to treat patients in ASCs, which may have contributed to slower growth in this sector in recent years (Exhibit 1).

In spite of reduced incentives for treating patients outside of hospitals, growth in outpatient volume was greater in ASCs than in hospitals during the period 2007–11. For example, volume among Medicare beneficiaries grew by 23.7 percent in ASCs, compared to 4.3 percent in hospital outpatient departments (Exhibit 2). This suggests that physicians and patients still increasingly prefer outpatient surgery in ASCs to that in hospitals, because of either perceived advantages in cost and quality or resource constraints that inhibit hospitals' ability to meet the growing demand for outpatient surgeries.

ASCs have been praised for their potential to provide less expensive, faster services for low-risk procedures and more convenient locations for patients and physicians, compared to outpatient departments.[11–14] However, if hospitals are better equipped to treat high-risk patients, treating higher-risk patients in ASCs could have negative consequences for patient outcomes.

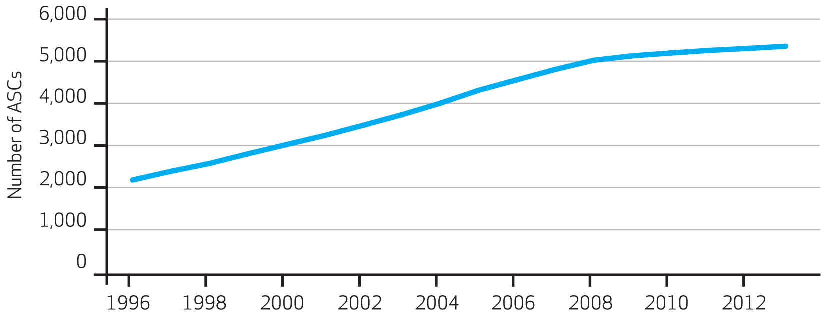
There is little evidence about the quality of care provided in ASCs or their ability to function as substitutes for hospitals in providing outpatient surgery. Comparisons of outcomes between these two types of outpatient facilities are complicated by the fact that ASCs tend to treat a healthier mix of patients than hospitals do. Thus, any differences in observed outcomes between the two settings could reflect differences in underlying patient health instead of differences in quality of care.

Elsewhere, we used variations in ASC use generated by changes in Medicare reimbursements to outpatient facilities to show that patients treated in ASCs fare better than those treated in hospitals.[15] In particular, we considered the likelihood that patients undergoing one of the five highest-volume outpatient procedures[16] visited an emergency department or were admitted to the hospital after surgery. These outcomes have been used in the medical literature as proxies for quality in outpatient surgical care.[17,18] These measures are also interesting from a policy perspective: As of October 2012, as part of the Ambulatory Surgical Center Quality Reporting Program,[19] ASCs are required to report transfers of patients directly from the ASC to a hospital and hospital admissions of ASC patients upon discharge from the facility.

Our findings indicate that the highest-risk Medicare patients were less likely than other high-risk Medicare patients to visit an emergency department or be admitted to a hospital following an outpatient surgery when they were treated in an ASC, even among similar patients

EXHIBIT 1

Number Of Medicare-Certified Ambulatory Surgery Centers (ASCs), 1996–2013



SOURCE Kay Tucker, director of communications, Ambulatory Surgery Center Association, October 29, 2013.

undergoing the same procedure who were treated by the same physician in an ASC and a hospital. These results indicate that ASCs provide high-quality care, even for the most vulnerable patients.

In this article we examine the question of whether or not ASCs are less costly than hospital outpatient departments. The answer to this question is not straightforward, since little is known about surgery cost and volume in ASCs. The often-cited cost differential between ASCs and outpatient departments is frequently attributed to differences in reimbursement rates for the two types of facilities, which reflect hospitals' greater complexity of patients and procedures. But for an average patient undergoing a high-volume procedure, are ASCs more efficient than hospital outpatient departments?

Study Data And Methods

Our analysis incorporated one important aspect of cost in the outpatient surgery setting: the time it takes to perform procedures in ASCs and hospital outpatient departments. For data on that time, we used the National Survey of Ambulatory Surgery. This survey of outpatient surgery in hospitals and freestanding surgery centers in the United States was conducted by the Centers for Disease Control and Prevention from 1994 to 1996 and in 2006.

The 2006 data include patients' diagnoses, demographic characteristics, and surgical procedures, as well as information about length of surgery and recovery for 52,000 visits at 437 facilities. There are four length-of-surgery measures: time in the operating room; time in surgery (a subset of time in the operating room); time in postoperative care; and total procedure time (time in the operating room, time in postoperative care, and transport time between the operating room and the recovery room).

Previous research has documented differences in surgery time between ASCs and hospital outpatient departments.[12,20] However, observed differences in procedure time may reflect underlying differences in patients' characteristics, instead of differences in efficiency between the two types of facilities. To address this concern, we estimated the relationship between outpatient setting and procedure time, controlling for a patient's primary procedure, number of procedures, and characteristics such as underlying health and demographics.[21]

Study Results

It is the nature of outpatient procedures that the patient spends most of his or her time in a surgical facility preparing for and recovering from surgery, not actually undergoing the surgery (Exhibit 3). This suggests that organization, staffing, and specialization may play a large role in the cost differences between ASCs and hospital outpatient departments.

Our estimates of the time savings for ASC treatment suggest that ASCs are substantially faster than hospitals at performing outpatient procedures, after procedure type and observed patient characteristics are controlled for (Exhibit 4). On average, patients who were treated in ASCs spent 31.8 fewer minutes undergoing procedures than patients who were treated in hospitals—a difference of 25 percent relative to the mean procedure time of 125 minutes (Exhibit 3). Thus, for an ASC and a hospital outpatient department that have the same number of staff and of operating and recovery rooms, the ASC can perform more procedures per day than the hospital can.

We estimated the cost savings for an outpatient procedure performed in an ASC using the results presented above and estimates of the cost of operating room time. Estimated charges for this time are $29–$80 per minute, not including fees for the surgeon and anesthesia provider.[22] Our

EXHIBIT 2

Number Of Outpatient Surgery Visits, By Facility Type, 2007 And 2011

Type	2007	2011	Change (%)
Ambulatory surgery center	373,284	461,718	23.7
Freestanding	260,466	344,292	32.2
Hospital-based	112,818	117,426	4.1
Hospital outpatient department	1,173,309	1,224,218	4.3
All types	1,546,593	1,685,936	9.0

SOURCE Authors' analysis of a 5 percent sample of Medicare claims data. **NOTE** The numbers of outpatient department visits include only those that involved at least one surgical procedure.

calculation suggests that even excluding physician payments and time savings outside of the operating room, ASCs could generate savings of $363–$1,000 per outpatient case.

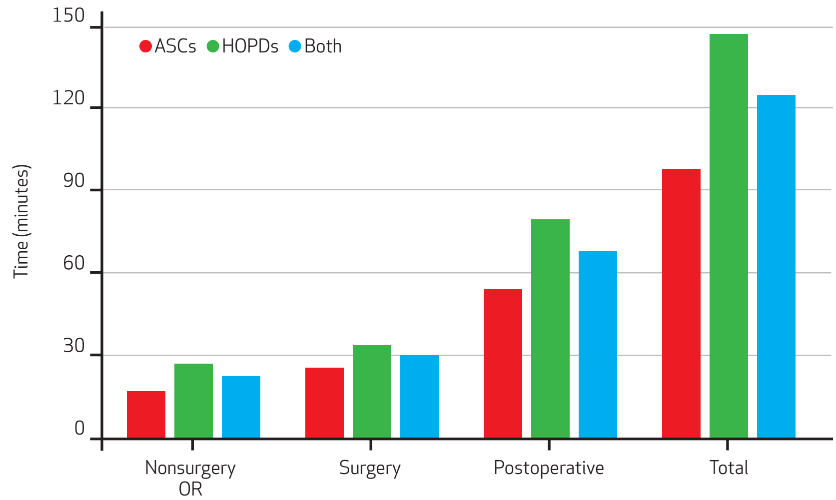
These results support the claim that ASCs provide outpatient surgery at lower costs than hospitals. However, they provide little information about what is driving these cost differences.

Terrence Trentman and coauthors discuss several factors that affect patient flow and could result in differences in preoperative and recovery times for outpatient procedures between in ASCs and hospitals.[20] For example, compared to the situation in hospitals, in ASCs surgeons are more likely to be assigned to a single operating room for all cases, which reduces delays; the operating room is often closer to the preoperative and recovery rooms, because facilities are smaller; teams of staff have clearer and more consistent roles, with less personnel turnover; and staffing is not done by shifts—that is, staff members go home only after all cases are finished, which creates incentives to work quickly. In addition, hospitals may be more likely to have emergency add-on and bring-back cases for more complex cases that compete with outpatient procedures for operating room time.

These differences suggest that hospitals would have to adopt a substantially different and highly specialized organizational model to achieve the same efficiencies as ASCs.

EXHIBIT 3

Average Outpatient Surgical Procedure Time, By Facility Type, 2006



SOURCE Authors' analysis of data from the 2006 National Survey of Ambulatory Surgery. NOTES Estimates were weighted using sample weights. ASC is ambulatory surgery center. HOPD is hospital outpatient department. "Both" is both types of facilities. OR is operating room. "Total" is total procedure time, from entering the operating room to leaving postoperative care, as described in the text.

Discussion

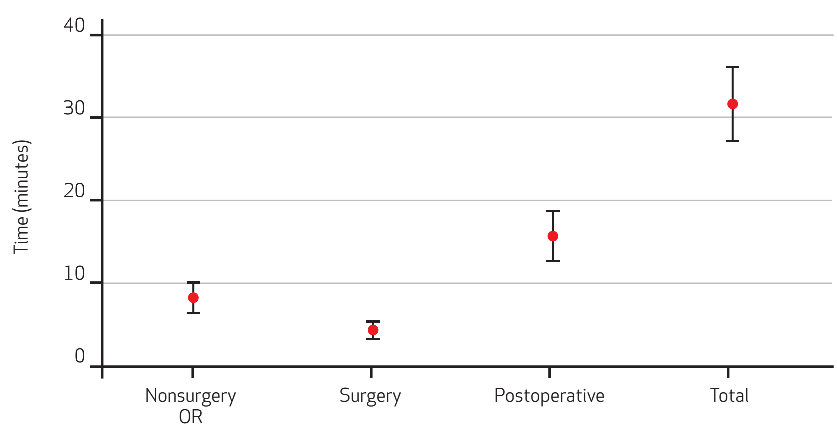
The findings presented here provide evidence that ASCs are a lower-cost alternative to hospitals for outpatient surgical procedures. The tremendous growth in the number of ASCs since the 1980s suggests that these facilities are quite flexible in meeting the growing demand for outpatient services. This is not surprising, given that ASCs have a smaller footprint than hospitals, which makes them less costly to build—particularly in urban environments, where available land may be scarce or difficult to acquire.

The Congressional Budget Office projects that as a result of the ACA, an additional twenty-five million people will have health insurance by 2016.[23] The question of whether the current supply of health care providers will be able to accommodate the anticipated surge in demand for services resulting from the ACA has received a considerable amount of attention.[24]

To get a sense of the magnitude of the anticipated growth in the outpatient surgery market following the ACA, we used a microsimulation model to project hospital outpatient surgical volume through 2021 (for details about the model, see the online Appendix).[25] Our estimates indicated that outpatient surgical volume in hospitals alone will increase by 8–16 percent annually between 2014 and 2021, compared to annual

EXHIBIT 4

Estimated Time Savings for Ambulatory Surgery Centers (ASCs) Relative to Hospital Outpatient Departments



SOURCE Authors' analysis of data from the 2006 National Survey of Ambulatory Surgery. NOTES Estimates and standard error bars represent results from separate ordinary least squares regressions of nonsurgical time in the operating room, surgery time, postoperative recovery time, and total time on an indicator for treatment in an ASC. (Total time is total procedure time, from entering the operating room to leaving postoperative care, as described in the text.) All regressions controlled for primary procedure, total number of procedures, patient's risk score, age, sex, disability status, type of insurance, and an indicator for whether the facility was located in a Metropolitan Statistical Area. The full specifications for these regressions are available in the online Appendix (see Note 25 in text). Data were balanced across surgery and postoperative time components; the final sample included 34,467 observations. Estimates were weighted using sample weights. Standard errors were clustered at the facility level. All estimates are significant ($p < 0.01$). OR is operating room.

growth rates of 1–3 percent in the previous ten years.

We did not have adequate data on surgical volume in ASCs to produce an equally precise estimate for the projected demand in this sector attributable to the ACA. However, our results indicate substantial growth even in hospital outpatient surgical volume, which has been growing at a much slower rate than ASC surgical volume. The trends in the growth in the number of ASCs before the passage of the ACA and our model for projected growth in the number of hospital outpatient department procedures suggest that it will be increasingly important to identify ways to accommodate growing demand for outpatient surgery. This is particularly important since hospitals will also likely face increased demand for other types of outpatient visits besides surgery after the ACA is implemented.

The rapid growth in the number of procedures performed at ASCs in recent years is a good indication of the ability of the market to expand quickly when there are sufficient incentives for it to do so. The range of surgeries performed in ASCs has increased considerably since the 1980s. In 1981 Medicare covered 200 procedures that were provided in ASCs. Today about 3,600 different surgical procedures are covered under Medicare's ASC payment system.[9] Consequently, the volume of procedures performed in ASCs has increased dramatically, and the share of all outpatient surgeries performed in freestanding ASCs increased from 4 percent in 1981 to 38 percent in 2005.[26,27] The Ambulatory Surgery Center Association has estimated that roughly 5,300 ASCs provide more than twenty-five million procedures annually in the United States.[27]

25 million

Procedures

The roughly 5,300 ASCs in the United States provide more than 25 million procedures each year.

Physicians who have an ownership stake in an ASC obtain greater profits from performing procedures in these facilities rather than in hospitals. Since physicians receive the same payment for their services regardless of whether procedures are performed in an ASC or a hospital, one implication of ASCs' lowering the cost of outpatient surgery without the price being adjusted accordingly—therefore leading to higher profit per procedure—is that it could create greater incentives for providers to recommend unnecessary procedures in physician-owned ASCs, a concept known as demand inducement. Another consequence of demand inducement is that physicians may respond to the increased number of patients with health insurance—as a result of the ACA—by performing surgeries that are not clinically indicated. Future research should examine the implications of reductions in the cost of outpatient surgery for demand inducement.

Conclusion

The ASC market faces challenges to meeting increased demand for outpatient surgery. As noted above, recent reimbursement changes have lowered payments to ASCs, which reduces the incentives to start or expand these facilities.

This gap in reimbursement is likely to continue to widen because Medicare's reimbursement rates for hospital procedures are updated annually according to projected changes in hospital prices, whereas ASC reimbursements are updated annually according to projected changes in the prices of all goods purchased by urban consumers, and medical spending is increasing at a much faster rate than other spending in the US economy. Furthermore, the disparity between medical and other consumer spending is expected to increase over time.

Critics of ASCs argue that these facilities "cherry pick" profitable patients and procedures, diverting important revenue streams from hospitals.[28–31] In combination with research on the quality of care in ASCs,[15] the findings in this article indicate that ASCs are a high-quality, lower-cost substitute for hospitals as venues for outpatient surgery. Increased use of ASCs may generate substantial cost savings, helping achieve the ACA's goals of reducing the cost and improving the quality of health care delivery. ■

These findings were previously presented at the National Bureau of Economic Research Hospital Organization and Productivity Conference, Harwich, Massachusetts, October 4–5, 2013.

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16 The five highest-volume procedures by ASC volume are cataract removals, other minor eye procedures, colonoscopies, upper gastrointestinal endoscopies, and minor musculoskeletal procedures. According to our calculations, the top five procedures account for 82 percent of claims in ASCs, compared to 74 percent of claims in hospital outpatient departments.

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Returns to Specialization: Evidence from the Outpatient Surgery Market

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April 2014

ABSTRACT

Ambulatory surgery centers (ASCs) were developed as a low-cost, convenient alternative to outpatient surgery in hospitals but have been criticized for "cream skimming" patients. Using a national sample of Medicare patients and controlling for physician fixed effects, we show that ASCs treat healthier patients than hospitals but as the ASC/hospital payment ratio increases, ASCs are more likely to treat high-risk patients. Using variation in ASC use generated by exogenous changes in Medicare payments, we find that high-risk patients treated in an ASC are less likely to be admitted to a hospital or an ER a short time after outpatient surgery.

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1. Introduction

Technological developments in medicine have drastically changed the landscape of medical care in the United States. Over the past 30 years, surgical care has shifted from the inpatient setting to hospital outpatient departments, in large part due to advances in anesthesia and the development of laparoscopic surgery that made it possible for patients to recover more quickly from surgery (Sloss et al., 2006; Kozak et al., 1999). During that time, the number of outpatient surgeries nationwide increased considerably, from 3.8 million in 1981 to nearly 39 million in 2005, and outpatient procedures now represent over 80 percent of all surgeries.[1] This massive change in surgical care has created new opportunities for providing medical services outside of traditional acute care hospitals in potentially lower cost, specialized settings.

A large part of the growth in outpatient surgery has occurred in ambulatory surgery centers (ASCs). Whereas hospitals provide a wide range of services in addition to outpatient surgery, including inpatient and emergency care, ASCs exclusively provide outpatient procedures. The share of all outpatient procedures that occurred in ASCs grew from 4 percent in 1981 to almost 40 percent in 2005 (American Hospital Association, 2008). Over 90 percent of ASCs are wholly or partly physician-owned, and 96 percent are for-profit (ASC Association, 2011; MedPAC, 2010).[2] Since surgeons often have operating privileges in both freestanding ASCs and hospitals, they may choose to refer patients to either type of outpatient setting.

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[1] Author calculations based on American Hospital Association (2008 and 2013).

[2] Only 18 percent of U.S. general hospitals are for-profit and less than one percent are physician-owned (American Hospital Association, 2013; Silva, 2010). Due to the federal "Stark Law," physicians are prohibited from referring Medicare or Medicaid patients to hospitals with which they have a financial relationship (e.g., investment or ownership), limiting physician ownership

ASCs have been praised for their potential to provide outpatient care that is less expensive, faster, and more convenient for both patients and physicians than services provided in hospitals (Hair, Hussey, and Wynn, 2012; Paquette et al., 2008; Grisel et al., 2009). Likewise, ASCs have been promoted as a cost-savings tool for Federal health care programs by the U.S. government (Government Accountability Office, 2006; Office of the Inspector General, 1999). In Munnich and Parente (2014), we document that outpatient surgeries performed in ASCs are significantly faster than those performed in hospitals, generating substantial cost savings. If specialized facilities like ASCs provide services more efficiently than hospitals, do they do so at the expense of quality of care?

One economic argument in favor of ASCs is that they may offer higher quality care due to specialization. An alternative view is that surgery centers offer faster, cheaper services at the expense of quality of care. Additionally, if hospitals are better equipped to take care of patients in the event of a surgical complication, ASC treatment may have negative consequences for patient outcomes, in particular for high-risk patients.

In this paper, we examine health outcomes associated with treating higher-risk patients in surgery centers by focusing on two quality of care measures: inpatient admission and ER visits soon after an outpatient procedure such as the same day, seven, or 30 days afterwards. These metrics have been used in the medical literature to measure quality differences in outpatient settings (Fleisher et al., 2004; Hollingsworth et al., 2012). In addition to their use by researchers, the Centers for Medicare and Medicaid Services (CMS) has recognized subsequent

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of general hospitals. However, the law exempts physicians who have an ownership stake in an entire hospital, such as an ASC or specialty hospital. See Casalino (2008) for more details on the Stark laws.

hospitalizations as an important quality measure for outpatient surgery. As of October 2012, ASCs are required to report direct hospital transfers and hospital admissions to CMS as part of the Ambulatory Surgical Center Quality Reporting (ASCQR) Program.[3]

Identifying the causal effect of facility specialization on patient outcomes is made difficult because holding quality of care constant, healthier patients have better surgical outcomes than riskier patients and healthier patients are more likely to choose or be referred to specialized settings.[4] Consequently, surgeons who choose to operate in ASCs have a different patient mix than those who only operate in hospitals. These differences could reflect physician preferences for different types of patients (or vice versa), facility preferences, differences in patient mix across hospital systems, or sorting within physician practices, e.g., if older physicians have more leverage in a practice and therefore more ability to choose settings and patients. If physicians who operate in ASCs have a healthier patient base than those who do not, any estimation of the relationship between patient health and ASC treatment that does not account for differences in case mix would be biased.

In the first half of this paper, we use Medicare claims from 2007 through 2009 to illustrate this selection problem and document the extent to which ASCs treat a different patient

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[3] Information about the ASCQR Program is available at http://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/ASC-Quality-Reporting/.

[4] While patient preferences are also a factor in the location of treatment, coinsurance rates for outpatient procedures did not vary over the period of our study so we do not expect that preferences changed during this time. The variation we exploit comes from facility fees, discussed later.

mix than hospitals. We restrict our analysis to Medicare patients in order to study a subset of patient claims that do not vary by insurer. Additionally, Medicare data contain unique physician identifiers, which allows us to confine our analysis to a subset of physicians who operate in both types of outpatient surgery facilities as well as control for physicians' underlying patient case mix via physician fixed effects. We construct a measure of patient risk using ICD-9 diagnosis codes, age, and sex. We find that holding the identity of the physician constant, the probability of the surgery being performed in an ASC is monotonically decreasing in patient risk. Patients in the highest risk quartile were half as likely to be treated in an ASC compared to those in the healthiest quartile.

Because we are concerned that observed differences in patient outcomes could reflect differences in underlying health rather than differences in quality of care, we use changes in federally set Medicare facility fees as an exogenous source of variation in surgery center utilization to estimate the effect of ASC treatment on patient outcomes. There are two types of payments for outpatient surgical procedures in the Medicare program. The first is a physician payment that is the same amount per procedure regardless of where the procedure if performed. The second is a facility fee that varies over time and by procedure, where the fee is a function of the setting in which the procedure is performed. Therefore, for any procedure performed in an ASC, an operating physician that has an ownership stake in the ASC would receive a payment for his or her services as well as any additional profit generated through the facility fee. ASC and hospital outpatient facility fees have historically been based on different Medicare payment systems, so the ratio of the two payments varies across procedure and time. Furthermore, Medicare reimbursements are determined nationally, so they represent a plausibly exogenous source of variation at the local-level. In response to concerns that ASCs face lower costs than

hospital outpatient departments and should therefore be reimbursed at lower rates, CMS froze ASC payment rates in 2003 and has steadily reduced ASC payments since 2008, while increasing payments to hospital outpatient departments. These adjustments in facility payments for outpatient services changed the relative reimbursement rates for outpatient procedures in ASCs and hospital outpatient departments, and the size of the change depended on the initial difference in payment rates, by procedure, across the two outpatient settings.

We find that Medicare facility fees are an important determinant of whether a patient was treated at an ASC or a hospital; as ASC payments increase relative to hospital payments, physicians treat riskier patients in ASCs. Although the riskiest quartile of patients are in general about half as likely to be treated in an ASC than the healthiest quartile, a 0.1 increase in the ASC/hospital payment ratio is associated with a 0.013 percentage point (3 percent) increase in the probability of being treated in an ASC for this group. We use an interaction between a patient's risk score quartile and the ASC/hospital payment ratio in his or her hospital region as an instrument for ASC treatment to examine differences in patient outcomes across outpatient facility settings. In particular, we exploit the fact that there is a heterogeneous response to payment changes across patient risk groups to estimate the effect of ASC treatment on patient outcomes. We find that ASC treatment reduces the probability of same day ER visits and 7-day inpatient admission for patients with the greatest morbidity. This suggests that ASCs provide higher quality care than hospital outpatient departments, even for high-risk patients.

Our findings indicate that factors other than patient and physician heterogeneity contribute to the observed returns to specialization in the outpatient surgery market. There are a number of factors that may contribute to this difference including specialization of surgical teams, differences in the quality of surgical staff, and facility organization may be important

determinants of patient outcomes. Identifying what factors contribute to these differences in outcomes is beyond the scope of this paper but a logical next step in our research program.

2. Background and Previous Literature

2.1 Growth in Outpatient Procedures and Ambulatory Surgery Centers

Outpatient surgery (i.e., ambulatory surgery) is surgery that does not require an overnight stay. In 2011, 64 percent of surgeries performed in community hospitals in the U.S. were done on an outpatient basis (American Hospital Association, 2013).[5] The number of outpatient surgeries has grown considerably in the U.S. since the early 1980s. Figure 1 shows the growth in outpatient surgeries accompanied by a decline in inpatient surgeries between 1980 and 2011 for community hospitals. Previous research on the outpatient surgery market has attributed much of its growth to two factors: technological advances in medicine, and changes in Medicare reimbursement policy (Ambulatory Surgery Center Association, 2011; Koenig et al., 2009). Indeed, Figure 1 indicates that most of the change in outpatient surgeries in community hospitals occurred in the early 1980s, when Medicare both began covering procedures performed in ASCs and also introduced the Inpatient Prospective Payment System (IPPS), and leveled out in 2002, shortly after Medicare introduced the Outpatient Prospective Payment System (OPPS). Inpatient surgeries declined until about 1995, and have since remained constant. These trends suggest that between 1981 and 1995, there was substitution of outpatient for inpatient surgeries, as well as expansion in the surgery market.

CMS defines an ambulatory surgery center (ASC) as a "distinct entity that operates exclusively for the purpose of providing surgical services to patients not requiring hospitalization

[5] Community hospitals include nonfederal, short-term general, and other special hospitals.

and in which the expected duration of services would not exceed 24 hours following an admission" (Ambulatory Surgical Services, 2009). The share of all outpatient surgeries in freestanding ASCs increased from 4 percent of the market in 1981 to 38 percent in 2005, shown in Figure 2. While the share of surgeries performed in physician offices grew over this period as well, ASCs in particular have posed a competitive threat to hospitals. Critics of ASCs have argued that they "cream skim" or "cherry pick" profitable patients and procedures, drawing patients who are more likely to have better outcomes, as well as important revenue streams, from hospitals. Hospital executives have expressed concern that ASCs have potentially "unfair" cost advantages because they treat healthier patients, are not required to provide unprofitable services, and are less regulated than hospitals (Casalino, Devers, Brewster, 2003; Vogt and Romley 2009).[6] Representing the American Hospital Association (AHA) at a Federal Trade Commission hearing in 2003, the CEO of the AtlantiCare hospital system noted that, "The rapid growth of specialty care providers threatens community access to basic health services and jeopardizes patient safety and quality of care" (Lynn 3/27/03, p. 27-28).[7] Accordingly, hospital systems and industry organizations like the American Hospital Association (AHA) have waged "a full scale attack on niche providers through their lobbying efforts" (Cimasi, 2005). CMS has also made deliberate efforts to change policies to encourage treatment in one type of facility over another (Scully 3/23/03, p. 46). On the other hand, in interviews of six hospital systems, Burns, David, and Helmchen (2011) found that new organizational models like ASCs and single specialty hospitals did not threaten hospital executives and clinicians. This may be influenced by the fact

[6] All Medicare-certified ASCs must be certified by a state agency, or private accredited. Although facilities must initially obtain this qualification, the Office of Inspector General has criticized CMS for insufficient oversight of states and accreditors regarding recertification and compliance, leading to very lenient regulation of ASCs. CMS also requires participating hospitals to comply with patients' rights requirements and implement quality improvement programs, which it does not require of ASCs (CMS, 2003; Office of Inspector General, 2002).

[7] Examples of specialty hospitals, as described by Lynn, include ambulatory surgery centers, children's hospitals, psychiatric hospitals, heart hospitals, cancer hospitals, dialysis clinics, pain centers, imaging centers, and mammography centers.

that there is little evidence to date that ASCs provide lower cost or higher quality care than hospitals. Despite the rapid growth in the ASC market and the policy responses to this growth, there is little empirical evidence backing the claims attributed to them. Likewise, there has been almost no research examining the impact on ASC operation of such policy factors as reimbursement rates.

The vast majority of ASC patients are covered by private insurance or Medicare. Figure 3 shows the number of outpatient surgeries in ASCs and hospitals by insurance type for 1996 (Panel A) and 2006 (Panel B). The number of surgeries in ASCs has increased relative to the number of surgeries in hospitals for all types of insurance coverage categories (private or commercial, Medicare, Medicaid, self-pay, and other).[8] Among Medicare patients, the number of surgeries in ASCs grew nearly 300 percent, compared to an 18 percent increase in the number of surgeries in hospital outpatient departments.

2.2. Quality of Care

The benefits of treating patients in ASCs in terms of cost efficiency would be mitigated if patient health outcomes were worse in these settings. The risk of serious complications associated with outpatient procedures is low relative to many inpatient procedures, but not trivial. For example, for screening colonoscopies, the risk of an adverse event—such as perforation of the bowel, bleeding, or reaction to anesthetic—is 2.8 per 1,000 procedures (American Society of Gastrointestinal Endoscopy, 2011). Stein et al. (2011) found that, among Medicare patients, the probability of serious complication for cataract surgery was 0.4 percent. In addition to complications associated with outpatient procedures, patients may acquire healthcare-associated infections (HAIs) during an ASC or hospital visit. Following a rise in HAIs acquired in

[8] Other insurance types include TRICARE, worker's compensation, and other government insurance.

outpatient settings, Schaefer et al. (2010) examined a sample of ASCs in three states and found that lapses in infection control practices were common in these facilities.

Several papers have tried to assess differences in quality of care between ASCs and hospitals (Hollingsworth et al., 2012; Chukmaitov et al., 2011; Woods et al., 2007; Fleisher et al., 2004). For example, Fleisher et al. (2004) found that hospital outpatient departments had higher rates of inpatient admission and ER visits than ASCs within 7 days of, or between 8 and 30 days after, outpatient procedures. In contrast to these findings, Hollingsworth et al. (2012) showed that same day hospital admission was higher for Medicare patients undergoing urological procedures in an ASC than for those treated in a hospital. However, since the patient mix in ASCs is on average healthier than in hospital outpatient departments, comparing patient outcomes across settings without accounting for unobserved heterogeneity likely leads to overestimations of the quality of care that ASCs provide relative to hospitals. Even after adjusting for patient risk factors, if unobserved patient characteristics are correlated both with the probability of ASC treatment and outcomes, estimates of the relationship between ASC treatment and patient outcomes would be biased. Our paper contributes to the literature on quality of care in specialized surgical settings by using exogenous variation in Medicare facility payments to estimate the effect of ASC treatment on patient outcomes.

2.3 Overview of Medicare Payments

Since our empirical analysis relies on variation in Medicare reimbursement, it is instructive to outline the structure of Medicare payments for outpatient surgical procedures. For any outpatient procedure, Medicare payments are separated into three components: a facility fee (e.g., to cover overhead costs, nursing and tech staff, and equipment and drugs directly related to

the procedure), professional (physician) fees, and fees for other services (e.g., physical therapy, a skilled nursing facility, and durable medical equipment). While physicians receive the same amount for an outpatient procedure regardless of whether it occurred in an ASC or a hospital, facility payments differ across settings. In general, reimbursements for outpatient procedures in hospitals are set higher than in ASCs because hospitals must meet additional regulatory requirements and treat patients who are more medically complex (MedPAC, 2003). For example, in 2003, the national facility fee for a cataract removal was $973 in an ASC and $1,160 in a hospital. However, that same year, the facility fee for an upper gastrointestinal (GI) endoscopy was $446 in an ASC and $387 in a hospital (MedPAC, 2003). Over 90 percent of ASCs are at least partly owned by physicians. When a physician treats a patient in an ASC over which he or she has some ownership, that physician captures part of the facility fee from Medicare. Consequently, previous research has found that physicians with financial interests in hospitals have a higher rate of self-referrals, and volume in surgery centers is higher for physician owners than non-owners (Yee, 2011; He and Mellor, 2012; Mitchell, 2008 and 2010; Casalino, 2008; Lynk and Longley, 2002). Similarly, ASC physician owners are more likely to refer well-insured patients to their ASCs and send Medicaid patients to hospital outpatient departments (Gabel et al., 2008).

Differences between ASC and hospital outpatient payments have varied over time. When Medicare first started covering outpatient procedures in 1982, hospital procedures were reimbursed using a cost-based system whereas ASC procedures were grouped into one of 4 payment categories based on cost and clinical similarity, and every procedure in a particular category was reimbursed at the same rate. Across both settings, facility payments did not vary based on the health of the patient. These payments were updated annually for inflation—hospital

procedures by the hospital market basket and ASC procedures by the Consumer Price Index for All Urban Consumers (CPI-U)—but were not otherwise adjusted until Medicare expanded to eight payment groups in 1990, and nine in 1991 (MedPAC, 2010).

In 2000, Medicare's traditional cost-based reimbursement system for outpatient care in hospitals was replaced with the Outpatient Prospective Payment System (OPPS). Like the payment group structure of ASCs, OPPS established 200 Ambulatory Payment Classifications (APCs) for hospital outpatient procedures. In response to the drastic growth in ASCs relative to hospital outpatient departments, CMS subsequently reduced ASC payments. In the 2003 Federal Trade Commission hearings on health care and competition, the former Administrator of CMS, Thomas Scully, remarked, "I can tell you when I drive around the country and see where ASCs are popping up, I can tell who we're overpaying" (Scully 2/26/03, p. 46). The Medicare Prescription Drug, Improvement, and Modernization Act of 2003 froze ASC payment updates and directed the Government Accountability Office (GAO) to examine the relative costs of procedures performed in ASCs and hospital outpatient departments to inform implementation of a new cost structure by January 1, 2008 (U.S. GAO, 2006). Between 2008 and 2011, Medicare phased in a new system for ASC payments based on the 200 Ambulatory Payment Classifications (APC) in the OPPS, and expanded the number of covered ASC procedures (MedPAC, 2010). The new rates mandated that the ASC facility fee for any procedure would be no greater than 59 percent of the facility fee paid to a hospital outpatient department, phased in fully by 2012.

This policy change reduces incentives to treat patients in ASCs, benefitting hospitals that use revenue from outpatient procedures to subsidize less profitable procedures. However, if ASCs provide more cost effective outpatient services without compromising patient safety, this

could have negative consequences for overall healthcare spending on outpatient care. In the sections that follow, we examine differences in treatment patterns across outpatient setting to estimate quality differences between ASCs and hospital outpatient departments.

3. Health Selection in the Outpatient Surgery Market

In the first part of our analysis, we document the extent of selection into ASCs based on patient health. ASCs have been criticized for skimming the most profitable patients in the outpatient surgery market. It has been well documented that patients who have health insurance with higher reimbursement rates are more likely to be treated in ambulatory surgery centers (Mitchell, 2010; Pham et al., 2004; Hadley and Reschovsky, 2006; Gabel et al., 2008; Hollingsworth et al., 2010). Similarly, ASCs on average treat healthier patients and perform higher profit procedures than hospital outpatient departments (Wynn et al., 2004; Winter, 2003; Plotzke and Courtemanche, 2011). David and Neuman (2011) compare treatment patterns among physicians who practice exclusively in ASCs (“non-splitters”) and those who practice in both ASCs and hospitals (“splitters”). They find that physicians who treat patients in both settings deliver care to higher-risk patients overall but select relatively healthier patients for treatment in ASCs. Research on cream skimming has been conducted for other physician-owned facilities such as specialty hospitals as well. For example, Swanson (2012) examines patient selection in cardiac specialty centers, and concludes that the distribution of patients across hospitals is driven by physicians’ average preferences over hospitals rather than cherry picking.

Although previous research documents differences in the composition of patients and procedures across facility types, it often relies on cross-sectional data and is unable to account for variation between physicians. For example, there may be underlying differences between physicians who work in ASCs and those who work in hospitals that influence the types of

patients that are referred to each facility. In a cross sectional data set, it is difficult to identify cream skimming if physicians have different client bases and receive different payments based on where a procedure is performed. In this paper, we circumvent this problem by restricting our analysis to cases performed by physicians who operate in both ASCs and hospitals. In doing so, we are able to identify within-physician patient selection to account for sorting of patients by acuity between physicians.

3.1. A Within-Physician Selection Model

We exploit the fact that Medicare claims data record a unique physician identifier which allows us to examine, holding physician identity constant, whether and by how much patient health is correlated with the likelihood of ASC treatment:

$$ASC_i = X_i\beta + \sum_r Risk_{ir}\alpha_r + \sum_p Proc_{ip}\delta_p + \sum_j Phys_{ij}\gamma_j + \sum_p\sum_j Proc_{ip} \times Phys_{ij}\,\rho_{jp} \sum_t Year_{it}\theta_t + \varepsilon_i \qquad (1)$$

In this model, ASC_i is an indicator equal to one if the procedure for patient claim *i* was performed in an ASC. We include a vector of demographic characteristics, X_i, including age group, sex, ethnicity, and an indicator variable equal to one if a patient is eligible for Medicare because of end stage renal disease. $Risk_{ir}$ is a dummy variable indicating a patient's health risk quartile *r*, where the first (healthiest) quartile is omitted. Since different procedures may be more prevalent in one type of facility, which could affect a patient's probability of treatment in an ASC, we include procedure fixed effects ($Proc_{ip}$). To account for physician-specific characteristics that may drive treatment decisions, as discussed earlier, we also include fixed effects for physicians ($Phys_{ij}$) and physician by procedure fixed effects ($Physn_{ij}$ x $Proc_{ip}$).[9] The variation in our model is therefore driven by a particular physician's decision to treat patients in one outpatient sector

[9] The physician fixed effects absorb geographic fixed effects. Therefore, we do not need to separately include state or other geographic fixed effects in this model.

over another, for physicians who care for patients in both ASCs and hospitals. Finally, we control for time varying factors that are common across patients by including a vector of dummy variables for year of procedure ($Year_{it}$). If a patient's risk score group is negatively related to ASC treatment—i.e., if α_2, α_3, and α_4, are less than zero—then riskier patients are less likely to be treated in an ASC than in a hospital outpatient department. To account for possible correlation within a geographic region over time, we cluster standard errors by Hospital Service Area (HSA).

3.2. Medicare Claims Data

In order to estimate the above model, we need a dataset that includes detailed patient and surgery information, as well physician identifiers. We achieve this using the Medicare Limited Data Set for 2007 through 2009. These data contain all institutional and non-institutional claims for a 5 percent sample of Medicare beneficiaries, including both hospital outpatient departments and ASCs. For each patient claim, we observe patient diagnoses and procedures, payment amount, dates of service, patient demographics, and an identifier for the attending and operating physicians in the procedure.[10] Procedures in Medicare claims are coded using the Health Care Common Procedure Coding System (HCPCS). Each HCPCS code is assigned to a procedure category using Berenson-Eggers Type of Service (BETOS) Codes, which represent readily understood clinical categories as well as groupings used in Medicare payments. For the remainder of this paper, we define "procedure" in Medicare claims as the BETOS code.

Descriptive statistics for patient claims are reported by physician and facility type in Table 1.[11] We consider two types of physicians: the full sample of physicians (those who treat

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[10] CMS changed its system for identifying physicians from unique physician identification numbers (UPIN) to National Provider Identifiers (NPI) beginning in 2007. We obtain NPI values where missing from the National Plan and Provider Enumeration System (NPPES), available at http://nppes.viva-it.com/NPI_Files.html.

[11] Over 40 percent of patients of physicians who operate in both types of facilities undergo more than one outpatient procedure in a year, so we observe multiple claims for these individuals.

patients in either ASCs or hospitals, or both), and those who treat patients in both types of facilities, which is the group that identifies the key parameters of interest in our fixed effect models.[12] Overall, patients treated by physicians who operate in both ASCs and hospitals (column 4) are very similar to patients in the full sample (column 1).[13] We then compare characteristics of patients in ASCs with those in hospitals for each physician type. For the full physician sample, patients treated in hospitals are younger, less likely to be female, more likely to be black, and more likely to have end stage renal disease or a disability as the primary for Medicare entitlements (columns 2 and 3).[14] For the subset of physicians who operated in both types of settings, patients treated in ASCs and hospitals appear to be very similar on observable characteristics (columns 5 and 6), though patients in hospitals are more likely to be on disability or have end stage renal disease.

The distribution of procedures also varies by physician type. In the full sample of physicians, each of the top 5 procedures in terms of ASC volume (cataract removals, colonoscopies, upper GI endoscopies, minor musculoskeletal procedures, and other eye procedures) comprised much larger shares of total procedures in ASCs than in hospitals. Again, these differences are much smaller for the restricted group of physicians. For example, cataract surgeries comprised 3 percent of procedures performed in hospitals among the full sample of physicians and 28 percent of procedures performed in ASCs. Among claims for procedures done by physicians that worked in both types of facilities, cataract surgeries represented 10 percent of hospital claims and 14 percent of ASC claims. This suggests that a number of physicians only provide some services, e.g., cataract surgeries, in one type of setting.

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[12] Physicians who work in both types of facilities are a subset of physicians who work in either type of facility.
[13] Given the large sample size, all differences are statistically significant.
[14] Patients who are under age 65 can qualify for Medicare benefits if they have a disability or end stage renal disease. Since a greater share of patients treated in hospitals are on disability as their primary reason for entitlement, it is not surprising that the average age of patients in ASCs is higher than the average age of patients treated in hospitals.

The descriptive statistics presented in Table 1 suggest that if we were to include all Medicare claims without accounting for idiosyncratic differences among physicians, our health selection estimates would be biased because physicians who operate in both types of facilities have a different patient composition than those who just operate in one type of setting. To address this problem, we restrict our sample to claims from procedures performed by physicians who operate in both types of facilities. We also employ a physician fixed effects model to control for differences between physicians that do not vary over time.

To measure underlying patient health, we generate patient risk scores using the Johns Hopkins University ACG Case-Mix System (v. 10) developed by the Health Services Research and Development Center. The ACG System uses ICD-9CM diagnosis codes and patient characteristics to construct measures of health status. The predictive modeling feature of the ACG software produces a concurrent weight (CW) that is a summary measure of the current individual health status and resource utilization. The CW is constructed so that the national average is 1.0 with higher values denoting poorer health and likely higher expenditures; for example, a patient with a weight of 2.0 is twice as sick, and expected to use twice as many resources, as a person with a weight of 1.0.

Patient acuity varies across outpatient settings. Figure 4 is a kernel density plot of patient risk scores in hospital outpatient departments and ASCs using Medicare claims for physicians who treated patients for any type of procedure in both types of facilities. As the figure illustrates, greater shares of patients with lower risk scores are treated in ASCs than in hospital outpatient departments. For ease of interpretation, we use aggregated measures of risk scores that have been grouped into four quartiles based on predicted patient resource utilization.

3.3. Health Selection Estimates from Physician Fixed Effects Model

Table 2 reports estimates from the health selection model described in Equation (1), with and without physician fixed effects. The first column includes estimates for all procedures in the full physician sample. Results in columns 2 and 3 include all procedures in the sample of physicians restricted to those who work in both ASCs and hospitals, without and with physician fixed effects, respectively. Since the number of different types of procedures performed in hospitals is much larger than the number performed in ASCs, we also restrict our analysis to the top 5 procedures by ASC volume to ensure that we are using a comparable set of procedures across settings.[15] Estimates for these 5 procedures are provided in the column 4. The remaining columns indicate results from separate regressions for each of the top 5 procedures based on ASC surgical volume: cataract surgeries, colonoscopies, upper GI endoscopies, minor musculoskeletal procedures, and other eye procedures. The share of patients treated in an ASC by risk quartile, and the share of claims in each risk quartile, are included in curly and square brackets, respectively. In all cases, patients that are less healthy (i.e., higher-risk score quartiles) are significantly less likely to be treated in an ASC than those in lower risk score quartiles. Among claims in the full physician sample, 18 percent of first quartile (healthiest) patients are treated in an ASC compared with 6 percent of fourth quartile (riskiest) patients. For the restricted physician sample (columns 2 and 3), 76 percent of first quartile (healthiest) patients are treated in an ASC compared to 36 percent of fourth quartile (riskiest) patients. ASC treatment also varies by procedure. Whereas 85 percent of first quartile patients undergoing cataract surgery were treated in an ASC, only 76 percent of patients in the same risk score group undergoing minor

[15] The top 5 procedures by ASC volume account for 82 percent of claims in ASCs compared to 74 percent of claims in hospital outpatient departments.

musculoskeletal procedures were treated in an ASC. The probability of ASC treatment is monotonically decreasing in risk for cataract surgeries, colonoscopies, and upper GI endoscopies.

Regression results indicate that across all types of procedures, the probability of being treated in an ASC decreases as a patient's risk score group increases. Coefficient estimates on the risk score quartile dummy variables are much larger in absolute value for the full physician sample than for the restricted sample, indicating that including all physicians leads to overstating the extent of health selection. Including fixed effects for the restricted physician sample reduces the magnitude of the coefficients slightly (column 3).[16] Holding physician identity constant, patients in the highest risk score quartile undergoing any procedure are still nearly 40 percentage points less likely to be treated in an ASC than patients in the healthiest quartile, or about half as likely given that 76 percent of patients in the healthiest quartile are treated in ASCs. Cataract patients in the highest risk quartile are 68 percentage points less likely than the healthiest patients to be treated in an ASC. These results indicate that even accounting for differences across physicians and only looking at the subset of physicians who treat patients in both hospitals and ASCs, physicians are much more likely to care for healthy patients in ASCs.

4. Outpatient Treatment Location and Patient Outcomes

In previous research, we have shown that, holding patient risk constant, ASCs are less costly at treating patients in terms of procedure duration (Munnich and Parente, 2014). In this section, we consider whether ASCs provide more cost efficient services than hospitals at the expense of quality of care. Estimating quality of care differences in the outpatient surgery market is difficult in single equation models because, as we have shown, ASCs have a different patient mix than hospital outpatient departments. Table 3 shows the rate of inpatient admissions and ER

[16] Differences between specifications with and without physician fixed effects are significant at the 10 percent level.

visits following an outpatient procedure alongside the share of patients that are treated in an ASC, by patient risk quartile. Not surprisingly, patients in higher risk groups are much more likely to visit the hospital following an outpatient procedure. Because ASCs treat healthier patients, observed differences in patient outcomes between ASCs and hospitals may be due to differences in underlying health rather than differences in quality of care. We address this problem by using variation in ASC use generated by changes in Medicare facility fees to estimate the effect of ASC treatment on patient outcomes by risk score group. Before doing this, we outline Medicare's facility payment structure and changes in facility payments over time, as well as estimate the relationship between facility payments and ASC market share.

4.1. Outpatient Facility Payments and ASC Market Share

As described earlier, for any outpatient procedure, ASCs and hospitals receive different facility payment amounts. Medicare payments to outpatient facilities are set nationally and adjusted to account for geographic differences in labor costs.[17] Specifically, the facility payment consists of a labor portion that is adjusted by a local wage index, and an unadjusted non-labor portion. CMS estimates that labor costs are higher in hospitals than in ASCs, and therefore set the labor portion as 60 percent of the facility fee for hospital outpatient departments and 50 percent of the fee for ASCs (MedPAC, 2003).[18] The wage index is updated annually based on average wages in acute care hospitals in a labor market area relative to the national average hourly wage, calculated separately for individual urban areas, with one rural wage index for each state (MaCurdy et al., 2009).[19] Because Medicare calculates the wage indexes using large geographic areas, hospitals that are located in the same urban area but that face different costs

[17] Outpatient payments are also adjusted for rural, cancer, and children's hospitals as well as extraordinarily costly services and new technologies (MedPAC, 2008).
[18] Coinsurance rates also vary by outpatient facility, but did not change for hospitals during the period of our analysis.
[19] Medicare defined urban areas by Metropolitan Statistical Areas (MSAs) until 2003, and Core Based Statistical Areas (CBSAs) thereafter. In 2008, there were 374 MSAs and 3,436 CBSAs in the U.S. (Nussle, 2008).

may receive the same wage index value. At the same time, hospitals that are near one another but in different urban areas would have different indices. Importantly, since facility payments are set at the federal level, adjustments are relatively coarse, and ASC and hospital payments are adjusted by the same wage index, changes in ASC and hospital payments represent a plausibly exogenous source of variation in Medicare reimbursement.

To look at this mechanism, we first consider the relationship between the share of Medicare outpatient surgeries treated in an ASC and the ratio of the average ASC payment to average hospital payment. We use total facility payments from Medicare claims data to calculate the average payment for each facility type (ASC and hospital outpatient department), by Hospital Service Area (HSA) and year.[20] HSAs, or local hospital markets, are defined by assigning ZIP codes to the hospital area where the greatest proportion of their Medicare residents were hospitalized in a region. The U.S. is comprised of 3,436 HSAs. We obtained HSA-zip code crosswalks from the Dartmouth Atlas of Healthcare.[21]

To generate ratios of ASC payments to hospital payments, we first let φ_{ifpht} denote the facility fee for patient claim *i*, in facility type *f* (ASC or hospital), for procedure *p*, in HSA *h*, in year *t*. We denote the median payment from all claims for a particular facility type, procedure, HSA, and year as $\tilde{\varphi}_{fpht}$. To scale the payment amount for each procedure, we divide the median ASC payment in year *t* by the median hospital outpatient payment in 2007, adjusted annually for inflation using the Center for Medicare and Medicaid Services' hospital market basket:

$$P_{pht} = \frac{\tilde{\varphi}_{ASC,pht}}{\tilde{\varphi}_{Hospital,ph}} \tag{2}$$

[20] To generate payment estimates, we use the combined revenue center payment and patient responsibility amount associated with a procedure for the Medicare outpatient plains, and the total allowed charges (which includes the line provider payment amount, deductible, and coinsurance) for ASC claims. In both cases we restrict our analysis to the first procedure listed for each claim.
[21] http://www.dartmouthatlas.org/tools/downloads.aspx

This measurement of the ratio of ASC payments to hospital outpatient payments therefore varies by procedure, HSA, and year. We restrict our sample to HSAs where we observe at least 10 claims in both ASCs and hospitals for a particular procedure in a particular year, allowing us to calculate the ratio of payments between the two types of facilities.

Average HSA payments are reported by facility, year, and procedure for the five highest volume ASC procedures in Table 4. Instead of national payment rates, which are fixed across all localities, we use facility payments from Medicare claims that have been adjusted for local labor costs, so level and relative payments to ASCs and hospitals vary across procedure and over time. For all procedures except minor musculoskeletal procedures, payments for hospitals exceeded payments to ASCs in 2007. During the period of our study, ASC payments stayed roughly constant or decreased while hospital payments increased, and the average ratio of ASC payments to hospital outpatient payments decreased. These changes correspond to policy changes made by CMS to reduce ASC payments relative to hospital payments, discussed earlier.[22]

To illustrate changes in ASC payments relative to hospital payments over time, Figure 5 plots ASC and hospital payments by procedure for 2007 and 2009. ASC payments are presented on the horizontal axis and hospital outpatient payments are on the vertical axis. Each bubble represents the median facility payment for one of the top 5 outpatient procedures; the size of the bubble denotes the number of Medicare claims for a particular procedure. The 45-degree line denotes equal payment to ASCs and hospital outpatient departments. Like the average HSA-level payments presented in Table 4, Panel A of Figure 5 shows that in 2007, facility fees for most of the top 5 procedures were higher in hospitals than ASCs, i.e., the ratio of ASC to hospital

[22] The “Average ASC/Hospital Payment Ratio” value in Table 4 is the average of the HSA-level payment ratios, which is calculated by first constructing the ratio of the median ASC payment in a year to the median hospital outpatient payment in 2007, by HSA, and averaging these values across all HSAs. It is therefore not the same as the ratio of the average ASC payment and average hospital payment listed in Table 4.

payments was less than one. While payments to ASCs stayed roughly constant or decreased between 2007 and 2009, most payments for hospital outpatient surgeries increased; consequently, the graph for 2009 (Panel B) shows a shift in the payment ratio in favor of hospitals.

Using this variation in facility fees, we examine the relative payments made to ASCs and hospitals as a possible mechanism driving ASC growth. We first consider the relationship between relative ASC/hospital payments and the share of all Medicare procedures in an HSA that were performed in an ASC. We estimate this relationship with the following model:

$$ASCShare_{pht} = P_{pht}\,\beta_1 + \delta_p + \lambda_h + \nu_t + \varepsilon_{pht} \qquad (3)$$

Here, $ASCShare_{pht}$ is the share of all patients treated in ASCs for procedure *p*, in HSA *h*, in year *t*. P_{pht} is the ratio of ASC to hospital payments by HSA and year in one of the top 5 procedure groups: cataract removal/lens insertion, colonoscopy, upper GI endoscopy, minor musculoskeletal procedures, or other eye procedures. As in earlier specifications, we also include procedure, HSA, and year fixed effects, and balance the data across all three of these dimensions. Therefore, only HSAs with claims for a procedure in both ASCs and hospitals in all years of the data are included in our sample.[23]

Table 5 presents an estimate of the relationship between the share of Medicare outpatient surgeries treated in an ASC and the ratio of the average ASC payment to average hospital payment. These findings confirm that higher ratios of ASC to hospital payments are associated with higher ASC market share, holding fixed procedure, HSA, and year. To put this in context, an annual increase of 0.1 in a payment ratio—a change that we find plausible based on estimates in Table 4—would be associated with a 0.004 increase in ASC market share. Over the period of our study, ASC-to-hospital ratios decreased. As an example, between 2007 and 2009, the

[23] Because we balance panels across facility type and year for each procedure and HSA, we lose observations as we add additional procedures with fewer annual claims. We therefore limit our sample for this analysis to the top 5 procedures.

payment ratio for upper GI endoscopies decreased from 0.88 to 0.74, a change of 0.14; using the estimates in Table 5, this change would be associated with a 0.006 percentage point *drop* in ASC market share. In our balanced HSA panel, 50 percent of all upper GI endoscopies were performed in ASCs in 2007, so the change in the payment ratio would equate to a one percent drop in ASC market share for this procedure in two years. These results suggest that Medicare facility payments are important drivers of ASC market share and CMS policies to decrease ASC payments relative to hospital payments may have contributed to the leveling out of market growth depicted in Figure 1.

4.2. Facility Payments and Outpatient Treatment Location

The findings presented thus far indicate that physicians care for healthier patients in ASCs than in hospital outpatient departments. We have also shown that the ratio of ASC to hospital payments is positively associated with ASC market share. Building on Equation (2), we use the variation in ASC use generated by facility fee changes to estimate the relationship between treatment in an ASC and interactions between the average ratio of ASC to hospital payments in a patient's HSA and his or her risk score quartile:

$$ASC_i = X_i\beta + \sum_r \left(Risk_{i,r}\alpha_{1,r} + Risk_{i,r} \times P_i^{pht}\alpha_{2,r}\right) + \sum_p Proc_{ip}\,\delta_p + \sum_j Phys_{ij}\,\gamma_j + \sum_p \sum_j Proc_{ip} \times Phys_{ij}\,\rho_{jp} + \sum_t Year_{it}\theta_t + \varepsilon_i \quad (4)$$

In this model, P_i^{pht} denotes the payment ratio that corresponds to claim *i* based on procedure, HSA, and year. The coefficients $\alpha_{2,1}$, $\alpha_{2,2}$, $\alpha_{2,3}$, and $\alpha_{2,4}$ capture the change in the probability of treatment in an ASC by risk score quartile as ASC payment rates increase relative to those in hospital outpatient departments in 2007.

The first column of Table 6 presents estimates of the relationship between facility payments and ASC treatment. As in Table 2, the likelihood of treatment in an ASC decreases

monotonically as patient health decreases, across all panels. However, as ASC payments increase, riskier patients are more likely to be treated in an ASC. This is not surprising given that the share of patients treated in ASCs is much lower for sicker groups of patients than for healthier ones; for example, 83 percent of first quartile patients undergoing one of the top 5 procedures did so in ASCs compared to 42 percent of fourth quartile patients (Table 2). This group therefore has the greatest margin for change.

4.3. Facility Payments and Patient Outcomes

Using variation in Medicare facility fees across procedures and over time as a source of exogenous variation in ASC treatment, we estimate the effect of ASC use on patient outcomes. Our analysis focuses on two patient outcomes: inpatient admission and emergency room visits following an outpatient procedure. Hospital admissions and emergency room visits are identified using inpatient and outpatient claims data for 2007 through 2009 to calculate the time in days between the date of the outpatient procedure and the date of the first subsequent inpatient admission or ER visit. [24] Table 5 shows that among all claims in our restricted physician sample (denoted by the row "All Patients"), 0.1 percent of patients were admitted to a hospital on the same day as, 1 percent were admitted between 1 and 7 days, and 3.1 percent were admitted between 8 and 30 days of an outpatient surgery. Similarly, 0.3, 1.5, and 4.1 percent of patients visited an ER on the same day as, 1 to 7 days after, or 30 days after outpatient surgery, respectively. With the exception of same day hospital admission, patients treated in a hospital outpatient department were more likely than those treated in an ASC to be subsequently admitted to a hospital or visit an ER.

[24] Patients that are seen in an ER may be admitted to the hospital as an inpatient or not admitted to the hospital.

We estimate a reduced form model to examine the relationship between ASC treatment and our two patient outcomes, where the dependent variable is an indicator for whether a patient was admitted to a hospital or visited an ER following outpatient surgery. Since changes in ASC payment are positively related to ASC market share, we use this ratio as a source of exogenous variation in ASC treatment:

$$y_i = X_i\beta + \sum_r \left(Risk_{i,r}\omega_{2,r} + Risk_{i,r} \times P_i^{pht}\omega_{2,r} \right) + \sum_p Proc_{ip}\delta_p + \sum_j Phys_{ij}\gamma_j + \sum_p \sum_j Proc_{ip} \times Phys_{ij}\rho_{jp} + \sum_t Year_{it}\theta_t + \varepsilon_i \quad (5)$$

In this model, y_i denotes whether a patient had an inpatient admission or ER visit within 0, 1 to 7, or 8 to 30 days of outpatient surgery.[25] The remaining variables are defined as in Equation (4), and we cluster standard errors by HSA.

The results in Table 6 (columns 2 to 6) show that when ASC payments increase, 7-day inpatient admission rates and same day ER visits decline for patients in higher-risk quartiles. We find no relationship between facility payments and same day inpatient admission, or 30-day inpatient admission and ER visits. These reduced form results indicate that the decline in hospital admission and ER visits is driven by higher quality ASC care as long as Medicare fee schedule changes are exogenous to relative quality changes in ASC versus hospital care.

4.4. Local Average Treatment Effect

In conjunction with the first stage results from Equation (4), the estimates discussed in Section 4.3 provide the local average treatment effect of ASC treatment on inpatient admission and ER visits. To scale results reported in Table 6 and estimate of the effect of ASC treatment on hospitalizations, we use a two-stage least squares (2SLS) model where we instrument the four payment ratio-by-quartile interactions for the four (endogenous) ASC-by-quartile interactions. If patients are better off when treated in ASCs, we expect the probability of hospitalization would

[25] An inpatient admission or ER visit within zero days of outpatient surgery indicates a same day hospitalization.

decrease as treatment in ASCs increases. On the other hand, if ASCs do a poorer job than hospitals of treating relatively sicker patients, we expect that patients would be more likely to get admitted to a hospital or visit the ER as the payment ratio increases.

The 2SLS estimates of the effect of ASC treatment on inpatient admission and ER visits, by quartile, are presented in Table 7. F-statistics from first stage regressions, shown in brackets, are large, alleviating concerns about finite sample bias from weak instruments.[26] The results indicate that ASC treatment has a large negative effect on 7-day inpatient admission and same day ER visits for patients in higher-risk quartiles. Patients in the highest risk quartile are less likely to visit an ER on the same day, 1 to 7 days, and 8 to 30 days of an outpatient surgery after ASC treatment than if they had undergone outpatient surgery in a hospital. These results suggest that the shift of the riskiest patients to ASCs does not appear to have negative consequences for patient health in terms of inpatient admission and ER visits.

6. Sensitivity Analysis

We have shown that high-risk patients who undergo an outpatient procedure in an ASC are less likely to visit an ER on the same day as an outpatient surgery or have an inpatient admission within 7 days of outpatient surgery. To better understand the mechanism through which ASC treatment would decrease subsequent hospitalization and ER visits, we follow the same 2SLS method used in Section 5 to consider the effect of ASC treatment on ER visits that are associated with medical errors and infections. These adverse events are identified using ICD-9-CM Adverse Event Codes from the Utah/Missouri Patient Safety Project. The Patient Safety Project defines an adverse event as “an undesirable and unintended injury resulting from a medical intervention” (Van Tuinen et al., 2005). Estimates of the effect of ASC treatment on

[26] Results for all first stage regressions are shown in Table A.1.

adverse events that resulted in an ER visit are presented in Table A.2. The estimates are imprecise, but suggest that ASC treatment leads to fewer ER visits due to adverse events among high-risk patients. Interestingly, the results also indicate that healthier patients may be more likely to visit an ER due to an adverse event in the 1 to 7 days following treatment in an ASC. Given that high-risk patients are more likely to be treated in an ASC as payments to ASCs increase, the greater likelihood of ER visits among lower risk patients could be related to different patient care and infection exposure associated with changing patient composition in ASCs.

In the previous section, we found that ASC treatment leads to better outcomes for high-risk patients. Diagnostic or exploratory procedures, such as colonoscopies and upper GI endoscopies, make up a large share of outpatient surgeries. While these procedures have complications that might result in inpatient admission, discussed earlier, they also detect more serious diseases that could lead to an inpatient admission for reasons other than complications associated with a diagnostic outpatient procedure. To ensure that our results are not driven by inpatient admissions associated with these procedures, we estimate the IV model restricted to corrective procedures. We use descriptions of the top HCPCS codes for each procedure category to approximate the intent and scope of a procedure in order to assign procedures to one of these two categories. Among the top 5 procedures, we define corrective procedures as cataract surgery, minor musculoskeletal procedures, and other eye procedures; 95,371 (35 percent) in our sample are considered corrective.

2SLS estimates for corrective procedures are presented in Table A.3. When we isolate our investigation by procedure type, the sample sizes decrease naturally leads to less precise estimates. Nonetheless, the results indicate that higher-risk patients undergoing one of the three

identified corrective procedures in an ASC are not more likely to be admitted for an inpatient hospital stay following an outpatient procedure. This suggests that the positive effects of ASC treatment on inpatient admission are not driven solely by diagnoses associated with exploratory procedures that lead to inpatient admission.

The physician responses we have addressed thus far suggest that as ASC payments increase relative to hospital payments, physicians substitute surgical care in ASCs for hospital outpatient departments. It could be the case, however, that when payments increase, physicians perform procedures that they would not have otherwise performed. Given limits on insurance coverage for many of the procedures in our analysis, it would be difficult for physicians to oversupply these procedures. For example, Medicare covers colonoscopies for beneficiaries that are age 50 and older once every 24 months for those that are at high-risk of colorectal cancer, and every 120 months otherwise. Still, we consider the impact of Medicare payment changes on the total volume of each type of outpatient procedure in an HSA using the model in Equation 3 with total surgical volume as the dependent variable. Results for this analysis are presented in Table A.4. We find no evidence that physicians changed surgical volume in response to Medicare's changes in facility payments. This suggests that the observed changes in ASC utilization are being driven by substitution between facilities rather than induced demand.

7. Conclusion

In this paper, we examined patient outcomes in ASCs, one example of specialization in medicine. We showed that ASCs treat a healthier patient mix than hospitals, but estimates that include procedures performed by all physicians likely overstate the effect of cream skimming because physicians who refer physicians to both types of facilities have a very different patients

mix from those that only refer patients to one type of facility. However, even limiting our sample to a subset of physicians who work in both ASC and hospital sectors, healthier patients are much more likely to be treated in ASCs. Using exogenous changes in the ratio of ASC facility fees to hospital outpatient facility fees for Medicare patients between 2007 and 2009, we find that changes in payments that favor ASCs induce physicians to refer increasingly risky patients to ASCs. Further, these patients have better health outcomes in terms of inpatient admission and ER visits following an outpatient procedure.

The findings in this paper provide insight into anticipated effects of recent changes in Medicare policies that increase hospital payments relative to ASC payments. We have shown that ASCs on average provide higher quality care for outpatient procedures than hospitals, and other research indicates that they do so at lower costs than hospitals (Munnich and Parente 2014). Reducing payments to ASCs appears to have limited growth in the ASC market, suggesting that policymakers are subsidizing hospitals at the expense of providing inexpensive, high quality care in ASCs.[27] However, one way in which ASCs may provide superior care is through specialization. Table 1 indicates that the top 5 highest volume procedures in ASCs comprise over 80 percent of all cases, whereas hospitals take on a much larger range of outpatient procedures. This may be due in part to limitations by insurance companies on what procedures are reimbursed in ASCs. In 2008, CMS began covering an additional 800 outpatient procedures in ASCs, including any surgical procedures other than those that pose a significant safety risk or generally require an overnight stay. If more procedures are offered at different types of facilities, patients will have greater flexibility over location of treatment, which could increase demand for ASCs and possibly outpatient care in general, and offset the slowing rate of ASC growth

[27] Dua and Fournier (2010, 2012) provide evidence that physicians and patients migrate to ASCs in response to declining quality in hospitals. The policy change we exploit in this analysis works in the opposite direction—declining ASC/hospital payment ratios lead to increased treatment in hospitals—alleviating concerns about possible confounding effects of this mechanism.

discussed in Section 2. On the other hand, if ASCs start providing more services, this could also negatively impact any gains from specialization observed in previous years.

Our findings indicate that ASCs provide efficient, high quality care for high volume outpatient surgeries. However, we acknowledge that this may come at the cost of reducing revenue sources from hospitals, which provide services that may be socially important. While ASCs offer cost effective treatment and superior patient outcomes for a subset of outpatient procedures, acute care hospitals provide a wider range of outpatient services as well as unprofitable services that may be valuable to society. Hospital administrators argue that through decreased outpatient volume, hospitals are losing important revenue streams that subsidize less profitable procedures and patients. A number of papers have documented that increased competition with ASCs is associated with lower hospital outpatient volume and profit (Carey, Burgess, and Young, 2011; Courtemanche and Plotzke, 2010; Lynk and Longley, 2002; Bian and Morrisey, 2007), and anecdotal evidence suggests that hospitals respond to losing profitable cases to ASCs by raising prices for other hospital service lines (Berenson, Bodenheimer, Pham, 2006; MedPAC, 2006). To date, proponents and critics of ASCs have predominantly voiced their appeals in isolation of one another, without acknowledging the trade-offs that exist between providing cost-effective, high quality care in ASCs, and subsidizing less profitable procedures and patients in hospitals. With less ability to cost shift across procedures, hospitals may reduce the amount of unprofitable services they provide or offer lower quality care overall in order to reduce costs. On the other hand, hospitals could increase use of profitable services that are not provided in ASCs or try to attract patients with other amenities. Both of these responses could lead to higher overall medical costs.

This illustrates a trade-off for health policy planners, between the superior and cheaper treatment patients receive in ASCs, and the subsidy these services provide for hospitals. While ASCs provide superior care at lower costs for a subset of outpatient services, hospitals provide a broader range of services and care for unprofitable patients. Future research should consider the effect of competition with ASCs on hospital finances as well as the quality and scope of the care that hospitals provide. Likewise, health care policies should jointly consider the more efficient, higher quality care provided in ASCs with the socially valued services that hospitals provide.

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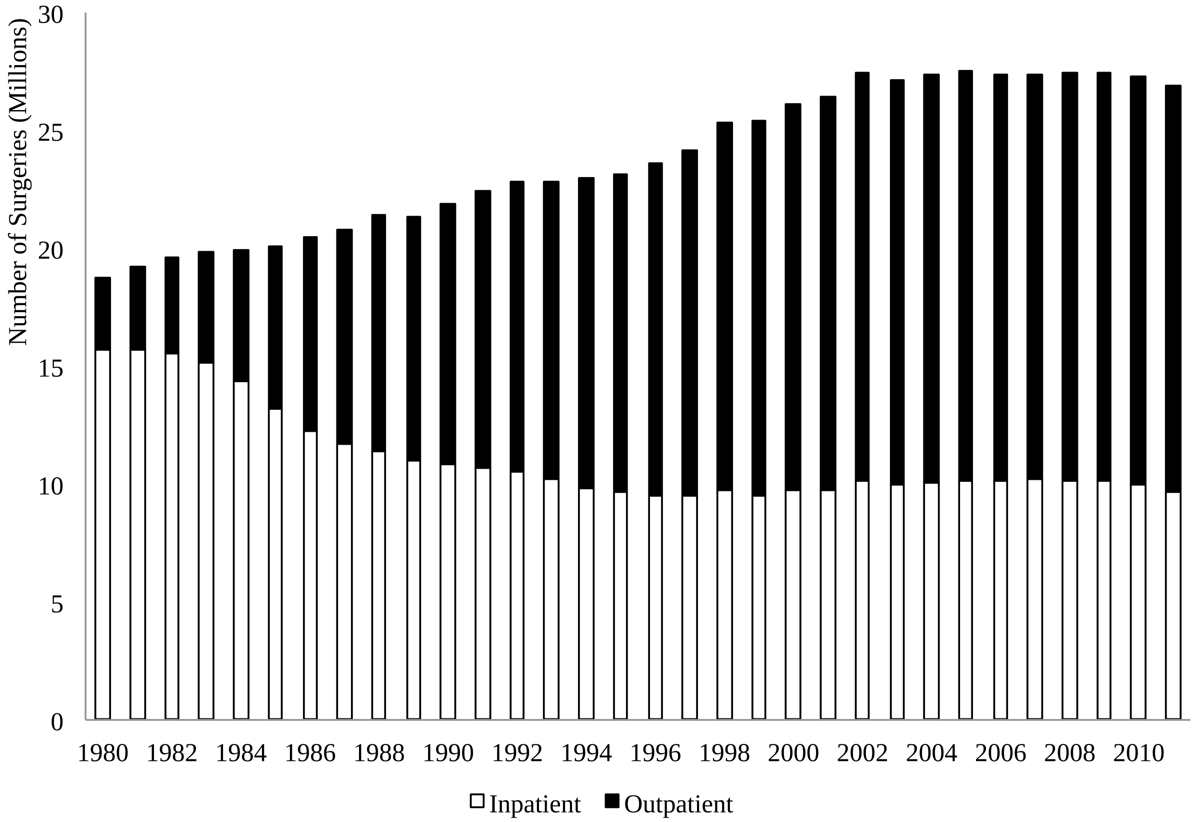
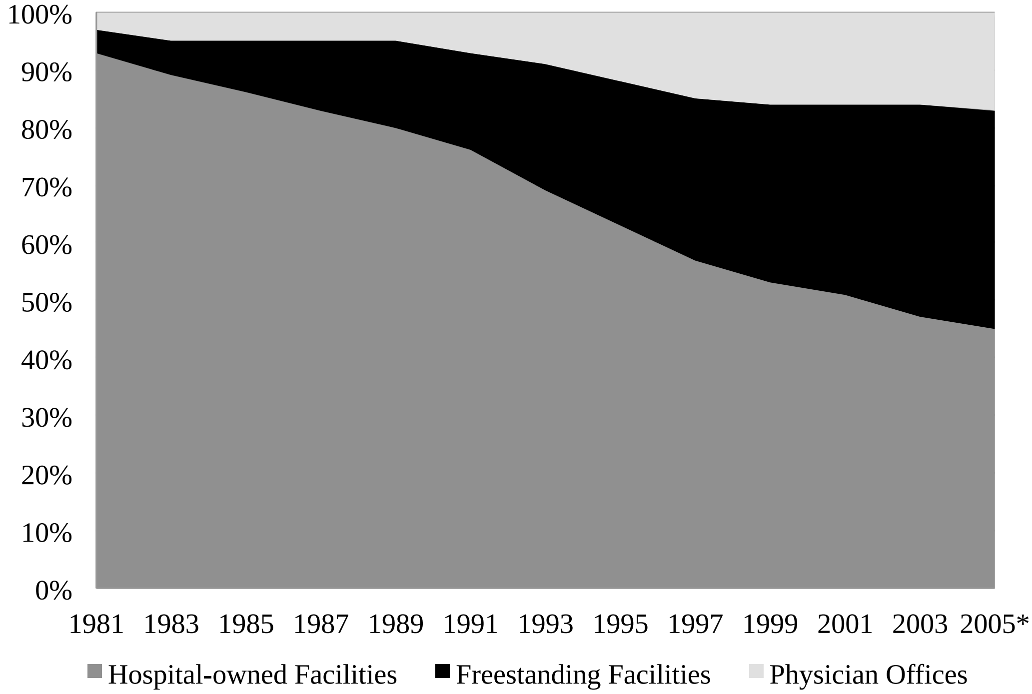
Figure 1
Inpatient and Outpatient Surgery Volume in Community Hospitals, 1980-2011



Source: American Hospital Association (2013)

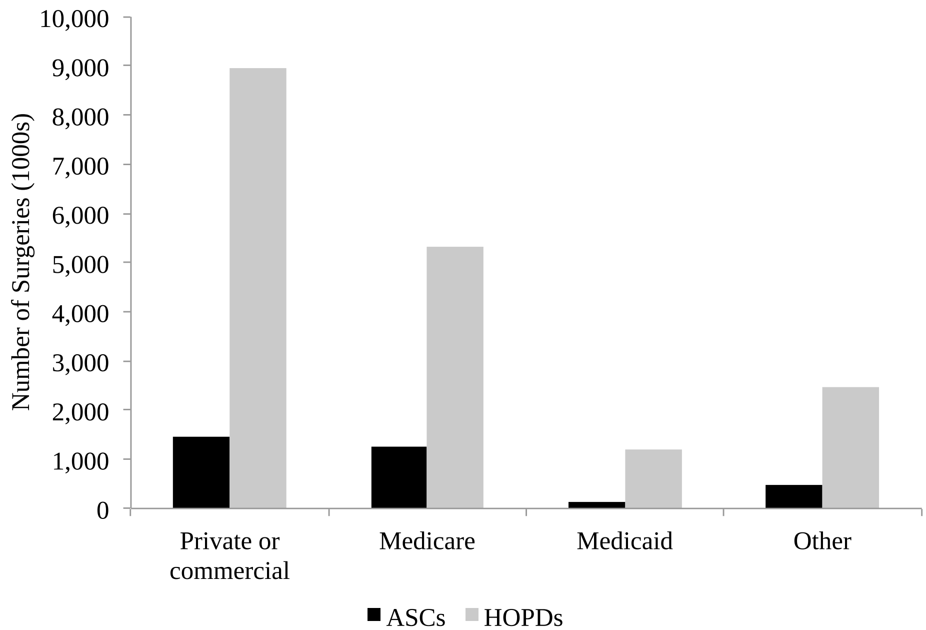
Figure 2
Percent of Outpatient Surgeries by Facility Type, 1981-2005



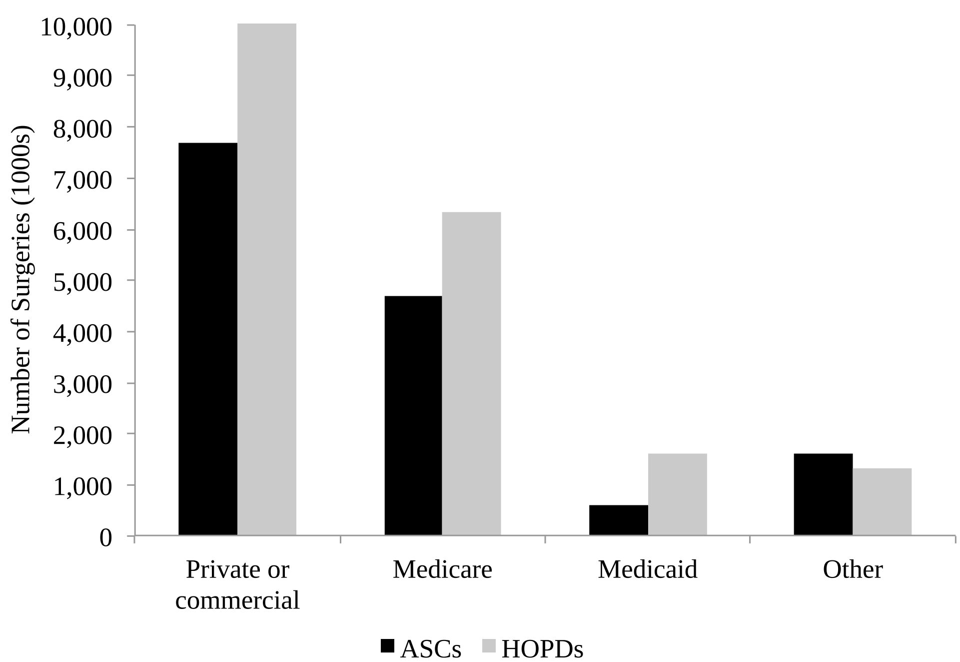
Source: American Hospital Association (2008)

Figure 3
Outpatient Surgeries by Patient's Primary Insurance
National Survey of Ambulatory Surgery

Panel A: 1996

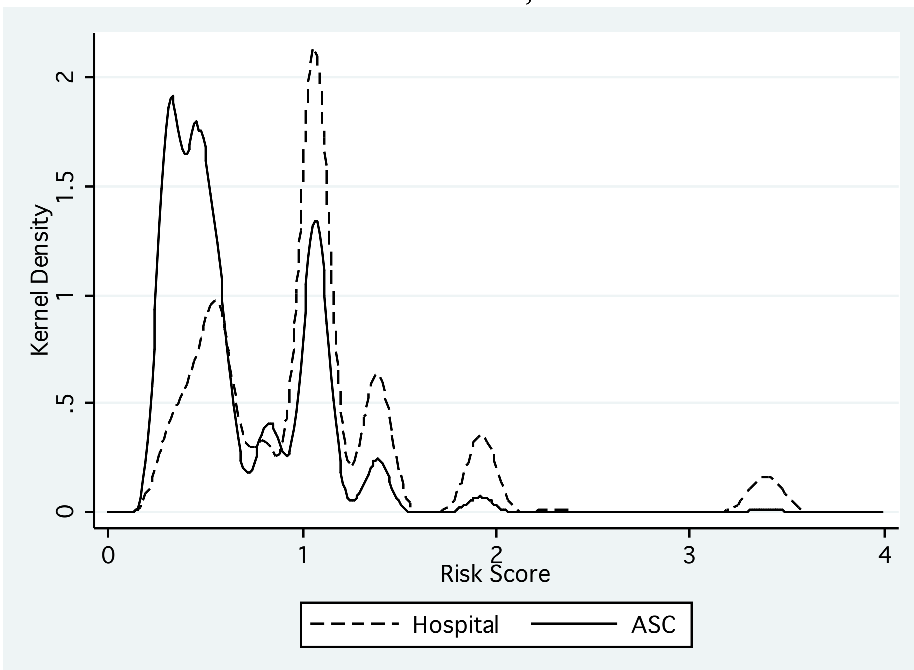


Panel B: 2006



Notes: "Other insurance" includes Worker's Compensation, TRICARE, charity care, and other government insurance.

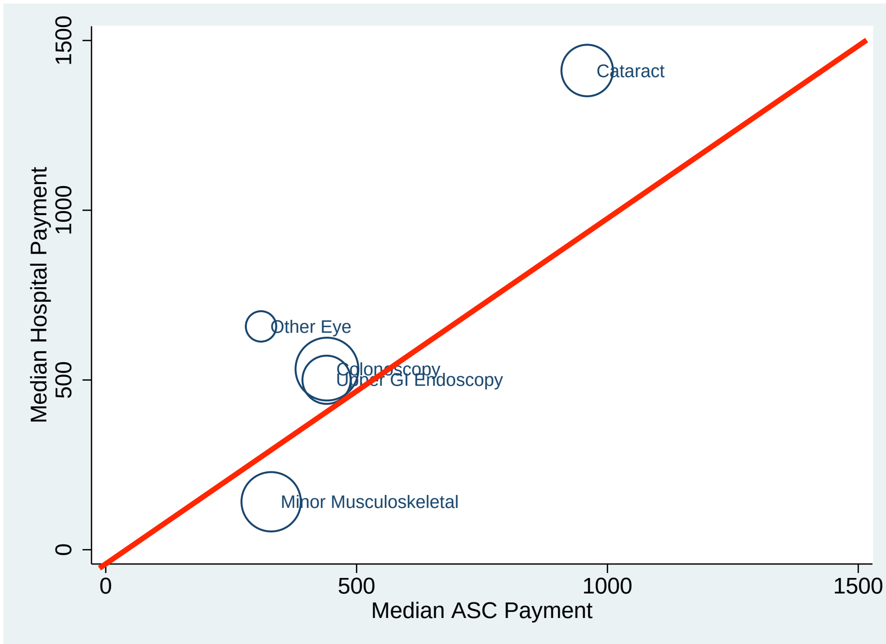
Figure 4
Patient Risk Score Kernel Density Plots by Facility Type, All Procedures
Medicare 5 Percent Claims, 2007-2009



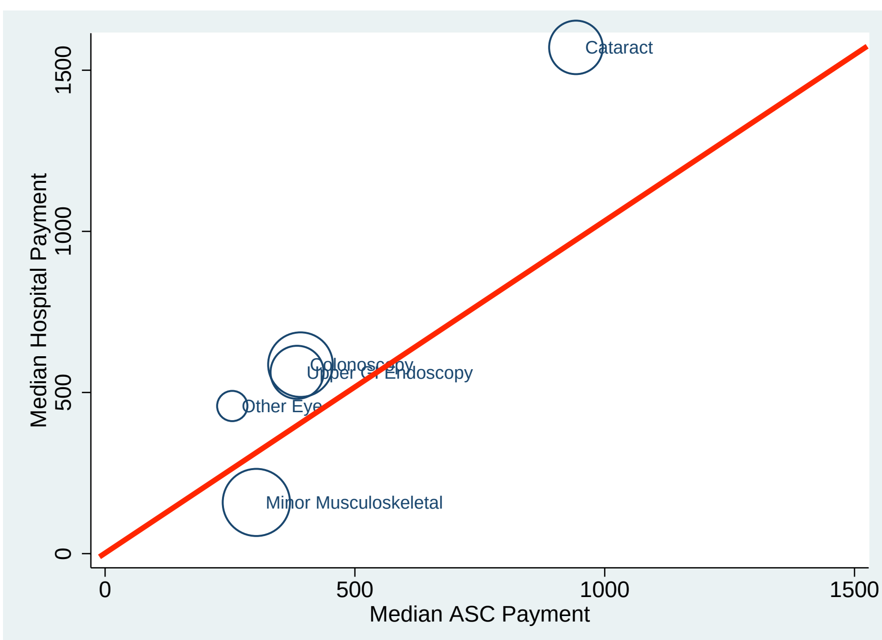
Notes: Sample size is 706,033 patient claims, restricted to patients with risk scores less than 4 (less than 1 percent of claims are from patients with risk scores greater than 4). Risk scores are based on concurrent weights calculated using the Johns Hopkins University ACG Case-Mix System (v. 10).

Figure 5
ASC and Hospital Outpatient Payments (Nominal $), by Procedure
Medicare 5 Percent Claims, 2007 & 2009

Panel A: 2007



Panel B: 2009



Notes: Bubble size represents number of Medicare claims for a particular procedure, based on HSAs where with at least 10 claims in both ASCs and hospitals for a given procedure. Line is 45-degree line. Procedures performed by physicians who only treated patients in one type of facility (ASC or hospital) were omitted.

Table 1
Descriptive Statistics for Outpatient Claims by Facility Type
All Procedures, Medicare 5 Percent Claims Data, 2007-2009
Means (Standard deviations)

Physician Sample:	All			Treats in Both		
Facility Type:	All	Hospitals	ASCs	All	Hospitals	ASCs
	(1)	(2)	(3)	(4)	(5)	(6)
Patient Characteristics						
Age	71.28	70.85	73.58	72.60	72.35	72.79
	(13.11)	(13.64)	(9.50)	(10.29)	(11.11)	(9.63)
Female	0.608	0.605	0.624	0.611	0.613	0.609
	(0.488)	(0.489)	(0.484)	(0.488)	(0.487)	(0.488)
Black	0.098	0.105	0.064	0.071	0.076	0.068
	(0.298)	(0.306)	(0.244)	(0.257)	(0.265)	(0.252)
Hispanic	0.017	0.017	0.016	0.014	0.014	0.014
	(0.129)	(0.129)	(0.126)	(0.117)	(0.118)	(0.116)
ESRD as Primary Reason for	0.029	0.033	0.008	0.013	0.020	0.008
Medicare Receipt	(0.169)	(0.179)	(0.092)	(0.114)	(0.139)	(0.091)
Disability as Primary Reason for	0.196	0.215	0.095	0.126	0.149	0.109
Medicare Receipt	(0.397)	(0.411)	(0.294)	(0.332)	(0.356)	(0.311)
Type of Procedure						
Cataract Removal	0.066	0.027	0.276	0.120	0.097	0.137
	(0.248)	(0.161)	(0.447)	(0.325)	(0.295)	(0.344)
Colonoscopy	0.070	0.043	0.214	0.252	0.153	0.326
	(0.255)	(0.203)	(0.410)	(0.434)	(0.360)	(0.469)
Upper GI Endoscopy	0.048	0.037	0.108	0.160	0.157	0.163
	(0.213)	(0.188)	(0.310)	(0.367)	(0.364)	(0.369)
Minor Musculoskeletal	0.071	0.061	0.130	0.105	0.082	0.122
	(0.258)	(0.238)	(0.337)	(0.307)	(0.274)	(0.328)
Other Eye Procedure	0.024	0.010	0.098	0.039	0.030	0.046
	(0.152)	(0.100)	(0.297)	(0.194)	(0.171)	(0.209)
Number of Claims	4,534,825	3,825,431	709,394	623,309	267,879	355,430

Notes: Procedures where physician identifier was missing were omitted. The physician sample "Treats in Both" indicates the sample of physicians for whom we observe patient claims in both ASCs and hospital outpatient departments.

Table 2
Probability of Treatment in ASC, Linear Probability Model with Physician Fixed Effects, by Procedure
Parameter Estimate (Standard Error) {Share Treated in ASC} [Share of Claims in Risk Score Quartile]
Medicare 5 Percent Claims Data, 2007-2009

Sample	(1) All Procedures	(2) All Procedures	(3) All Procedures	(4) Top 5 Procedures	(5) Cataract	(6) Colonoscopy	(7) Upper GI Endoscopy	(8) Minor Musculoskeletal	(9) Other Eye
Risk Score Quartile 1	*Omitted*	*Omitted*	*Omitted*	*Omitted*	*Omitted*	*Omitted*	*Omitted*	*Omitted*	*Omitted*
	{0.4075}	{0.7567}	{0.7567}	{0.8310}	{0.8506}	{0.8732}	{0.8534}	{0.7628}	{0.7690}
	[0.1768]	[0.2511]	[0.2511]	[0.2615]	[0.6649]	[0.1141]	[0.1501]	[0.2847]	[0.5194]
Risk Score Quartile 2	-0.1158***	-0.1166***	-0.0884***	-0.0857***	-0.1730***	0.0048	-0.0589***	-0.1047***	-0.0316**
	(0.0028)	(0.0046)	(0.0037)	(0.0043)	(0.0191)	(0.0033)	(0.0054)	(0.0113)	(0.0123)
	{0.1593}	{0.6692}	{0.6692}	{0.8110}	{0.6844}	{0.8726}	{0.7823}	{0.5354}	{0.7862}
	[0.2114]	[0.2500]	[0.2500]	[0.2413]	[0.0506]	[0.3663]	[0.2645]	[0.1185]	[0.2608]
Risk Score Quartile 3	-0.1704***	-0.2818***	-0.2542***	-0.2572***	-0.5891***	-0.1308***	-0.2453***	-0.0711***	-0.3347***
	(0.0041)	(0.0064)	(0.0059)	(0.0067)	(0.0143)	(0.0069)	(0.0082)	(0.0135)	(0.0195)
	{0.1116}	{0.4925}	{0.4925}	{0.5949}	{0.2171}	{0.6951}	{0.5276}	{0.7015}	{0.3396}
	[0.2676]	[0.2490]	[0.2490]	[0.2506]	[0.1591]	[0.2722]	[0.2336]	[0.3607]	[0.1180]
Risk Score Quartile 4	-0.2003***	-0.4343***	-0.3853***	-0.4131***	-0.6838***	-0.2945***	-0.4207***	-0.1758***	-0.4977***
	(0.0046)	(0.0074)	(0.0070)	(0.0077)	(0.0141)	(0.0086)	(0.0095)	(0.0188)	(0.0218)
	{0.0597}	{0.3590}	{0.3590}	{0.4230}	{0.1477}	{0.5218}	{0.3413}	{0.5592}	{0.2301}
	[0.3442]	[0.2500]	[0.2500]	[0.2467]	[0.1255]	[0.2474]	[0.3518]	[0.2360]	[0.1018]
# Observations	4,524,827	620,952	620,952	419,522	74,438	156,013	99,406	65,286	24,379
# Physicians	358,315	26,819	26,819	16,323	3,225	8,200	7,439	4,212	3,024
R^2	0.3889	0.2681	0.5988	0.4757	0.5874	0.4190	0.4392	0.5315	0.6093
Restricted Sample	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Physician FE	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Procedure FE	No	No	Yes	Yes	No	No	No	No	No
Physician x Procedure FE	No	No	Yes	Yes	No	No	No	No	No
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Risk score quartile 1 denotes the healthiest group of patients. “Restricted sample” indicates that procedures performed by physicians who only treated patients in one type of facility (ASC or hospital) were omitted. Controls include age <65, age 70-74, age 75-79, age 80-84, age 85+, black, female, Hispanic, and an indicator where ESRD was the only reason for Medicare eligibility. Standard errors clustered by HSA.

Table 3
Descriptive Statistics, ASC Treatment and Subsequent Hospital Visits
Medicare 5% Claims, Top 5 Procedures, 2007-2009
Means (Standard Deviations)

Dependent Variable	ASC	Inpatient Admission			Emergency Room Visit		
		Same Day	1-7 Days	8-30 Days	Same Day	1-7 Days	8-30 Days
1st Quartile	0.860	0.001	0.007	0.024	0.002	0.012	0.035
	(0.347)	(0.027)	(0.084)	(0.154)	(0.043)	(0.110)	(0.185)
2nd Quartile	0.835	0.001	0.009	0.029	0.003	0.015	0.037
	(0.371)	(0.037)	(0.096)	(0.169)	(0.053)	(0.123)	(0.189)
3rd Quartile	0.651	0.001	0.010	0.032	0.003	0.016	0.043
	(0.477)	(0.035)	(0.100)	(0.175)	(0.055)	(0.127)	(0.202)
4th Quartile	0.467	0.001	0.012	0.040	0.005	0.018	0.048
	(0.499)	(0.036)	(0.109)	(0.196)	(0.068)	(0.133)	(0.214)
All Patients	0.703	0.001	0.010	0.031	0.003	0.015	0.041
	(0.457)	(0.034)	(0.098)	(0.174)	(0.056)	(0.123)	(0.198)
Observations	273,944	273,944	271,781	254,158	273,944	271,781	254,158

Notes: Procedures performed by physicians who only treated patients in one type of facility (ASC or hospital) were omitted.

Table 4
HSA Facility Payments in Nominal Dollars and Payment Ratios by Procedure, 2007-2009
Medicare 5 Percent Carrier Claims and Hospital Outpatient Data
Means (Standard Deviations)

		2007	2008	2009
Cataract Removal	Average ASC Payment	$962	$966	$960
		($87)	($73)	($76)
	Average Hospital Payment	$1,437	$1,515	$1,601
		($169)	($154)	($171)
	Average Payment Ratio	0.689	0.691	0.640
		(0.278)	(0.053)	(0.263)
	Number of HSAs	308	294	286
Colonoscopy	Average ASC Payment	$443	$419	$397
		($35)	($49)	($34)
	Average Hospital Payment	$545	$571	$602
		($57)	($61)	($64)
	Average Payment Ratio	0.817	0.791	0.687
		(0.086)	(0.081)	(0.036)
	Number of HSAs	524	526	504
Upper GI Endoscopy	Average ASC Payment	$434	$412	$387
		($51)	($45)	($39)
	Average Hospital Payment	$505	$534	$562
		($76)	($85)	($83)
	Average Payment Ratio	0.883	0.857	0.737
		(0.201)	(0.179)	(0.155)
	Number of HSAs	428	251	252
Minor Musculoskeletal Procedures	Average ASC Payment	$329	$315	$304
		($38)	($47)	($43)
	Average Hospital Payment	$213	$216	$232
		($146)	($162)	($170)
	Average Payment Ratio	2.620	2.557	2.28
		(1.76)	(1.715)	(1.531)
	Number of HSAs	455	481	489
Other Eye Procedures	Average ASC Payment	$327	$302	$285
		($59)	($75)	($105)
	Average Hospital Payment	$943	$641	$733
		($742)	($482)	($576)
	Average Payment Ratio	0.648	0.671	0.582
		(0.530)	(0.509)	(0.474)
	Number of HSAs	147	127	108

Notes: Payment ratio is calculated by dividing the median ASC payment for each year by the 2007 median hospital payment, by Hospital Service Area and procedure; the average payments are calculated over HSA-level median values, for all HSAs with at least 10 claims in both ASCs and hospitals for a given procedure.

Table 5
OLS Regressions of ASC Share on Facility Payment Ratio for Top 5 Procedures by HSA
Medicare 5 Percent Claims Data, 2007-2009

Payment Ratio	0.0393***
	(0.0081)
Colonoscopy	-0.0912***
	(0.0204)
Upper GI	-0.2544***
	(0.0207)
Minor Musculoskeletal	-0.3458***
	(0.0210)
Other Eye	-0.1144***
	(0.0270)
Year (2008)	0.0135***
	(0.0033)
Year (2009)	0.0257***
	(0.0046)
Mean of Dependent Variable	0.557
	(0.208)
Observations	4,224
R^2	0.6978
HSA Fixed Effects	Yes

Notes: Panels balanced by Hospital Service Area (HSA) across years, by procedure. Payment ratio is calculated by dividing the median ASC payment for each year by the median hospital payment in 2007, by HSA and procedure for all HSAs with at least 10 claims in both ASCs and hospitals for a given procedure. All estimates weighted by population of Medicare enrollee claims in each procedure-HSA-year cell. Standard errors, clustered by HSA, in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 6
ASC Treatment and Subsequent Hospital Visits by Risk Score Quartile, Top 5 Procedures
Linear Probability Model with Physician-Procedure Fixed Effects
Medicare 5 Percent Claims, 2007-2009

Dependent Variable	ASC	Inpatient Admission			Emergency Room Visit		
		Same Day	1-7 Days	8-30 Days	Same Day	1-7 Days	8-30 Days
2nd Quartile	-0.0568***	-0.0006	0.0018	0.0037*	0.0005	0.0031**	0.0058**
	(0.0071)	(0.0005)	(0.0011)	(0.0022)	(0.0006)	(0.0014)	(0.0028)
3rd Quartile	-0.2828***	0.0003	0.0037***	0.0068***	0.0018***	0.0043***	0.0076***
	(0.0112)	(0.0003)	(0.0012)	(0.0020)	(0.0006)	(0.0013)	(0.0024)
4th Quartile	-0.4482***	0.0002	0.0055***	0.0157***	0.0033***	0.0064***	0.0136***
	(0.0131)	(0.0003)	(0.0012)	(0.0022)	(0.0006)	(0.0015)	(0.0027)
1st Quartile*Pmt Ratio	0.0419**	0.0001	-0.0008	-0.0004	-0.0003	0.0001	-0.0003
	(0.0183)	(0.0002)	(0.0012)	(0.0022)	(0.0005)	(0.0014)	(0.0029)
2nd Quartile*Pmt Ratio	0.0377**	0.0007	-0.0017	-0.0017	-0.0008	-0.0009	-0.0027
	(0.0181)	(0.0004)	(0.0012)	(0.0026)	(0.0006)	(0.0015)	(0.0033)
3rd Quartile*Pmt Ratio	0.1086***	0.0000	-0.0021**	-0.0024	-0.0011**	-0.0012	-0.0026
	(0.0184)	(0.0002)	(0.0011)	(0.0022)	(0.0005)	(0.0013)	(0.0028)
4th Quartile*Pmt Ratio	0.1265***	0.0000	-0.0026**	-0.0030	-0.0012**	-0.0025*	-0.0038
	(0.0179)	(0.0002)	(0.0011)	(0.0023)	(0.0005)	(0.0014)	(0.0028)
Observations	276,091	276,091	273,896	256,131	276,091	273,896	256,131
R^2	0.5070	0.0867	0.0866	0.0961	0.1392	0.0857	0.0985

Notes: Controls include age <65, age 70-74, age 75-79, age 80-84, age 85+, black, female, Hispanic, and ESRD as the only reason for Medicare eligibility, as well year and physician-procedure fixed effects. Payment ratio is calculated by dividing the median ASC payment for each year by the median hospital payment in 2007, by Hospital Service Area (HSA) and procedure for all HSAs with at least 10 claims in both ASCs and hospitals for a given procedure. Procedures performed by physicians who only treated patients in one type of facility (ASC or hospital) were omitted. For regressions with 7- and 30-day measures as the dependent variable, observations that occurred within 7 and 30 days of the end of the calendar year (respectively) were omitted. Standard errors, clustered by HSA, in parentheses.

Table 7
Two-Stage Least Squares Estimates of the Effect of ASC Treatment on Subsequent Hospital Visits by Risk Square Quartile, Top 5 Procedures
Linear Probability Model with Physician-Procedure Fixed Effects
Medicare 5 Percent Claims, 2007-2009
(Standard Error)[First Stage F-Statistic]

	Inpatient Admission			Emergency Room Visit		
Dependent Variable	0 Days	1-7 Days	8-30 Days	0 Days	1-7 Days	8-30 Days
1st Quartile*ASC	0.0442	-0.0836	-0.0881	-0.0375	-0.0457	-0.1526
	(0.0286)	(0.0635)	(0.1446)	(0.0326)	(0.0896)	(0.1880)
	[97.10]	[95.96]	[89.49]	[97.10]	[95.96]	[89.49]
2nd Quartile*ASC	-0.1362	0.1855	0.2553	0.0859	0.1495	0.4863
	(0.0941)	(0.1699)	(0.4321)	(0.0964)	(0.2636)	(0.5810)
	[15.09]	[14.99]	[12.70]	[15.09]	[14.99]	[12.70]
3rd Quartile*ASC	0.0076	-0.0309**	-0.0386	-0.0164**	-0.0232	-0.0529
	(0.0057)	(0.0150)	(0.0331)	(0.0072)	(0.0204)	(0.0419)
	[1003.74]	[1001.20]	[928.50]	[1003.74]	[1001.20]	[928.50]
4th Quartile*ASC	0.0048	-0.0288**	-0.0367	-0.0136**	-0.0307*	-0.0529*
	(0.0039)	(0.0115)	(0.0227)	(0.0058)	(0.0166)	(0.0287)
	[693.35]	[686.51]	[671.38]	[693.35]	[686.51]	[671.38]
Observations	273,955	271,781	254,158	273,955	271,781	254,158
R-squared	0.0781	0.0772	0.0863	0.0897	0.0762	0.0905

Notes: Controls include age <65, age 70-74, age 75-79, age 80-84, age 85+, black, female, Hispanic, ESRD as the only reason for Medicare eligibility, and quartile dummy variables, as well year and physician-procedure fixed effects. Payment ratio is calculated by dividing the median ASC payment for each year by the median hospital payment in 2007, by Hospital Service Area (HSA) and procedure for all HSAs with at least 10 claims in both ASCs and hospitals for a given procedure. Procedures performed by physicians who only treated patients in one type of facility (ASC or hospital) were omitted. For regressions with 7- and 30-day measures as the dependent variable, observations that occurred within 7 and 30 days of the end of the calendar year (respectively) were omitted. Standard errors, clustered by HSA, in parentheses.

Table A.1
First Stage Estimates of Effect of ASC Payments on ASC Treatment
By Risk Score Quartile, Top 5 Procedures
Linear Probability Model with Physician-Procedure Fixed Effects
Medicare 5 Percent Claims, 2007-2009

Dependent Variable	1st Quartile* ASC	2nd Quartile* ASC	3rd Quartile* ASC	4th Quartile* ASC
1st Quartile*Payment Ratio	0.0384***	0.0113***	-0.0084	0.0006
	(0.0082)	(0.0032)	(0.0060)	(0.0052)
2nd Quartile*Payment Ratio	0.0244***	0.0036	0.0038	0.0059
	(0.0076)	(0.0076)	(0.0059)	(0.0056)
3rd Quartile*Payment Ratio	0.0169**	0.0097***	0.0780***	0.0040
	(0.0073)	(0.0030)	(0.0070)	(0.0055)
4th Quartile*Payment Ratio	0.0183***	0.0094***	-0.0029	0.1017***
	(0.0069)	(0.0031)	(0.0062)	(0.0079)
F-Statistic	97.10	15.09	1003.74	693.35
Observations	273,955	273,955	192,421	192,421
R-squared	0.6882	0.5551	0.6710	0.5443

Notes: Controls include age <65, age 70-74, age 75-79, age 80-84, age 85+, black, female, Hispanic, ESRD as the only reason for Medicare eligibility, and quartile dummy variables, as well year and physician-procedure fixed effects. Payment ratio is calculated by dividing the median ASC payment for each year by the median hospital payment in 2007, by Hospital Service Area (HSA) and procedure for all HSAs with at least 10 claims in both ASCs and hospitals for a given procedure. Procedures performed by physicians who only treated patients in one type of facility (ASC or hospital) were omitted. For regressions with 7- and 30-day measures as the dependent variable, observations that occurred within 7 and 30 days of the end of the calendar year (respectively) were omitted. Standard errors, clustered by HSA, in parentheses.

Table A.2
Two-Stage Least Squares Estimates of the Effect of ASC Treatment on Adverse Events
By Risk Square Quartile, Top 5 Procedures
Linear Probability Model with Physician-Procedure Fixed Effects
Medicare 5 Percent Claims, 2007-2009
(Standard Error)[First Stage F-Statistic]{Mean of Dependent Variable}

	Emergency Room Visit for Adverse Event		
Dependent Variable	0 Days	1-7 Days	8-30 Days
1st Quartile*ASC	-0.0001	0.0247	-0.0768
	(0.0129)	(0.0491)	(0.1114)
	[97.10]	[95.96]	[89.49]
	{0.000}	{0.004}	{0.012}
2nd Quartile*ASC	-0.0097	0.0585	0.3528
	(0.0416)	(0.1269)	(0.3623)
	[15.09]	[14.99]	[12.70]
	{0.001}	{0.005}	{0.013}
3rd Quartile*ASC	-0.0020	-0.0081	-0.0320
	(0.0026)	(0.0111)	(0.0254)
	[1003.74]	[1001.20]	[928.50]
	{0.001}	{0.005}	{0.014}
4th Quartile*ASC	-0.0019	-0.0039	-0.0212
	(0.0020)	(0.0089)	(0.0173)
	[693.35]	[686.51]	[671.38]
	{0.001}	{0.007}	{0.018}
Observations	273,955	271,781	254,158
R-squared	0.0742	0.0802	0.0851

Notes: Adverse events are defined using ICD-9-CM Adverse Event Codes from the Utah/Missouri Patient Safety Project. For 7- and 30-day measures, observations that occurred within 7 and 30 days of the end of the calendar year (respectively) were omitted. Controls include age <65, age 70-74, age 75-79, age 80-84, age 85+, black, female, Hispanic, ESRD as the only reason for Medicare eligibility, and quartile dummy variables, as well year and physician-procedure fixed effects. Payment ratio is calculated by dividing the median ASC payment for each year by the median hospital payment in 2007, by Hospital Service Area (HSA) and procedure for all HSAs with at least 10 claims in both ASCs and hospitals for a given procedure. Procedures performed by physicians who only treated patients in one type of facility (ASC or hospital) were omitted. For regressions with 7- and 30-day measures as the dependent variable, observations that occurred within 7 and 30 days of the end of the calendar year (respectively) were omitted. Standard errors, clustered by HSA, in parentheses. Standard errors, clustered by HSA, in parentheses.

Table A.3
Two-Stage Least Squares Estimates of the Effect of ASC Treatment on Inpatient Hospital Admission by Risk Square Quartile, Corrective Procedures
Linear Probability Model with Physician-Procedure Fixed Effects
Medicare 5 Percent Claims, 2007-2009
(Standard Error)[First Stage F-Statistic]

	Inpatient Admission		
Dependent Variable	0 Days	1-7 Days	8-30 Days
1st Quartile*ASC	0.0002	-0.0315	-0.0395
	(0.0036)	(0.0239)	(0.0435)
	[194.54]	[192.54]	[185.35]
2nd Quartile*ASC	0.0174	-0.0469*	-0.0733
	(0.0111)	(0.0255)	(0.0605)
	[59.21]	[58.10]	[54.33]
3rd Quartile*ASC	0.0011	-0.0155**	-0.0187
	(0.0012)	(0.0075)	(0.0175)
	[1356.44]	[1352.31]	[1258.93]
4th Quartile*ASC	0.0008	-0.0101	-0.0098
	(0.0009)	(0.0068)	(0.0164)
	[903.24]	[896.66]	[879.02]
Observations	95,371	94,609	88,311
R-squared	0.0496	0.0739	0.0853

Notes: Corrective procedures include cataract removal, minor musculoskeletal, and other eye procedures. Controls include age <65, age 70-74, age 75-79, age 80-84, age 85+, black, female, Hispanic, ESRD as the only reason for Medicare eligibility, and quartile dummy variables, as well year and physician-procedure fixed effects. Payment ratio is calculated by dividing the median ASC payment for each year by the median hospital payment in 2007, by Hospital Service Area (HSA) and procedure for all HSAs with at least 10 claims for each procedure in both ASCs and hospitals. Procedures performed by physicians who only treated patients in one type of facility (ASC or hospital) were omitted. For regressions with 7- and 30-day measures as the dependent variable, observations that occurred within 7 and 30 days of the end of the calendar year (respectively) were omitted. Standard errors, clustered by HSA, in parentheses. Standard errors, clustered by HSA, in parentheses.

Table A.4
OLS Regressions of Surgical Volume on Facility Payment Ratio for Top 5 Procedures by HSA
Medicare 5 Percent Claims Data, 2007-2009

Payment Ratio	2.45
	(5.44)
Colonoscopy	18.35*
	(10.22)
Upper GI	-69.04***
	(9.43)
Minor Musculoskeletal	44.07**
	(18.27)
Other Eye	-161.57***
	(27.22)
Year (2008)	-4.16**
	(1.99)
Year (2009)	-5.36**
	(2.52)
Mean of Dependent Variable	146.69
	(127.86)
Observations	4,224
R^2	0.9006
HSA Fixed Effects	Yes

Notes: Panels balanced by Hospital Service Area (HSA) across years, by procedure. Payment ratio is calculated by dividing the median ASC payment for each year by the median hospital payment in 2007, by HSA and procedure for all HSAs with at least 10 claims in both ASCs and hospitals for a given procedure. All estimates weighted by population of Medicare enrollee claims in each procedure-HSA-year cell. Standard errors, clustered by HSA, in parentheses. *** p<0.01, ** p<0.05, * p<0.1

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 SEPTEMBER 19, 2013 VOL. 369 NO. 12

Long-Term Colorectal-Cancer Incidence and Mortality after Lower Endoscopy

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ABSTRACT

BACKGROUND

Colonoscopy and sigmoidoscopy provide protection against colorectal cancer, but the magnitude and duration of protection, particularly against cancer of the proximal colon, remain uncertain.

METHODS

We examined the association of the use of lower endoscopy (updated biennially from 1988 through 2008) with colorectal-cancer incidence (through June 2010) and colorectal-cancer mortality (through June 2012) among participants in the Nurses' Health Study and the Health Professionals Follow-up Study.

RESULTS

Among 88,902 participants followed over a period of 22 years, we documented 1815 incident colorectal cancers and 474 deaths from colorectal cancer. With endoscopy as compared with no endoscopy, multivariate hazard ratios for colorectal cancer were 0.57 (95% confidence interval [CI], 0.45 to 0.72) after polypectomy, 0.60 (95% CI, 0.53 to 0.68) after negative sigmoidoscopy, and 0.44 (95% CI, 0.38 to 0.52) after negative colonoscopy. Negative colonoscopy was associated with a reduced incidence of proximal colon cancer (multivariate hazard ratio, 0.73; 95% CI, 0.57 to 0.92). Multivariate hazard ratios for death from colorectal cancer were 0.59 (95% CI, 0.45 to 0.76) after screening sigmoidoscopy and 0.32 (95% CI, 0.24 to 0.45) after screening colonoscopy. Reduced mortality from proximal colon cancer was observed after screening colonoscopy (multivariate hazard ratio, 0.47; 95% CI, 0.29 to 0.76) but not after sigmoidoscopy. As compared with colorectal cancers diagnosed in patients more than 5 years after colonoscopy or without any prior endoscopy, those diagnosed in patients within 5 years after colonoscopy were more likely to be characterized by the CpG island methylator phenotype (CIMP) (multivariate odds ratio, 2.19; 95% CI, 1.14 to 4.21) and microsatellite instability (multivariate odds ratio, 2.10; 95% CI, 1.10 to 4.02).

CONCLUSIONS

Colonoscopy and sigmoidoscopy were associated with a reduced incidence of cancer of the distal colorectum; colonoscopy was also associated with a modest reduction in the incidence of proximal colon cancer. Screening colonoscopy and sigmoidoscopy were associated with reduced colorectal-cancer mortality; only colonoscopy was associated with reduced mortality from proximal colon cancer. Colorectal cancer diagnosed within 5 years after colonoscopy was more likely than cancer diagnosed after that period or without prior endoscopy to have CIMP and microsatellite instability. (Funded by the National Institutes of Health and others.)

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N Engl J Med 2013;369:1095-105.
DOI: 10.1056/NEJMoa1301969

RANDOMIZED, CONTROLLED TRIALS HAVE shown that screening with flexible sigmoidoscopy reduces the incidence of colorectal cancer and associated mortality, albeit with diminished effectiveness for cancers of the proximal colon.[1-3] Although comparable data from randomized, controlled trials of screening colonoscopy are not yet available,[4] colonoscopy is also widely endorsed by expert bodies for population-based screening, largely on the basis of case–control studies that show associations with reduced colorectal-cancer incidence and mortality.[5-9] However, as with flexible sigmoidoscopy, there is uncertainty about the effectiveness of colonoscopy in reducing the incidence of and mortality associated with proximal colon cancer[10-19] and about the frequency and interval at which testing should be offered.[5-9] Moreover, it remains unclear why a considerable proportion of colorectal cancers are diagnosed in persons who have recently undergone colonoscopy.[5] Such cancers may result from missed lesions or from the rapid progression of new neoplasia,[20-25] which may be associated with specific molecular characteristics.[25]

To address these uncertainties, we conducted a prospective analysis of the association between lower gastrointestinal endoscopy and the long-term risk of incident colorectal cancer in two large U.S. cohorts prospectively followed over a period of 22 years. We also comprehensively examined the molecular features in a subset of tumors.

METHODS

STUDY POPULATION

We used data from two prospective cohort studies: the Nurses' Health Study, which included 121,700 U.S. female nurses, 30 to 55 years of age at enrollment in 1976; and the Health Professionals Follow-up Study, which included 51,529 U.S. male health professionals, 40 to 75 years of age at enrollment in 1986.[26,27] The return of mailed questionnaires was considered to constitute written informed consent.

The study protocol was approved by the institutional review boards of the Harvard School of Public Health and Brigham and Women's Hospital. The authors assume full responsibility for the analyses and interpretation of these data.

ASSESSMENT OF LOWER ENDOSCOPY AND POLYPECTOMY

Details of the endoscopy assessment are provided in the Supplementary Appendix, available with the full text of this article at NEJM.org. In both cohorts, beginning in 1988 and continuing through 2008, as part of a questionnaire administered every 2 years, participants were asked whether they had undergone either sigmoidoscopy or colonoscopy and, if so, the reason for the investigation. In 2004, we additionally collected comprehensive information on whether previously reported lower endoscopies were colonoscopies or sigmoidoscopies.[26,27] Every cycle thereafter, responses for sigmoidoscopy and colonoscopy were recorded separately.

When participants reported a diagnosis of colorectal polyps, consent was obtained to review medical records and pathology reports.[26,27] Study physicians, who were unaware of all the data obtained from the questionnaires, confirmed adenomatous polyps. Persons with polyps that met one or more of the criteria for advanced adenoma (≥10 mm in diameter, tubulovillous or villous histologic features, or high-grade dysplasia) and persons with three or more adenomatous polyps were classified as having high-risk adenoma.[5] Colonoscopic polypectomy was defined as the excision of one or more confirmed adenomatous polyps, excluding hyperplastic polyps. A negative endoscopy was defined as a procedure that did not result in the diagnosis of adenomas or colorectal cancer.

COLORECTAL-CANCER ASCERTAINMENT AND MOLECULAR ANALYSES

Detailed descriptions of cancer ascertainment and molecular analyses are provided in the Supplementary Appendix. A diagnosis of colorectal cancer was confirmed with the use of the National Death Index, medical records, and pathology reports. We extracted DNA from paraffin-embedded tumor specimens and normal tissue specimens. Microsatellite instability status and mutation status for *BRAF* (codon 600), *KRAS* (codons 12 and 13), and *PIK3CA* (exons 9 and 20) were determined as previously described.[28,29] DNA methylation was quantified at eight CpG island methylator phenotype (CIMP)–specific promoters (*CACNA1G*, *CDKN2A* [p16], *CRABP1*, *IGF2*, *MLH1*, *NEUROG1*, *RUNX3*, and *SOCS1*) and in long

interspersed nucleotide element 1 (LINE-1), with the use of the MethyLight technique or pyrosequencing.[28,30]

STATISTICAL ANALYSIS

A detailed description of the statistical analysis is provided in the Supplementary Appendix. We followed participants from the month of return of the 1988 baseline questionnaire through June 2010 for the incidence analysis and through June 2012 for the mortality analysis. We excluded participants with a baseline history of cancer (except for nonmelanoma skin cancer), ulcerative colitis, colorectal polyps, familial polyposis syndromes, or previous lower endoscopy (Fig. S1 in the Supplementary Appendix). We used Cox proportional-hazards models to calculate hazard ratios and 95% confidence intervals. All analyses were stratified according to age (in months), sex (in the combined cohort analysis), and calendar year of the questionnaire cycle. Multivariate models were adjusted for known or suspected risk factors for colorectal cancer, listed in Table 1.

For the incidence analysis, to minimize the influence of endoscopies performed for the diagnostic evaluation of colorectal cancer, we examined the association of endoscopy status reported on the biennial questionnaire before the diagnosis of colorectal cancer, death from any cause, or the end of follow-up, whichever came first. We used the most recently updated information for all variables before each 2-year follow-up and treated all variables as time-varying to account for changes during follow-up. For the mortality analysis, we evaluated the association of screening sigmoidoscopy or screening colonoscopy with mortality on the basis of the endoscopy status reported up to and including the date of diagnosis of colorectal cancer, death from any cause, or the last follow-up cycle, whichever came first.

We calculated the population-attributable risk, estimated as the proportion of incident colorectal cancers that would have been prevented in our population if all participants had undergone colonoscopy (with negative results or polypectomy) at least once and risk factors had not changed.[31] We also conducted a case–case analysis using a logistic-regression model to examine whether specific molecular features were associated with cancer occurring within 5 years after colonoscopy. All statistical analyses were two-sided, and a P value of less than 0.05 was considered to indicate statistical significance.

RESULTS

INCIDENT COLORECTAL CANCER

Among 88,902 participants (31,736 men and 57,166 women), we documented a total of 1815 incident cases of colorectal cancer (in 714 men and 1101 women) during 22 years of follow-up, encompassing a total of 1,738,396 person-years. Age-adjusted demographic characteristics at the midpoint of follow-up (1998), according to endoscopy status, are described in Table 1.

In the combined cohorts, the multivariate hazard ratios for colorectal cancer among participants who had undergone endoscopy, as compared with those who had not, were 0.57 (95% confidence interval [CI], 0.45 to 0.72) after removal of adenomatous polyps, 0.60 (95% CI, 0.53 to 0.68) after negative sigmoidoscopy, and 0.44 (95% CI, 0.38 to 0.52) after negative colonoscopy (Table 2). These associations were consistent among men and women and were evident for all disease stages at presentation. A reduced incidence of distal colorectal cancer was observed with polypectomy (multivariate hazard ratio, 0.40; 95% CI, 0.27 to 0.59), negative sigmoidoscopy (multivariate hazard ratio, 0.44; 95% CI, 0.36 to 0.53), and negative colonoscopy (multivariate hazard ratio, 0.24; 95% CI, 0.18 to 0.32). However, only negative colonoscopy was associated with a significantly reduced risk of proximal colon cancer (multivariate hazard ratio, 0.73; 95% CI, 0.57 to 0.92).

In analyses restricted to endoscopy for screening, the results were similar to those obtained in our analyses of endoscopy for any indication (Table S1 in the Supplementary Appendix). In addition, we observed consistent results in the analysis that used propensity-score adjustment and in the subanalyses excluding cases of colorectal cancer diagnosed within 2 years after a previously reported initial endoscopy and excluding those for which the participant or medical record indicated that the diagnosis had been made at the initial screening endoscopy (Table S2 in the Supplementary Appendix). We estimated that the population-attributable risk of colorectal cancer (the proportion of incident cancers that would have been prevented with colonoscopy) was 40%

Table 1. Age-Adjusted Demographic and Clinical Characteristics According to Status with Respect to Lower Endoscopy and Polypectomy in 1998.*

Characteristic	Men				Women			
	No Lower Endoscopy (N=14,287)	Polypectomy (N=1259)	Negative Sigmoidoscopy (N=8091)	Negative Colonoscopy (N=3578)	No Lower Endoscopy (N=31,423)	Polypectomy (N=1481)	Negative Sigmoidoscopy (N=16,748)	Negative Colonoscopy (N=3957)
Age (yr)	62.5±8.9	68.3±8.8	64.8±9.1	65.8±9.0	63.4±7.1	66.4±6.7	65.0±6.9	64.3±6.8
Body-mass index†	25.9±3.4	26.2±3.3	25.7±3.3	25.8±3.2	25.4±4.5	25.7±4.5	25.1±4.2	25.2±4.3
History of colorectal cancer in first-degree relative (%)	9	25	13	19	10	33	17	29
Smoking status (%)								
Never smoked	46	40	47	46	45	40	46	44
Former smoker	47	53	48	49	43	50	46	48
Current smoker	7	6	5	5	12	10	7	8
Weekly physical activity level (METs)‡	32.9±28.6	31.0±28.0	33.3±28.4	32.7±26.7	17.5±16.9	16.5±14.7	17.4±16.4	17.3±16.1
Red-meat intake (servings/day)	1.2±0.9	1.1±0.8	1.1±0.8	1.1±0.8	0.9±0.4	0.9±0.4	0.9±0.4	0.9±0.4
Folate intake (μg/day)	532±226	540±222	558±230	562±231	432±164	431±149	456±167	448±164
Calcium intake (mg/day)	918±346	903±331	934±342	936±340	965±327	994±332	1031±342	1019±342
Total caloric intake (kcal/day)	2004±543	1961±546	1954±523	1967±520	1716±415	1715±395	1719±408	1716±411
Alcohol intake (g/day)	10.8±13.6	11.8±14.1	10.3±12.3	10.9±12.8	5.7±8.5	6.1±8.8	5.7±8.3	5.8±8.3
Current multivitamin use (%)	56	57	60	61	58	56	64	65
Regular use of aspirin (%)§	55	57	57	57	41	40	43	44
Nonsteroidal antiinflammatory drug use (%)¶	17	19	19	19	31	33	35	34
Cholesterol-lowering drug use (%)¶	12	18	17	17	14	19	17	17
History of postmenopausal hormone use (%)	NA	NA	NA	NA	67	78	80	81

* Plus–minus values are means ±SD. Values were standardized to the age distribution of the study population, except for the values for age. Data were for the midpoint of the follow-up period (1998) for the Health Professionals Follow-up Study for men and the Nurses' Health Study for women. Polypectomy was defined as removal of an adenoma. Percentages do not always sum to 100 owing to rounding. NA denotes not applicable.
† The body-mass index is the weight in kilograms divided by the square of the height in meters.
‡ Metabolic equivalents (METs) are defined for each type of physical activity as a multiple of the number of metabolic equivalents for sitting quietly for 1 hour. For example, a participant who walked at a rate of 3.0 miles per hour for 1 hour once per week would have a MET score of 3.3.
§ Regular aspirin use was defined as current use of two or more aspirin tablets per week for the Nurses' Health Study and use of aspirin at least two times per week for the Health Professionals Follow-up Study.
¶ Drug use was defined as current, regular use of the agent.

(95% CI, 32 to 46) for all colorectal cancers, 22% (95% CI, 10 to 34) for proximal colon cancers, and 61% (95% CI, 52 to 69) for distal colorectal cancers.

SCREENING COLONOSCOPY INTERVAL

To gain insight into the recommended screening interval for low-risk persons, we evaluated colorectal-cancer incidence according to the time since the last negative colonoscopy (Table 3). The multivariate hazard ratios for colorectal cancer were 0.35 (95% CI, 0.28 to 0.45) for an interval of 3.0 years or less after a negative colonoscopy as compared with no endoscopy, 0.40 (95% CI, 0.31 to 0.52) for 3.1 to 5.0 years, 0.52 (95% CI, 0.38 to 0.70) for 5.1 to 10.0 years, and 0.26 (95% CI, 0.12 to 0.59) for 10.1 to 15.0 years. In addition, reduced risks were observed up to 15.0 years after the last negative colonoscopy for both proximal colon cancer (multivariate hazard ratio for 5.1 to 15.0 years, 0.60; 95% CI, 0.38 to 0.94) and distal colorectal cancer (multivariate hazard ratio for 5.1 to 15.0 years, 0.35; 95% CI, 0.22 to 0.54).

SURVEILLANCE COLONOSCOPY INTERVAL

Among participants who had undergone endoscopy with removal of adenomatous polyps, as compared with those who had not undergone endoscopy, a lower incidence of colorectal cancer was observed with a surveillance interval of 3.0 years or less (multivariate hazard ratio, 0.48; 95% CI, 0.33 to 0.69) and with an interval of 3.1 to 5.0 years (multivariate hazard ratio, 0.49; 95% CI, 0.33 to 0.73) (Table S3 in the Supplementary Appendix). Similar risks across time intervals were observed among participants with a history of adenoma in the proximal colon or distal colorectum. For participants with high-risk adenoma, the association was attenuated and of shorter duration, with a multivariate hazard ratio of 0.70 (95% CI, 0.43 to 1.14) for colonoscopy performed within 3.1 to 5.0 years after the last colonoscopy.

SUBGROUP ANALYSES

The inverse association of colonoscopy with colorectal cancer appeared to be similar across subgroups defined according to age, body-mass index, smoking status, and status with respect to regular use of aspirin (Table S4 in the Supplementary Appendix). Among participants with a family history of colorectal cancer, a significant association was no longer observed beyond 5 years after colonoscopy (multivariate hazard ratio, 0.91; 95% CI, 0.55 to 1.52). By contrast, there was a sustained association beyond 5 years among persons without a family history of colorectal cancer (multivariate hazard ratio, 0.43; 95% CI, 0.32 to 0.58) (P = 0.04 for interaction).

LIFETIME COLONOSCOPY HISTORY AND CANCER INCIDENCE

We considered only negative colonoscopies that occurred at least 4 years apart to account for repeat examinations performed within a shorter interval owing to inadequate bowel preparation. As compared with no endoscopy, the multivariate hazard ratios for colorectal cancer were 0.43 (95% CI, 0.35 to 0.51) after one negative colonoscopy, 0.32 (95% CI, 0.22 to 0.48) after two negative colonoscopies, and 0.23 (95% CI, 0.08 to 0.67) after three negative colonoscopies (Table S5 in the Supplementary Appendix).

MOLECULAR CHARACTERISTICS OF CANCERS

We identified 62 cancers diagnosed within 5 years after colonoscopy for which molecular data were available (Table S6 in the Supplementary Appendix). As compared with cancers diagnosed in patients more than 5 years after colonoscopy or without any prior endoscopy, those diagnosed in patients within 5 years after colonoscopy were more likely to be characterized by CIMP (multivariate odds ratio, 2.19; 95% CI, 1.14 to 4.21), microsatellite instability (multivariate odds ratio, 2.10; 95% CI, 1.10 to 4.02), and an increased LINE-1 methylation level (multivariate odds ratio for each 30% increment, 3.21; 95% CI, 1.29 to 8.00). *BRAF*, *KRAS*, and *PIK3CA* mutations were not significantly associated with cancer diagnosed within 5 years after colonoscopy.

MORTALITY AFTER SCREENING ENDOSCOPY

During follow-up, we identified a total of 474 deaths attributable to colorectal cancer. We observed lower mortality from colorectal cancer among participants who had undergone screening sigmoidoscopy (multivariate hazard ratio, 0.59; 95% CI, 0.45 to 0.76) and among those who had undergone screening colonoscopy (multivariate hazard ratio, 0.32; 95% CI, 0.24 to 0.45) than among those who had never undergone screening endoscopy (Table 4). Screening colonoscopy was associated with reduced mortality from both distal colorectal cancer (multivariate

hazard ratio, 0.18; 95% CI, 0.10 to 0.31) and proximal colon cancer (multivariate hazard ratio, 0.47; 95% CI, 0.29 to 0.76), whereas screening sigmoidoscopy was associated only with reduced mortality from distal colorectal cancer (multivariate hazard ratio, 0.31; 95% CI, 0.20 to 0.49).

DISCUSSION

In two large, U.S. prospective cohort studies, we found that the long-term incidence of colorectal cancer was lower among men and women who had a history of negative sigmoidoscopy, negative colonoscopy, or polypectomy for adenoma than among those who had no history of endoscopy. Negative colonoscopy was associated with a lower incidence of both distal colorectal cancer and proximal colon cancer, whereas negative sigmoidoscopy and colonoscopy with polypectomy were associated primarily with a lower incidence of distal colorectal cancer. We estimated that 40% of colorectal cancers (including 61% of distal colorectal cancers and 22% of proximal colon cancers) that developed during follow-up would have been prevented if all the participants in our study had undergone colonoscopy. Moreover, screening sigmoidoscopy and screening colonoscopy were associated with lower mortality

Table 2. Incident Colorectal Cancer after No Lower Endoscopy, Negative Lower Endoscopy, or Polypectomy.*

Variable	No Lower Endoscopy	Polypectomy	Negative Sigmoidoscopy	Negative Colonoscopy
All participants				
No. of person-yr	980,154	72,375	381,093	304,774
No. of cases of colorectal cancer	1164	82	348	221
Age-adjusted incidence rate†	45.7	31.4	19.3	14.1
Age-adjusted hazard ratio (95% CI)	1.00	0.60 (0.47–0.76)	0.59 (0.52–0.66)	0.44 (0.37–0.51)
Multivariate hazard ratio (95% CI)‡	1.00	0.57 (0.45–0.72)	0.60 (0.53–0.68)	0.44 (0.38–0.52)
Disease stage§				
I or II				
No. of cases	484	38	143	89
Age-adjusted hazard ratio (95% CI)	1.00	0.68 (0.48–0.96)	0.57 (0.47–0.69)	0.42 (0.32–0.54)
Multivariate hazard ratio (95% CI)‡	1.00	0.62 (0.44–0.88)	0.57 (0.47–0.70)	0.41 (0.32–0.53)
III				
No. of cases	253	12	72	41
Age-adjusted hazard ratio (95% CI)	1.00	0.43 (0.23–0.81)	0.59 (0.45–0.77)	0.40 (0.28–0.58)
Multivariate hazard ratio (95% CI)‡	1.00	0.43 (0.23–0.80)	0.62 (0.47–0.81)	0.42 (0.29–0.62)
IV				
No. of cases	159	7	55	26
Age-adjusted hazard ratio (95% CI)	1.00	0.34 (0.15–0.74)	0.66 (0.48–0.91)	0.35 (0.22–0.55)
Multivariate hazard ratio (95% CI)‡	1.00	0.34 (0.15–0.75)	0.70 (0.51–0.97)	0.36 (0.23–0.58)
Tumor location¶				
Proximal colon				
No. of cases	379	40	179	119
Age-adjusted hazard ratio (95% CI)	1.00	0.88 (0.63–1.25)	0.90 (0.75–1.08)	0.72 (0.57–0.92)
Multivariate hazard ratio (95% CI)‡	1.00	0.83 (0.59–1.18)	0.92 (0.77–1.11)	0.73 (0.57–0.92)
Distal colorectum				
No. of cases	650	28	136	61
Age-adjusted hazard ratio (95% CI)	1.00	0.41 (0.28–0.61)	0.43 (0.35–0.52)	0.24 (0.18–0.31)
Multivariate hazard ratio (95% CI)‡	1.00	0.40 (0.27–0.59)	0.44 (0.36–0.53)	0.24 (0.18–0.32)

Table 2. (Continued.)

Variable	No Lower Endoscopy	Polypectomy	Negative Sigmoidoscopy	Negative Colonoscopy
Men				
No. of person-yr	318,287	31,455	120,016	114,284
No. of cases of colorectal cancer	471	38	109	96
Age-adjusted hazard ratio (95% CI)	1.00	0.55 (0.39–0.78)	0.47 (0.37–0.58)	0.46 (0.36–0.58)
Multivariate hazard ratio (95% CI)‡	1.00	0.52 (0.37–0.74)	0.47 (0.38–0.59)	0.46 (0.36–0.58)
Women				
No. of person-yr	661,868	40,921	261,077	190,490
No. of cases of colorectal cancer	693	44	239	125
Age-adjusted hazard ratio (95% CI)	1.00	0.63 (0.46–0.86)	0.66 (0.57–0.77)	0.42 (0.34–0.52)
Multivariate hazard ratio (95% CI)‡	1.00	0.61 (0.44–0.83)	0.69 (0.59–0.81)	0.43 (0.35–0.54)

* Endoscopy status was assigned on the basis of the biennial questionnaire that was returned before a diagnosis of colorectal cancer, death from any cause, or the end of follow-up, whichever came first. Negative sigmoidoscopy and negative colonoscopy were defined as lower endoscopy without detection of an adenoma.

† Age-adjusted incidence rates (per 100,000 person-years) were standardized to the age distribution of the population.

‡ Models were further adjusted for body-mass index (<25.0 vs. 25.0–29.9 vs. ≥30.0), smoking status (never smoked vs. former smoker vs. current smoker), status with respect to a history of colorectal cancer in a first-degree relative, status with respect to regular use of aspirin, physical activity level (quintiles of mean METs per week), red-meat intake (quintiles of servings per day), total caloric intake (quintiles of kilocalories per day), alcohol intake (0 or quartiles of grams per day), folate intake (quintiles of micrograms per day), calcium intake (quintiles of milligrams per day), and status with respect to current multivitamin use, nonsteroidal antiinflammatory drug use, cholesterol-lowering drug use, and postmenopausal hormone use (for women only).

§ Data on disease stage were available for 1379 of 1815 participants (76%): 896 participants who had not undergone lower endoscopy, 57 who had undergone polypectomy, 270 who had negative findings on sigmoidoscopy, and 156 who had negative findings on colonoscopy.

¶ Data on tumor location were available for 1592 of 1815 participants (88%): 1029 participants who had not undergone lower endoscopy, 68 who had undergone polypectomy, 315 who had negative findings on sigmoidoscopy, and 180 who had negative findings on colonoscopy.

from colorectal cancer, as compared with no endoscopy, although only screening colonoscopy was associated with lower mortality from proximal colon cancer.

Previous randomized, controlled trials have had inconsistent findings regarding the influence of sigmoidoscopy on the incidence of proximal colon cancer,[1-3,32] probably owing to differences in subsequent exposure to colonoscopy. In the U.K. Flexible Sigmoidoscopy Screening Trial, no reduction in the incidence of proximal cancer was detected; however, only 5% of participants underwent follow-up colonoscopy on the basis of sigmoidoscopic findings.[2] By contrast, the Prostate, Lung, Colorectal, and Ovarian Cancer Screening Trial showed a 14% reduction in the incidence of proximal colon cancer, potentially owing to the 21.9% of participants who underwent colonoscopy for follow-up of sigmoidoscopic findings or outside the study protocol.[1] As is consistent with the findings in previous randomized, controlled trials,[2,3] our results suggest that screening sigmoidoscopy alone is probably insufficient for reducing the incidence of proximal colon cancer and associated mortality.

Our results are consistent with the findings of the National Polyp Study, which showed a lower incidence of colorectal cancer among persons after colonoscopic polypectomy, as compared with population-based estimates of expected rates.[16,33] Our study expands on these results, since we were able to directly compare actual incidences of cancer among persons after polypectomy with the incidences among persons from the same background population who did not undergo endoscopy, while adjusting for potential confounders. We did not observe a significantly reduced incidence of proximal colon cancer in association with polypectomy. This result might be due, in part, to limited statistical power. Alternatively, the presence of an adenoma may be a marker of an increased risk of subsequent proximal colon cancer that is not completely mitigated by polypectomy. A recent case–control study also showed a smaller reduction in the incidence of proximal colon cancer, as com-

Table 3. Incident Colorectal Cancer, According to Time since Last Negative Colonoscopy.*

Variable	No Lower Endoscopy	Years since Last Negative Colonoscopy				
		≥15.1	15.0–10.1	10.0–5.1	5.0–3.1	≤3.0
No. of person-yr	980,154	1668	10,929	54,601	99,783	131,333
No. of cases of colorectal cancer	1164	3	8	51	70	77
Age-adjusted hazard ratio (95% CI)	1.00	0.69 (0.20–2.32)	0.26 (0.11–0.58)	0.50 (0.37–0.68)	0.40 (0.31–0.52)	0.35 (0.27–0.45)
Multivariate hazard ratio (95% CI)†	1.00	0.65 (0.19–2.23)	0.26 (0.12–0.59)	0.52 (0.38–0.70)	0.40 (0.31–0.52)	0.35 (0.28–0.45)

* The last negative colonoscopy was defined as the last colonoscopy without detection of an adenoma. Colonoscopy status was assigned on the basis of the biennial questionnaire that was returned before a diagnosis of colorectal cancer, death from any cause, or the end of follow-up, whichever came first.

† Models were further adjusted for body-mass index (<25.0 vs. 25.0–29.9 vs. ≥30.0), smoking status (never smoked vs. former smoker vs. current smoker), status with respect to a history of colorectal cancer in a first-degree relative, status with respect to regular use of aspirin, physical activity level (quintiles of mean METs per week), red-meat intake (quintiles of servings per day), total caloric intake (quintiles of kilocalories per day), alcohol intake (0 or quartiles of grams per day), folate intake (quintiles of micrograms per day), calcium intake (quintiles of milligrams per day), and status with respect to current multivitamin use, nonsteroidal antiinflammatory drug use, and cholesterol-lowering drug use.

pared with distal colorectal cancer, after polypectomy.[14]

In our analysis, negative colonoscopy was associated with a significantly reduced incidence of distal colorectal cancer or proximal colon cancer up to 15 years after the procedure. Previous estimates of the duration of protection associated with a negative colonoscopy have varied widely, ranging from 5 to 20 years.[11-13,34] These inconsistent results may be due to relatively short follow-up[12,13,34] or the limitations of a case–control design,[11] including biases related to selection of controls. Our findings support the 10-year examination interval recommended by existing guidelines for persons at average risk who have a negative colonoscopy.[5-9] Our study suggests that even a single negative colonoscopy is associated with a very low long-term risk of colorectal cancer.[2,3] However, our data support screening at more frequent intervals for persons with a family history of colorectal cancer.

Among participants with a history of adenoma, we observed a reduced incidence of cancer up to 5 years after colonoscopy, which supports current surveillance guidelines.[5,6] However, we found that the apparent reduction in risk was attenuated among participants with high-risk adenomas, a finding that is consistent with the results of other studies.[15] This observation may reflect a persistently elevated incidence of cancer associated with predisposing host or lifestyle risk factors, the biologic characteristics of high-risk adenomas, or the uncertain quality of colonoscopic detection and clearance of neoplasia in persons with high-risk lesions.[20-25]

Our finding that cancer diagnosed within 5 years after colonoscopy was associated with specific molecular features (CIMP, microsatellite instability, and high-level LINE-1 methylation) complements the existing literature.[20-25,35] Serrated lesions, particularly sessile serrated adenomas, are widely considered to be probable precursors of colorectal cancers characterized by CIMP, and these lesions may be particularly difficult to detect endoscopically or remove adequately.[36-38] It remains unclear whether any of the challenges posed by these biologic differences can be addressed by improvements in colonoscopic technique, including more meticulous inspection or improved bowel cleansing.

Our study has several strengths. First, because we collected information biennially for a period of 22 years, we were able to update endoscopy status in order to accurately assess associations with the subsequent risk of colorectal cancer or death. Second, our detailed exposure information, including lifestyle factors, enabled us to finely adjust for potential confounders. Third, our prospective design minimized biases inherent in case–control studies, including recall and selection biases. Fourth, we were able to directly compare the incidence of colorectal can-

Table 4. Colorectal-Cancer Mortality after Screening Lower Endoscopy.

Variable	No Screening Lower Endoscopy	Screening Sigmoidoscopy	Screening Colonoscopy*
All participants			
All deaths from colorectal cancer			
No. of person-yr	1,182,248	302,330	357,008
No. of deaths	349	73	52
Age-adjusted hazard ratio (95% CI)	1.00	0.57 (0.44–0.73)	0.32 (0.24–0.44)
Multivariate hazard ratio (95% CI)†	1.00	0.59 (0.45–0.76)	0.32 (0.24–0.45)
Deaths from proximal colon cancer‡			
No. of deaths	121	46	25
Age-adjusted hazard ratio (95% CI)	1.00	1.04 (0.73–1.47)	0.49 (0.31–0.79)
Multivariate hazard ratio (95% CI)†	1.00	1.04 (0.73–1.48)	0.47 (0.29–0.76)
Deaths from distal colorectal cancer‡			
No. of deaths	195	21	16
Age-adjusted hazard ratio (95% CI)	1.00	0.29 (0.19–0.46)	0.18 (0.10–0.30)
Multivariate hazard ratio (95% CI)†	1.00	0.31 (0.20–0.49)	0.18 (0.10–0.31)
Men			
No. of person-yr	366,773	101,259	141,554
No. of deaths from colorectal cancer	131	30	26
Age-adjusted hazard ratio (95% CI)	1.00	0.57 (0.38–0.86)	0.34 (0.22–0.53)
Multivariate hazard ratio (95% CI)†	1.00	0.59 (0.39–0.90)	0.36 (0.23–0.56)
Women			
No. of person-yr	815,475	201,072	215,453
No. of deaths from colorectal cancer	218	43	26
Age-adjusted hazard ratio (95% CI)	1.00	0.56 (0.41–0.79)	0.31 (0.20–0.48)
Multivariate hazard ratio (95% CI)†	1.00	0.61 (0.43–0.85)	0.31 (0.20–0.48)

* Colonoscopy included removal of an adenoma.
† Models were further adjusted for body-mass index (<25.0 vs. 25.0–29.9 vs. ≥30.0), smoking status (never smoked vs. former smoker vs. current smoker), status with respect to a history of colorectal cancer in a first-degree relative, status with respect to regular use of aspirin, physical activity level (quintiles of mean METs per week), red-meat intake (quintiles of servings per day), total caloric intake (quintiles of kilocalories per day), alcohol intake (0 or quartiles of grams per day), folate intake (quintiles of micrograms per day), calcium intake (quintiles of milligrams per day), and status with respect to current multivitamin use, nonsteroidal antiinflammatory drug use, and cholesterol-lowering drug use.
‡ Data on tumor location were available for 316 participants who had not undergone screening lower endoscopy, 67 who had undergone screening sigmoidoscopy, and 41 who had undergone screening colonoscopy.

cer and mortality associated with colorectal cancer among persons who underwent endoscopy with the incidence and mortality among persons from the same background population who did not undergo endoscopy. By contrast, previous cohort studies have used comparisons with population-based estimates.[12,16,33] Fifth, since all study participants were health care professionals, the accuracy of our classification according to endoscopy status was high. Finally, our comprehensive molecular profiling of tumors allowed us to elucidate molecular features of cancer occurring within 5 years after colonoscopy, adjusting for other potential confounding factors.

There are limitations to our study. As with all observational studies, we cannot rule out unmeasured confounding, including potential bias introduced by the pooling of data from two separate cohorts. Second, our participants were health care professionals, and our findings may not be

generalizable to other populations. However, previous studies have shown that the prevalences of risk factors for colorectal cancer, including smoking and body-mass index, among our participants are consistent with those of the broader population,[39,40] and the incidence and stage distribution of colorectal cancers in our cohorts are similar to those in other population-based registries. Moreover, there is little evidence to suggest that the putative mechanisms by which endoscopy is associated with a reduced incidence of colorectal cancer would differ according to occupation or educational background.

In conclusion, as compared with no endoscopy, colonoscopy and sigmoidoscopy were associated with a lower incidence of distal colorectal cancer, whereas only colonoscopy was associated with a reduced incidence of proximal colon cancer, and that reduction was modest. As compared with no screening endoscopy, screening colonoscopy and sigmoidoscopy were associated with lower mortality from colorectal cancer, whereas only colonoscopy was associated with lower mortality from proximal colon cancer. Tumor molecular features of the serrated pathway might be involved in the development of cancer within 5 years after colonoscopy.

The views expressed in this article are those of the authors and do not necessarily represent the official views of the National Institutes of Health (NIH).

Supported by grants from the NIH (P01 CA87969; P01 CA55075 and 1UM1 CA167552, to Dr. Willett; P50 CA127003, to Dr. Fuchs; R01 CA151993, to Dr. Ogino; R01 CA137178, to Dr. Chan; and K24 DK098311, to Dr. Chan) and from the Bennett Family Foundation and the Entertainment Industry Foundation through the National Colorectal Cancer Research Alliance. Dr. Chan is a Damon Runyon Clinical Investigator, Dr. Lochhead is a Scottish Government Clinical Academic Fellow and was supported by a Harvard University Frank Knox Memorial Fellowship, Dr. Inamura was supported by a Japan Society for the Promotion of Science Postdoctoral Fellowship for Research Abroad, and Dr. Kim was supported by an Early Exchange Postdoctoral Fellowship Grant from Asan Medical Center, Seoul, Korea.

Dr. Chan reports receiving consulting fees from Bayer Healthcare, Pfizer, Millennium Pharmaceuticals, and Pozen. No other potential conflict of interest relevant to this article was reported.

Disclosure forms provided by the authors are available with the full text of this article at NEJM.org.

We thank the participants and staff of the Nurses' Health Study and the Health Professionals Follow-up Study for their valuable contributions; and Scott G. Smith of the Department of Nutrition, Harvard School of Public Health, for assistance with data management.

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February 19, 2014, Vol 311, No. 7 >

Original Investigation | February 19, 2014

Surgical Site Infections Following Ambulatory Surgery Procedures FREE

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JAMA. 2014;311(7):709-716. doi:10.1001/jama.2014.4.

ABSTRACT

Importance Surgical site infections can result in substantial morbidity following inpatient surgery. Little is known about serious infections following ambulatory surgery.

Objective To determine the incidence of clinically significant surgical site infections (CS-SSIs) following low- to moderate-risk ambulatory surgery in patients with low risk for surgical complications.

Design, Setting, and Participants Retrospective analysis of ambulatory surgical procedures complicated by CS-SSIs that require a postsurgical acute care visit (defined as subsequent hospitalization or ambulatory surgical visit for infection) using the 2010 Healthcare Cost and Utilization Project State Ambulatory Surgery and State Inpatient Databases for 8 geographically dispersed states (California, Florida, Georgia, Hawaii, Missouri, Nebraska, New York, and Tennessee) representing one-third of the US population. Index cases included 284 098 ambulatory surgical procedures (general surgery, orthopedic, neurosurgical, gynecologic, and urologic) in adult patients with low surgical risk (defined as not seen in past 30 days in acute care, length of stay less than 2 days, no other surgery on the same day, and discharged home and no infection coded on the same day).

Main Outcomes and Measures Rates of 14- and 30-day postsurgical acute care visits for CS-SSIs following ambulatory surgery.

Results Postsurgical acute care visits for CS-SSIs occurred in 3.09 (95% CI, 2.89-3.30) per 1000 ambulatory surgical procedures at 14 days and 4.84 (95% CI, 4.59-5.10) per 1000 at 30 days. Two-thirds (63.7%) of all visits for CS-SSI occurred within 14 days of the surgery; of those visits, 93.2% (95% CI, 91.3%-94.7%) involved treatment in the inpatient setting. All-cause inpatient or outpatient postsurgical visits, including those for CS-SSIs, following ambulatory surgery occurred in 19.99 (95% CI, 19.48-20.51) per 1000 ambulatory surgical procedures at 14 days and 33.62 (95% CI, 32.96-34.29) per 1000 at 30 days.

Conclusions and Relevance Among patients in 8 states undergoing ambulatory surgery, rates of postsurgical visits for CS-SSIs were low relative to all causes; however, they may represent a substantial

number of adverse outcomes in aggregate. Thus, these serious infections merit quality improvement efforts to minimize their occurrence.

Surgical site infections (SSIs) are among the most common health care–associated infections. Surgical site infections account for 20% to 31% of health care–associated infections in hospitalized patients[1,2] and have considerable morbidity, a mortality rate of 3%, stays prolonged by 7 to 10 days, and costs of $20 000 to $27 600 per admission.[2-5] Reducing SSIs is a national priority, as reflected in the US Department of Health and Human Services' National Action Plan to Prevent Healthcare-Associated Infections.[6] Initially focused on high-priority areas related to health care–associated infections within acute care hospitals, the action plan broadened to address additional types of health care settings, including ambulatory surgery.[7] Although ambulatory surgeries represent a substantial portion of surgical health care, there is a dearth of information on adverse events, including health care–associated infections following operations performed in the ambulatory setting.[8-10]

The problem of health care–associated infections following ambulatory surgery may not be small. The preponderance of surgical procedures are now performed in ambulatory settings.[11] Ambulatory surgery cases totaled 18.7 million in 2010 in the United States[12] and accounted for 63.6% of all operations.[13] During inspections of Medicare-certified ambulatory surgical centers, serious breaches of infection control practices were found to be common.[14] Yet very little information is available regarding infectious outcomes following ambulatory operations.

To better understand the spectrum of clinically significant infections that follow ambulatory surgery, we calculated population estimates of 14- and 30-day acute care visit rates (ie, hospitalizations or ambulatory surgical visits) for clinically significant SSIs (CS-SSIs) following selected low- to moderate-risk ambulatory surgical procedures performed on adults with low surgical risk.

METHODS

ABSTRACT | METHODS | RESULTS | DISCUSSION | CONCLUSIONS | ARTICLE INFORMATION | REFERENCES

Databases and Study Population

Encounter data were abstracted from 2010 Agency for Healthcare Research and Quality Healthcare Cost and Utilization Project (HCUP) State Ambulatory Surgery Databases and State Inpatient Databases.[15] State Ambulatory Surgery Databases include all-payer, encounter-level information on surgical procedures performed in hospital-owned ambulatory settings, with no overnight inpatient stay. These include surgical suites within the hospital as well as physically freestanding surgical facilities owned by the hospital. The data do not include procedures performed in physician offices or freestanding facilities not owned by a hospital. State Inpatient Databases contain all-payer, encounter-level information on inpatient discharges. HCUP state databases are discharge-level (not patient-level) files; each record represents 1 ambulatory surgical visit or inpatient stay. Discharge abstracts contain information found on a billing record, such as demographics; up to 30 *International Classification of Diseases, Ninth Revision, Clinical Modification* (*ICD-9-CM*) diagnoses, *ICD-9-CM* procedures or *Current Procedural Terminology* (*CPT*) procedures, or both; length of stay; expected payer; admission and discharge dates; and discharge disposition.

Although the HCUP contains data from 47 states,[16] 8 states have data from the 2 settings of interest (ambulatory surgery and inpatient) and robust encrypted identifiers that allow patients to be observed across time and across hospital settings. The present study used data from those 8 states (California, Florida, Georgia, Hawaii, Missouri, Nebraska, New York, and Tennessee), accounting for one-third of the US population.

We initially identified records for selected low- to moderate-risk surgical procedures performed in hospital-owned ambulatory surgery settings in 2010. Twelve surgical procedures were selected, including a spectrum of specialties: general surgery, orthopedics, neurosurgery, gynecology, and urology (eAppendix 1 in Supplement). Selected general surgery procedures included laparoscopic cholecystectomy and 6 types of hernia repair (open and laparoscopic for inguinal or femoral; umbilical; and incisional or abdominal). Selected orthopedic procedures and neurosurgical procedures included spinal laminectomy or diskectomy and anterior cruciate ligament (ACL) repair. Selected gynecologic procedures included vaginal and abdominal hysterectomy, excluding those performed for treatment of cancer. The selected urologic procedure was transurethral prostatectomy, excluding procedures performed for treatment of cancer. These selected surgical procedures were considered low to moderate risk, because they are moderately invasive and require general or regional anesthesia. The surgical procedures are elective, of short duration, and do not require an overnight inpatient stay.

JAMA. 2015;313(5):483-495.
doi:10.1001/jama.2014.18614.

The Evolution of Surgery: The Story of "Two Poems"
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doi:10.1001/jama.2014.14448.

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Safety of early enrollment into outpatient cardiac rehabilitation after open heart surgery. *Am J Cardiol* 2015;115(4):548-52.

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To determine how representative the surgical procedures conducted at hospital-owned settings are for all outpatient surgical procedures, we examined the type of ambulatory setting where each procedure was performed using 2 HCUP State Ambulatory Surgery Databases states (Florida and South Carolina) with complete reporting of data in ambulatory surgery settings regardless of hospital ownership.

Our overall objective was to analyze a population of adult patients with low surgical risk. Therefore, we excluded patients who had been seen in acute care in the prior 30 days, had a length of stay of 2 or more days, experienced more than 1 surgery on the same day, or had an infection coded on the day of surgery.

Measures

Primary Outcomes

The primary outcome was the rate of postsurgical acute care visits following each of the selected surgical procedures. The denominator was the number of ambulatory surgical procedures. The numerator was the number of those procedures that resulted in at least 1 subsequent ambulatory surgery visit or inpatient stay for a CS-SSI within 14 or 30 days. A patient with a subsequent visit was counted only once in the numerator, regardless of other visits within the 14- or 30-day postsurgical period. To target the analysis to clinically important, serious infections, postsurgical visits were limited to hospitalizations (including those that began in the emergency department) and ambulatory surgical visits. Patients with SSIs who made postsurgical visits to physician offices or who were released from emergency departments were not included, because their infections were considered less serious. The rates were reported per 1000 ambulatory surgical procedures. The time between the index ambulatory surgical procedure and a subsequent ambulatory surgical visit or inpatient stay was calculated from the discharge date of the index ambulatory surgical procedure to the admission date of the subsequent visit.

Postsurgical encounters for CS-SSIs were identified by an algorithm that used *ICD-9-CM* diagnosis codes, *ICD-9-CM* or *CPT* procedure codes, or both on a discharge abstract for an ambulatory surgical visit or inpatient stay subsequent to the surgery. CS-SSIs included infections generally related to surgery as well as those specific to the type of surgery (eAppendix 2 in Supplement). A sensitivity analysis was conducted to determine the validity of the algorithm. The sensitivity analyses examined which types of codes identified infections using the following hierarchy: (1) any listed procedure specific to an infection from the surgery, such as arthroscopy of the knee for lavage and drainage of infection for ACL repair, (2) any listed diagnosis indicating infection specific to the surgery, such as a diagnosis of peritonitis and cellulitis of the trunk for abdominal procedures, (3) any listed procedure indicating an infection generally related to having surgery, such as drainage of an abscess or debridement of infected skin, and (4) any listed diagnosis indicating an infection, such as pyoderma, local skin infection, or postoperative infection.

We computed rates of ambulatory surgical visits or postsurgical inpatient stays for all causes (including CS-SSIs) to indicate the relative importance of SSIs as a reason for postsurgical visits. Additional reasons for postsurgical visits included, but were not limited to, postoperative pain and swelling, gastrointestinal conditions, respiratory conditions, constitution-related diagnoses (eg, dizziness, syncope, fever, dehydration), and more general infections (eg, methicillin-resistant *Staphylococcus aureus*, *Clostridium difficile*, pneumonia, urinary tract infections).

Demographic Characteristics

The patient's age, sex, and residential area were based on the index ambulatory surgical visit. We classified primary expected payer into 5 groups: Medicare, Medicaid, private insurance, uninsured (self-pay or no charge), and other types of insurance.

Statistical Analysis

We examined patient and payer characteristics associated with ambulatory surgical procedures. Observed rates of postsurgical acute care visits for CS-SSIs and all causes were assessed at 14 and 30 days. We determined observed rates of postsurgical visits for CS-SSIs by type of surgery. Jeffreys intervals were used to calculate 95% CIs, assuming a binomial distribution.[17] We made comparisons between rates of postsurgical visits following open and laparoscopic surgery for hernia repair and vaginal and abdominal hysterectomies.

The use of HCUP administrative data is not considered human subjects research by the Agency for Healthcare Research and Quality institutional review board. Analyses were conducted using Base SAS and SAS/STAT version 9. 3 (SAS Institute Inc). The criterion for statistical significance was a 2-sided χ^2 test at $P < .01$.

RESULTS

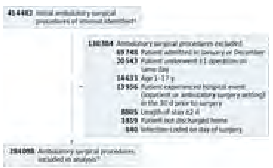
ABSTRACT | METHODS | RESULTS | DISCUSSION | CONCLUSIONS | ARTICLE INFORMATION | REFERENCES

The Figure displays the selection of index ambulatory surgical procedures. We extracted all ambulatory surgery records for patients with any *ICD-9-CM* procedure or *CPT* codes related to 1 of the 12 surgical procedures (n = 414 482). We excluded records for surgical procedures performed in January or December to allow a window of 30 days before and after surgery to examine other hospital visits (n = 69 748). Next, we excluded ambulatory surgical procedures that signaled a complication in care because of a discharge disposition other than routine (n = 1859) or with a length of stay of 2 or more days (n = 8805).

Figure.

Ambulatory Surgical Procedures Meeting Study Criteria[a]

[a]Source: Agency for Healthcare Research and Quality, Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project; State Ambulatory Surgery Databases and State Inpatient Databases for 8 states: California, Florida, Georgia, Hawaii, Missouri, Nebraska, New York, and Tennessee, 2010.[b]Patients total 282 086; some patients underwent more than 1 ambulatory surgical procedure that met all of the study criteria.



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To select a homogeneous group of patients at low surgical risk, we excluded additional patients with more than 1 of the selected surgical procedures on the same ambulatory surgery visit (n = 20 543), any ambulatory surgical visit or inpatient stay within the previous 30 days (n = 13 956), and infection on the surgery day (n = 840). Patients younger than 18 years (n = 14 633) were also excluded. We retained 284 098 records for ambulatory surgical procedures performed in a hospital-owned ambulatory setting.

eAppendix 3 in Supplement shows that for all but 1 of the ambulatory surgical procedures of interest, at least two-thirds (and 80% or greater for 9 of the 12 surgical procedures) were performed at hospital-owned settings. Patients with more than 1 ambulatory surgical procedure during the 10-month period may be represented more than once: the 284 098 ambulatory surgical procedures represented 282 086 patients.

Utilization

The mean age of patients undergoing 1 of the selected ambulatory surgical procedures ranged from 34.1 years (ACL repair) to 70.5 years (transurethral prostatectomy) (Table 1). Laparoscopic cholecystectomy was more likely to be performed on women (75.9%); laparoscopic repair of inguinal or femoral hernia was less likely to be performed on women (6.1%). At least 75.0% of each selected ambulatory surgical procedure was performed on patients from metropolitan areas, varying from a low of 75.0% for spine surgery to a high of 90.1% for laparoscopic inguinal or femoral hernia repairs.

Table 1. Characteristics of Patients Undergoing Ambulatory Surgical Procedures in Hospital-Owned Settings, 2010[a]

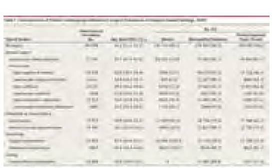

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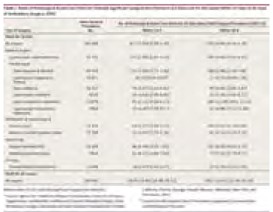
Table 1 also shows variations in private insurance as the primary expected payer for ambulatory surgical procedures. More than 75% of ACL repairs and hysterectomies were billed to private insurance. In contrast, 27.4% of transurethral prostatectomies were billed to private insurance. With a mean patient age of 70.5 years, the majority of transurethral prostatectomies procedures were covered by Medicare.

Rates of Postsurgical Visits

Postsurgical Visits for CS-SSIs Within 14 Days

As shown in Table 2, the overall rate of postsurgical acute care visits for CS-SSIs within 14 days following the selected ambulatory surgical procedures was relatively low (3.09 [95% CI, 2.89-3.30] per 1000 ambulatory surgical procedures). The visit rates varied by type of surgery and ranged from 0.27 (95% CI, 0.09-0.65) per 1000 laparoscopic repairs of inguinal or femoral hernia to 6.44 (95% CI, 5.25-7.82) per 1000 vaginal hysterectomies, respectively. Two-thirds of the records for the postsurgical visits for CS-SSIs had a surgery-specific procedure or diagnosis code indicating the infection (eAppendix 4 in Supplement).

Table 2. Rates of Postsurgical Acute Care Visits for Clinically Significant Surgical Site Infections (CS-SSIs) and for All Causes Within 14 Days vs 30 Days of Ambulatory Surgery, 2010[a]



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Rates of postsurgical visits for CS-SSIs following an open vs laparoscopic repair did not differ, except for repair of inguinal or femoral hernia. The 14-day postsurgical visit rate for CS-SSIs following laparoscopic inguinal or femoral hernia repair (0.27 [95% CI, 0.09-0.65] per 1000 hernia repairs) was significantly less than the 14-day postsurgical visit rate for CS-SSIs following open inguinal or femoral hernia repair (2.06 [95% CI, 1.72-2.46] per 1000 hernia repairs, $P < .001$). There was no difference in the 14-day rate of postsurgical visits for CS-SSIs following vaginal hysterectomies (6.44 [95% CI, 5.25-7.82] per 1000 hysterectomies) compared with abdominal hysterectomies (6.21 [95% CI, 4.80-7.92] per 1000 hysterectomies). The overall rate of postsurgical visits within 14 days for all causes, including CS-SSIs, was 19.99 (95% CI, 19.48-20.51) per 1000 ambulatory surgical procedures.

Postsurgical Visits for CS-SSIs Within 30 Days

The overall rate of postsurgical acute care visits for CS-SSIs across all surgical procedures increased from 3.09 (95% CI, 2.89-3.30) to 4.84 (95% CI, 4.59-5.10) per 1000 ambulatory surgical procedures when the time frame was extended to 30 days (Table 2). The 30-day rates of postsurgical visits for CS-SSIs also varied by type of surgery, ranging from a low of 0.75 (95% CI, 0.40-1.30) per 1000 laparoscopic repairs of inguinal or femoral hernia to a high of 11.38 (95% CI, 9.81-13.12) per 1000 open repairs of incisional or abdominal hernia. Similar to 14-day rates of postsurgical visits for CS-SSIs, there were no significant differences in 30-day rates of postsurgical visits for CS-SSIs following vaginal vs abdominal hysterectomies or open vs laparoscopic hernia repair, with 1 exception. The 30-day postsurgical visit rate for CS-SSIs following laparoscopic inguinal or femoral hernia repair (0.75 [95% CI, 0.40-1.30] per 1000 hernia repairs) was significantly less than the 30-day postsurgical visit rate for CS-SSIs following open inguinal or femoral hernia repair (2.98 [95% CI, 2.56-3.46] per 1000 hernia repairs ($P < .001$). The overall rate of postsurgical visits within 30 days for all causes including CS-SSIs was 33.62 (95% CI, 32.96-34.29) per 1000 ambulatory surgical procedures.

Follow-up Time for Postsurgical Visits

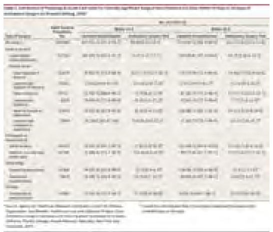
Two-thirds (63.7%) of all postsurgical acute care visits for CS-SSIs following these ambulatory surgical procedures occurred in the first 14 days (877 visits within 14 days [3.09 per 1000 ambulatory surgical procedures] compared with 1376 visits within 30 days [4.84 per 1000 ambulatory surgical procedures]). This pattern was similar for each type of surgery except laparoscopic repair of inguinal or femoral hernia, open repair of incisional or abdominal hernia, and spine surgery; the postsurgical visit rate for CS-SSIs more than doubled between 14 and 30 days (ie, less than half of the postsurgical visits for CS-SSIs for these procedures occurred in the first 14 days).

Location of Postsurgical Visits

More than 90% of postsurgical acute care visits for CS-SSIs within 14 days were treated in the inpatient setting (95% CI, 91.3%-94.7%), and nearly 90% of postsurgical acute care visits for CS-SSIs within 30 days were treated in the inpatient setting (95% CI, 86.4%-89.9%) (Table 3). Similar to the variation in rates of CS-SSIs by type of surgery, the proportion of postsurgical inpatient visits for CS-SSIs also varied by type of surgery. For CS-SSI visits within 14 days, the portion occurring in the inpatient hospital setting ranged from 75.0% (95% CI, 28.4%-97.2%) to 100.0% (95% CI, 87.8%-100.0%) for laparoscopic repair of inguinal or femoral hernia and laparoscopic repair of incisional or abdominal hernia,

respectively. For CS-SSI visits within 30 days, the portion occurring in the inpatient hospital setting ranged from 72.7% (95% CI, 43.5%-91.7%) to 96.7% (95% CI, 92.4%-98.9%) for laparoscopic repair of inguinal or femoral hernia and for vaginal hysterectomy, respectively.

Table 3. Distribution of Postsurgical Acute Care Visits for Clinically Significant Surgical Site Infections (CS-SSIs) Within 14 Days vs 30 Days of Ambulatory Surgery by Hospital Setting, 2010[a]



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DISCUSSION

ABSTRACT | METHODS | RESULTS | DISCUSSION | CONCLUSIONS | ARTICLE INFORMATION | REFERENCES

Our findings affirmed that the rate of clinically important infections following ambulatory surgery was low, despite documented poor infection control practices in ambulatory surgery centers[14] and in contrast to higher rates of infections following inpatient operations.[1,2] However, because of the large number of ambulatory surgical procedures performed annually, in absolute terms, a substantial number of patients undergoing ambulatory surgical procedures develop clinically significant postoperative infections. Most of these infections occurred within 2 weeks after surgery and resulted in hospital admission. Therefore, reporting rates at both 14 and 30 days are relevant, because routine follow-up visits for these procedures are frequently scheduled outside this 14-day time frame. For example, studies have shown that routine follow-up was 3 weeks for inguinal hernia, laparoscopic cholecystectomy, and anorectal surgical procedures, and a range of 2 to 4 weeks for adenotonsillectomy.[18-20] Our findings suggest that earlier access to a clinician or member of the surgical team (eg, telephone check-in prior to 2 weeks) may help identify and treat these infections early and reduce overall morbidity.

Given the paucity of information available regarding postoperative ambulatory infection rates, this study provides important baseline information regarding current infection rates following ambulatory surgery. The patterns and substantial variations in rates of CS-SSIs across different types of ambulatory surgical procedures emphasize the importance of reporting and studying rates of adverse events by surgical specialty. In addition to producing up-to-date and surgical procedure–specific infection rates for a range of surgical procedures not found in previous studies, our analysis benefited from the use of multistate, all-payer data sources using all inpatient and ambulatory surgery encounters occurring at hospital-owned facilities. Rates of CS-SSIs were relatively low, but because the CS-SSIs entailed hospitalization or additional procedures to treat infections, their clinical importance may be substantial.

With only a single exception, CS-SSI rates following laparoscopic procedures were not lower than those for open procedures. This unexpected finding may be explained several ways. Unmeasured clinical confounders between the groups such as differing body mass index or revisional surgery could have been present. Because low-risk patients selectively undergo surgery in ambulatory settings, this seems unlikely. It is more likely that because CS-SSI rates were relatively low, the power to detect differences between groups undergoing open vs laparoscopic surgery might have been insufficient.

With the exception of hernia repair, our findings are not directly comparable to prior published articles on SSIs after ambulatory surgery because those studies were mostly conducted outside the United States, examined small study populations, or used contrasting data sources such as medical records, physician and patient surveys, and patient registries. Many of these studies were from the 1990s and early 2000s and may not reflect current surgical practice. Prior studies assessed either surgical procedures different from those we examined (eg, hand,[21,22] laparoscopic appendectomy,[23] dermatology[24]) or diagnosis-specific procedures[25-27] (eg, cancer-related surgery[28]). Studies of all hernia repair types combined reported SSI rates between 0.5%[29] and 0.7%.[26] Rates of SSIs specific to inguinal hernia repair range from 1%[30-33] to 5%.[27,34]

Among the limitations of using the selected HCUP data was that the 8 states, although geographically

dispersed, may not reflect rates in other regions of the country. The data sets only capture postsurgical visits for CS-SSIs in hospital-owned settings (ambulatory surgery or inpatient) and exclude CS-SSIs subsequently managed in physician offices and emergency departments. Although we did not capture the universe of postoperative infections, those we did analyze represent serious infections that caused substantial morbidity and were costly to manage. We showed that 90% of these serious infections were treated in the hospital after ambulatory surgery. Quality improvement initiatives targeting reduction in the incidence of these infections could substantially benefit patients and reduce health care costs. Previous research revealed frequent, substantial breaches in infection control practices in ambulatory surgery centers,[14] suggesting that more rigorous attention to infection control might reduce the absolute number of CS-SSIs we observed.

Our findings do not include CS-SSIs following ambulatory surgical procedures performed at nonhospital-owned ambulatory surgery settings. However, the subanalysis of HCUP State Ambulatory Surgery Databases data for 2 states with complete reporting of ambulatory surgery encounters in all facilities regardless of hospital ownership demonstrates that this is not a significant limitation. The hospital-owned ambulatory surgery settings accounted for more than two-thirds of the ambulatory procedures of interest (eAppendix 3 in Supplement).

Last, identifying postsurgical CS-SSIs requires using all diagnoses and procedures reported on the record. Several studies have demonstrated the validity of coding for SSIs using administrative data.[35-38] In addition, our sensitivity analysis showed that 28.2% of postsurgical visits for CS-SSIs within 14 days were identified using any listed procedure codes specific to an infection, 38.9% were identified using any listed infection diagnosis codes specific to a surgical procedure, and 32.9% were identified using any listed procedures or diagnosis codes indicating an infection (eAppendix 4 in Supplement). These results suggest that the algorithm is robust and that the infections and symptoms are not related to other conditions.

CONCLUSIONS

ABSTRACT | METHODS | RESULTS | DISCUSSION | CONCLUSIONS | ARTICLE INFORMATION | REFERENCES

Among patients in 8 states the rates of CS-SSIs were relatively low. However, given how common ambulatory surgery is, the absolute number of patients with these complications is substantial. Prior studies showing significant lapses in infection control practices at ambulatory surgery centers suggest that quality improvement efforts may facilitate reducing CS-SSIs following ambulatory surgery.

ARTICLE INFORMATION

ABSTRACT | METHODS | RESULTS | DISCUSSION | CONCLUSIONS | ARTICLE INFORMATION | REFERENCES

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Author Contributions: Drs Owens and Steiner and Ms Barrett had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

Study concept and design: Owens, Barrett, Steiner.

Acquisition of data: Owens, Barrett, Steiner.

Analysis and interpretation of data: All authors.

Drafting of the manuscript: Owens, Barrett, Raetzman.

Critical revision of the manuscript for important intellectual content: All authors.

Statistical analysis: Owens, Barrett, Raetzman, Steiner.

Administrative, technical, and material support: Owens, Steiner.

Study supervision: Steiner.

Conflict of Interest Disclosures: All authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest and none were reported.

Funding/Support: This study was funded by the Agency for Healthcare Research and Quality (AHRQ) under a contract to Truven Health Analytics to develop and support the Healthcare Cost and Utilization Project (HCUP) (contract HHSA-290-2013-00002-C).

Role of the Sponsor: The AHRQ had no role in the design and conduct of the study; the collection, management, analysis, and interpretation of the data; the preparation, review, or approval of the manuscript; or the decision to submit the manuscript for publication.

Disclaimer: The views expressed in this article are those of the authors and do not necessarily reflect those of the AHRQ or the US Department of Health and Human Services.

Additional Contributions: We would like to thank 8 data organizations that contributed data to the HCUP that were used in this study: the California Office of Statewide Health Planning and Development; Florida Agency for Health Care Administration; Georgia Hospital Association; Hawaii Health Information Corporation; Missouri Hospital Industry Data Institute; Nebraska Hospital Association; New York State Department of Health; and Tennessee Hospital Association. In addition, we would like to thank the following individuals, who were compensated for their contributions: Minya Sheng, MS (Truven Health Analytics), and Tim Kenney, MA (Kenny IS Consulting), for the statistical programming; Lorena Lopez-Gonzalez, PhD (Truven Health Analytics), for the literature review; and Linda Lee, PhD (Truven Health Analytics), for editorial assistance.

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ABSTRACT | METHODS | RESULTS | DISCUSSION | CONCLUSIONS | ARTICLE INFORMATION | REFERENCES

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McGUIREWOODS

Reverse Migration?: A Trend of ASC Conversion to HOPD

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February 1, 2013
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Over the past 30 years, the health-care industry has witnessed the birth and growth of the ambulatory surgery center (ASC) industry, and a great migration to an ASC setting of procedures that previously were performed in hospitals.[1] Today, procedures performed in ASCs are broad in scope, including shoulder, hip, knee and spine surgeries, as well as many pain management and diagnostic services. For example, more than 50 percent of colonoscopy services performed in the United States are completed in ASCs.[2] Over the past decade, surgeries and procedures performed at ASCs have risen drastically, along with the number of ASC locations. According to the Medicare Payment Advisory Commission (MedPAC), in 2010, ASCs served 3.3 million fee-for-service Medicare beneficiaries, an increase of 0.9 percent from 2009.[3] Moreover, there were 5,316 Medicare-certified ASCs in 2010, an increase of 2.6 percent over the previous year.[4] In all, Medicare spent roughly $3.4 billion on ASC services in 2010 alone.[5]

Although the number and types of procedures that are performed in an ASC setting continue to expand, studies and reports indicate a slower growth in the number of ASCs and volume of services performed at ASCs compared to previous years.[6] Furthermore, the heath-care industry has experienced a reverse migration of sorts in the increasing acquisition by hospitals of freestanding ASCs and their conversion to hospital outpatient departments (HOPDs). This paper will discuss several areas related to conversion of ASCs to HOPDs. First, it will examine factors driving conversion of ASCs to HOPDs. Then, it will explore various legal considerations for hospitals considering converting an ASC into an HOPD. Finally, it will discuss co-management agreements and their place in the conversion of an ASC to an HOPD.

I. FACTORS DRIVING CONVERSION

A. Higher Reimbursement for Services Performed at HOPDs.

A primary factor driving conversion of freestanding ASCs to HOPDs is the great differential in reimbursement rates between the two facilities. Hospitals view freestanding ASCs as an avenue to return patients and revenue streams that were previously “lost” to ASCs. Beginning in 2007, Medicare payments to ASCs were lower than or equal to Medicare payments to HOPDs for comparable services for 100 percent of procedures.[7] Although HOPDs historically had always received higher reimbursement from Medicare than freestanding ASCs, this disparity grew larger when Centers for Medicare & Medicaid Services (CMS) implemented a revised ASC payment system effective Jan. 1, 2008, in accordance with the Medicare Prescription Drug, Improvement, and Modernization Act (MMA) of 2003.

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[1] ASC to HOPD Conversion: Costly Consequences, Ambulatory Surgery Center Association.
[2] Ambulatory Surgery Center; A Brief History, Ambulatory Surgery Center.info, available at www.ambulatorysurgerycenter.info.
[3] Report to Congress: Medicare Payment Policy, Chpt. 5 Ambulatory Surgical Center Services, p. 115, Medicare Payment Advisory Commission (2012).
[4] Report to Congress: Medicare Payment Policy, Chpt. 5 Ambulatory Surgical Center Services, p. 115, Medicare Payment Advisory Commission (2012).
[5] Report to Congress: Medicare Payment Policy, Chpt. 5 Ambulatory Surgical Center Services, p. 115, Medicare Payment Advisory Commission (2012).
[6] *See* Report to Congress: Medicare Payment Policy, Chpt. 5 Ambulatory Surgical Center Services, p. 115, Medicare Payment Advisory Commission (2012); *see also* Intelligmarker 2011: Multi-Specialty ASC Study, VMG Health (2011) *available at* http://www.vmghealth.com/Downloads/VMG_Intellimarker11.pdf.
[7] Testimony on HB 2522 Physician Self-Referral Legislation, Monica M. Ziegler, (June 8, 2010), Pennsylvania House of Representatives Insurance Committee.

The revised payment system greatly expanded the types of services eligible for payment in the ASC setting to cover roughly 3,500 surgical procedures and excluded from eligibility only those procedures that pose a significant safety risk to beneficiaries. However, the reformed policy also caused significant variation between ASC and HOPD reimbursement rates in the past several years. In 2003, Medicare paid hospitals 16 percent more, on average, than it paid ASCs.[8] Today, on average, Medicare pays ASCs 56 percent of the amount paid to HOPDs for performing the same procedure.[9] For example, Medicare pays $362 for a colonoscopy surgery performed at an ASC, and $643 for the same service performed in an HOPD.[10]

This growing divergence in payments is driven, in part, by differences in how the payment systems are updated each year to account for inflation. Despite the fact that ASCs and HOPDs offer the same services, the CMS applies two different measures of inflation to update the payment systems for the two surgical providers. For ASCs, that measure is tied to consumer prices. For HOPDs, it is tied to medical costs. The ASC inflation update based on consumer prices is unrelated to changes in medical costs and is historically lower than the inflation update based on medical costs.

Defenders of the disparity in reimbursement contend that the variance in payment is reasonable because ASCs are likely to incur lower operating costs than HOPDs and because HOPDs must meet additional regulatory requirements and treat patients who have more complex cases.[11] According to a comparison between ASC and HOPD costs conducted by the Government Accountability Office, ASC costs are, on average, lower than HOPD costs.[12] Moreover, MedPAC claims patients treated in HOPDs are typically more medically complex than patients treated in ASCs, and these more complex patients are therefore more costly.[13] Lastly, unlike ASCs, HOPDs are subject to the Emergency Medical Treatment and Active Labor Act (EMTALA), which mandates HOPDs to stabilize and transfer patients who are believed to be experiencing a medical emergency when presented at the facility, regardless of the patient's ability to pay for services.[14]

While the defenders of the reimbursement disparity can point to factors to support the different treatment of ASCs and HOPDs, the fact remains that the lower reimbursement rates for procedures performed in an ASC can result in significant cost savings to the party responsible for paying for the patient's heath-care. For example, coinsurance payments are typically less for procedures performed at ASCs rather than at HOPDs.[15] A beneficiary could pay as much as $496 in coinsurance for a cataract extraction procedures performed in a HOPD, whereas that same beneficiary's copayment in the ASC would be only roughly $195.[16] By having procedures completed in an ASC rather than an HOPD, a patient may save as much as 61 percent compared to

[8] ASC to HOPD Conversion: Costly Consequences, Ambulatory Surgery Center Association.
[9] ASC to HOPD Conversion: Costly Consequences, Ambulatory Surgery Center Association.
[10] ASC to HOPD Conversion: Costly Consequences, Ambulatory Surgery Center Association.
[11] Medicare Payment Advisory Commission 2003, Medicare Payment Advisory Commission 2004.
[12] Government Accountability Office 2006.
[13] Medicare Payment Advisory Commission (2004).
[14] 42 USC § 1395dd.
[15] Testimony on HB 2522 Physician Self-Referral Legislation, Monica M. Ziegler, (June 8, 2010), Pennsylvania House of Representatives Insurance Committee.
[16] Testimony on HB 2522 Physician Self-Referral Legislation, Monica M. Ziegler, (June 8, 2010), Pennsylvania House of Representatives Insurance Committee.

their out-of pocket coinsurance for the same procedures in an HOPD.[17] Overall, Medicare and its beneficiaries save more than $2.5 billion each year from procedures performed in ASCs rather than at HOPDs.[18] It is not surprising that the Office of the Inspector General (OIG) has included in its work plan this year an examination of the conversion of ASCs to HOPDs, as discussed more fully below. This reverse migration of cases back to a hospital setting has the potential to cost the federal government a significant amount of money.

B. Physician Alignment.

The conversion of an ASC to an HOPD can also be an effective physician alignment tool for hospitals. While many hospitals still joint venture with physicians in a freestanding ASC to create physician alignment, conversion of an ASC to an HOPD provides many benefits to physicians that investment in a freestanding ASC cannot provide. The main benefit of a freestanding ASC joint venture between physicians and a hospital is that the parties' financial interests are strongly aligned. Each party has a financial incentive to operate the facility as effectively and as efficiently as possible to increase the overall profits. Physician investment in an ASC, however, carries financial risk for physicians. Although investment in a freestanding ASC has the potential for higher returns and overall compensation, there is also a risk of loss of the investment. This is especially true in light of the growing disparity in reimbursement between ASCs and HOPDs, and the overall trend in the slowing growth of the ASC industry. Additionally, many start-up ASCs require debt guarantees from individual investors, which puts their personal assets at risk if the ASC does not perform as expected.

There are several benefits to physicians when a hospital purchases their ASC and converts it to an HOPD. One is the proceeds from the sale of the ASC, which can result in a large payout for the physicians. Another is the elimination of the risk of loss of a physician's capital investment or payment of a guarantee of debt of a freestanding ASC. Finally, many times a hospital will enter into a co-management agreement with the physicians to manage the ASC after it is converted to an HOPD, which has many benefits for physicians. First, management payments have a high degree of certainty and predictability. Moreover, physicians can have direct involvement and control of the surgery process even though they are no longer owners.

Co-management arrangements do have some limitations. Although HOPDs allow for more predictable fees paid to physicians under a management agreement, such agreements must reflect fair market value, which may be much less than what physicians could earn in an ASC joint venture. For example, a highly successful ASC can generate a much higher return on investment for its physician owners than a management agreement would pay. Further, because there is no direct equity physician ownership in an HOPD, there is not always a true congruence of interest between the hospital and the physicians. As a result, despite the management arrangement, some parties have found the physicians do not have strong incentives to operate in the most efficient way possible. In addition, compared to an equity investment, a co-management arrangement is a relatively short-term relationship.

[17] Testimony on HB 2522 Physician Self-Referral Legislation, Monica M. Ziegler, (June 8, 2010), Pennsylvania House of Representatives Insurance Committee.
[18] ASC to HOPD Conversion: Costly Consequences, Ambulatory Surgery Center Association.

II. OIG WORK PLAN

The growing trend of ASC conversion to HOPDs has caught the attention of the OIG. The OIG's Fiscal Year 2013 Work Plan indicated several areas of review related to ASCs, including a review of hospital acquisition of ASCs and the impact such acquisitions have on Medicare spending, specifically on Medicare payments and beneficiary cost sharing.[19] Investigations will focus on the extent to which hospitals acquire ASCs and convert them into HOPDs, causing Medicare to reimburse at higher rates for services performed in HOPDs rather than ASCs.[20] The OIG will also review the appropriateness of Medicare's methodology for reimbursing ASCs under the revised payment system[21] and compare payment rate disparities within ASC and HOPD settings for similar surgical procedures.[22] Lastly, the OIG plans to review the quality of care and safety of Medicare beneficiaries obtaining surgeries and receiving care in ASCs and HOPDs.[23] Investigations will focus on assessing pre-operative care and care during surgeries and procedures, and will indicate adverse events identified in each setting.

III. LEGAL CONSIDERATIONS

A hospital's acquisition of a freestanding ASC and conversion to an HOPD implicates a number of regulatory and other legal considerations, especially if the conversion involves a co-management agreement with the former physician owners of the ASC. Therefore, the hospital and physicians involved need to be mindful of these considerations when structuring these transactions, particularly in light of the OIG's focus on these transactions in this year's work plan. The OIG recently issued Advisory Opinion 12-22, which can help guide physicians and hospitals in structuring the co-management element of these transactions.

A. Purchase/Sale Agreement.

The hospital's purchase of the ASC and the payment of the purchase price to the physician owners of the ASC will need to fit within an exception to the Stark Law[24] assuming that the physician owners make referrals to the hospital. Generally, these transactions can fit within the isolated transactions or fair market value exceptions to the Stark Law.

To meet the fair market value exception, the compensation paid to a physician must be pursuant to an arrangement that (1) is set forth in writing, signed by all parties and covering items or services specified in the agreement; (2) is for a specified time period; (3) specifies the compensation that will be provided under the arrangement (the compensation must be set in advance, consistent with fair market value, and not determined in a manner that takes into account volume or value of referrals or other business generated by the referring physician); (4) is commercially reasonable and furthers the legitimate business purpose of both parties; (5) does not violate the Anti-Kickback Statute; (6) and does not include counseling or promotion of a business arrangement that violates the law in the services performed. 42 C.F.R. § 411.357(l).

The transaction must meet the following conditions to qualify for the isolated financial transactions exception: (1) The amount of remuneration must be both (i) consistent with the fair

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[19] OIG Work Plan 2013, p. 7.
[20] OIG Work Plan 2013, p. 7.
[21] Federal law required the secretary to implement a revised payment system for payment of surgical services furnished in ASCs, beginning Jan. 1, 2008. *See* 42 C.F.R. § 416.171.
[22] OIG Work Plan 2013, p. 22.
[23] OIG Work Plan 2013, p. 22.
[24] 42 U.S.C. § 1395nn.

market value of the transaction and (ii) not be determined in a manner that takes into account volume or value of any referrals by the referring physician or other business generated between the parties; (2) the remuneration must be provided under an agreement that would be commercially reasonable even if the physician made no referrals to the entity; and (3) there are no additional transactions between the parties for six months after the "isolated transaction" (except for those that meet another exception) and except for commercially reasonable post-closing adjustments that do not take into account (directly or indirectly) the volume or value of the referrals or other business generated by the referring physician. 42 CFR § 411.357(f).

Both of these exceptions require that the purchase price reflect fair market value. Accordingly, the hospital should obtain a valuation from a third-party appraiser experienced in health-care transactions.

There is no safe harbor to the Anti-kickback Statute that applies to the sale of an ASC to a hospital. Unlike the Stark Law, there is no isolated transaction safe harbor or fair market value safe harbor under the Anti-Kickback Statute. Therefore, it is important that the hospital's purchase of the ASC not be conditioned in any way to the physician's referrals to the hospital.

B. Provider-Based Regulations.

1. *Requirements Applicable to all Provider-Based Facilities.* Hospitals interested in converting an ASC into an HOPD should also review and follow Medicare's requirements for provider-based entities found at 42 C.F.R. § 413.65. All provider-based facilities are required to be operationally, clinically and financially integrated with the main hospital provider. Accordingly, HOPD must satisfy the following requirements:

    a. *Licensure and Operations*. The location must be operated under the same license as the hospital. Additionally, The Joint Commission should be notified about the existence of the hospital's off-campus location for survey purposes.

    b. *Clinical Integration*. The location must be clinically integrated with the hospital, as evidenced by the following:

        i. All professional staff providing professional services at the HOPD must have clinical privileges at the hospital;

        ii. The hospital must maintain the same monitoring and oversight at the HOPD as it does for any of its other departments;

        iii. The medical director of the HOPD must maintain a reporting relationship with the chief medical officer or other similar hospital official that has the same frequency, intensity and level of accountability that exists in the relationship between the medical director of a department of the hospital and the chief medical officer or other similar official of the hospital, and must be under the same type of supervision and accountability as any other director, medical or otherwise, of the hospital;

        iv. Medical staff committees or other professional committees at the hospital must be responsible for medical activities at the HOPD (i.e., quality assurance, utilization

review, and the coordination and integration of services, to the extent practicable, between each location and the hospital);

v. Medical records of patients treated at the HOPD must be integrated (or cross-referenced) into a unified hospital retrieval system; and

vi. Inpatient and outpatient services provided at the HOPD and the hospital must be integrated, and patients treated at the HOPD requiring further care must have full access to all inpatient and outpatient services of the hospital.

c. *Financial Integration*. The financial operations of the HOPD must be fully integrated within the financial system of the hospital, as evidenced by shared income and expenses between the hospital and the HOPD. The costs of the HOPD must be reported in a cost center of the hospital and the financial status of the HOPD must be incorporated and readily identified in the hospital's trial balance.

d. *Public Awareness*. The HOPD must be held out to the public and other payors as being part of the hospital (i.e., by including such locations in phone books, websites, marketing and hospital brochures). Patients must be made aware when they enter the HOPD that they are entering an outpatient department of the hospital and must be billed accordingly.

The government has indicated that satisfying each of these requirements is an important part of demonstrating that a HOPD is an integral part of the hospital.

2. *Requirements Applicable to Off-Campus Locations.* Medicare requires the HOPD to be located on the main hospital's campus, defined as an area within 250 yards of the hospital's main campus,[25] or the HOPD must be located within a 35-mile radius of the main provider.[26] If the HOPD's location falls within 250 yards of the hospital's main campus, the facility is essentially considered an on-campus entity. If, however, the ASC is located farther than 250 yards from the hospital campus, but within a 35-mile radius, the facility is an off-campus entity and may qualify for HOPD designation. If the HOPD is off-campus, it will also need to satisfy certain requirements applicable to off-campus facilities.

a. *Ownership and Control by the Hospital*

i. The HOPD must be wholly-owned by the hospital and must operate under the hospital's governing body and in accordance with the hospital's bylaws, rules, regulations and operating decisions. It is not necessary to establish a new holding company to own the off-campus locations; and

ii. The hospital must also have final responsibility for administrative decisions, final approval for contracts with outside parties effecting the location, final responsibility for personnel policies and final approval for medical staff appointments.

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[25] 42 C.F.R. §413.65(a)(2).
[26] 42 C.F.R §413.65(e)(3)(i).

b. *Administration and Supervision by the Hospital*

i. The HOPD must have a reporting relationship with the hospital that has the same frequency, intensity, and level of accountability that exists in the relationship between the hospital and an existing department — in essence, direct supervision;

ii. The administrator of the HOPD must maintain a reporting relationship with a manager at the hospital that is the same as the relationship between the manager and other hospital departments and be accountable to the hospital's governing body; and

iii. Administrative functions of the HOPD must be integrated with the hospital, including billing, records, human resources, payroll, employee benefits, salary structures, and purchasing services. Either the same employees must handle these administrative functions for the HOPD and the hospital, or the administrative functions for both entities must be contracted out under the same contract agreement, or the administrative functions must be handled under different contract agreements but the HOPD's contract be managed by the hospital.

3. Requirements Applicable to Hospital Outpatient Department. The location, and the physicians providing services at such location, will also need to meet the following requirements applicable to HOPDs.

a. *Site-of-Service Codes.* Physicians would be required to bill Medicare Part B physician services using the correct site-of-service code (e.g., hospital code POS 22, instead of physician office code POS 11).

b. *Medicare Provider Agreement.* The location must comply with the hospital's Medicare Provider Agreement.

c. *Civil Rights Act Compliance.* Physicians would be required to comply with the non-discrimination provisions of the Civil Rights Act.

d. *Treatment as Hospital Outpatients.* The hospital must treat all Medicare patients receiving services at the HOPD, for billing purposes, as hospital outpatients (i.e., the hospital cannot treat some Medicare patients to which it provides services as physician office patients and other Medicare patients as hospital patients).

e. *Patient Notice.* The hospital must provide written notice to Medicare beneficiaries, prior to the delivery of service, of the amount of the beneficiary's potential financial liability (i.e., the co-insurance liability amounts for an outpatient visit to the hospital and for the provision of physician professional services).

f. *Payment Window Requirements.* If a patient is admitted to the hospital as an inpatient after receiving care in the HOPD, payments for services provided in the HOPD are subject to the three-day payment window provisions such that outpatient diagnostic services related to the admission furnished by the admitting hospital within three days immediately preceding the Medicare beneficiary's admission are deemed to be inpatient services and included in the inpatient payment.

g. *Incident-To Services.* A physician must be present (on campus or within the same building) and immediately available to furnish assistance and direction throughout the performance of procedure performed by mid-level practitioners. This does not mean that a physician must be present in the room when the procedure is being performed.

h. *Conditions of Participation.* The location would also be required to comply with all health and safety rules for Medicare hospitals and to satisfy Medicare hospital conditions of participation (including hospital building code requirements).

If the location can satisfy all these requirements, it is likely the hospital will be able to qualify the location as an off-campus provider-based HOPD.

4. *Requirements Applicable to Off-Campus Facilities Operated Under Management Contracts.* If a provider-based HOPD is not located on the main campus of the hospital but is operated under a management contract, it must also meet the following criteria:

   a. *Staff Employment.* The hospital must employ the staff of the HOPD who are directly involved in the delivery of patient care, except for management staff and certain other staff. The hospital may not otherwise utilize the services of "leased" employees (i.e., personnel who are actually employed by the management company but provide services for the hospital under a staff leasing or similar agreement) who are directly involved in the delivery of patient care.

   b. *Control.* The administrative functions of the HOPD must be integrated with the hospital, and the hospital must have significant control over the HOPD's operations.

   c. *The Management Contract.* The management contract must be held by the hospital, not by a parent organization that controls both the hospital and the HOPD, if applicable.

C. Licensing and Certificate of Need.

Hospitals converting an ASC into an HOPD also need to consider various licensure and permit requirements. For example, if the hospital is located in a Certificate of Need state, it may need to obtain approval from the state Certificate of Need board before the ASC can be sold and converted to an HOPD. In addition, depending on the state licensure requirements, the facility may be required to obtain heath-care facility licenses maintained through the state's Department of Health.[27] Various notices and forms must be filed with Medicare and the state's Medicaid programs. A hospital will also need to examine the various accreditation and local, state and federal licenses and permit requirements for the conversion.

D. Co-Management Agreements.

Co-management arrangements are frequently used to align and reward physicians for assisting in managing a surgery center and often include incentive compensation to improve the facility's quality and efficiency. A typical co-management relationship involves an agreement between a hospital and a specialty physician group, such as a cardiology or orthopedic group, whereby either

[27] *E.g. see* S.C. Code 44-7-260 (2011), South Carolina facility license.

the physician group alone, or the physician group in partnership with the hospital, manages the operational and clinical activities of a hospital-based specialty service line. Generally, the co-management agreement provides for fair market value compensation in exchange for the provision of management services. Under a typical co-management agreement, the compensation includes an annual base fee and a quality-based incentive fee. The base fee is pre-determined, consistent with the fair market value of the services provided, and includes compensation for management and oversight in addition to service line development activities. The incentive fee is typically structured to include a series of pre-determined payments that are contingent on the achievement of specified, mutually agreed-upon quantifiable targets based on quality improvement and efficiency. Such arrangements, however, implicate a unique combination of regulatory issues.

E. The Anti-Kickback Statute.

Payments under a co-management arrangement implicate the federal Anti-Kickback Statute because they could be interpreted as remuneration to physicians in exchange for referrals to the hospital. The personal services and management contracts safe harbor is the most applicable safe harbor to a co-management relationship. In order to qualify for safe harbor protection, the arrangement must: (i) be set out in writing and signed by the parties; (ii) specify the services to be provided;(iii) if the agreement is intended to provide for services on a periodic, sporadic or part-time basis, the agreement must specify the exact schedule of such intervals, their precise length, and the exact charge for such intervals; (iv) the term must be for not less than one year; (v) the compensation must be set in advance, consistent with fair market value, and not determined in a manner that takes into account the volume or value of referrals; and (vi) the services performed under the agreement must not involve the counseling or promotion of a business arrangement or other activity that violates any state or federal law. 42 CFR 1001.952(d).

A co-management arrangement providing for a percentage-based compensation structure (for example, with an incentive fee that varies based on achievement of certain clinical quality improvement metrics) likely would not satisfy the personal services and management contracts safe harbor. The personal services and management contracts safe harbor requires “aggregate compensation” to be set in advance, and the OIG’s position is that percentage compensation is not “set in advance.” However, a co-management arrangement can meet many of the other elements of this safe harbor. Specifically, a co-management agreement should be set forth in writing and include all the services to be provided; the term of the agreement should be for a duration of one year or greater; any contracted services should be reasonably necessary to accomplish the business purposes of the agreement; and the compensation should be consistent with fair market value in arms-length transactions and not take into account the volume or value of referrals.

As is the case with the purchase price paid to physicians in the hospital’s acquisition of the ASC, the hospital’s payments under a co-management arrangement should be supported by an independent third-party fair market valuation. The compensation and incentive payment structure should be revisited throughout the course of the relationship to ensure that incentive payments are being provided only for performance improvements and to ensure that the compensation is still fair market value. If compensation provided is not commensurate with fair market value, such compensation could be construed as a kickback from the party paying greater than fair market value for the services actually provided.

F. Stark Law.

Payments under a co-management arrangement also implicate the Stark Law. The Stark Law personal service arrangements and fair market value exceptions are potentially applicable to co-management agreements. Both of these exceptions contain a requirement that the compensation must be consistent with fair market value, set in advance, and not vary with the volume or value of referrals. The "set in advance" requirement permits a specific formula that is set in advance, can be objectively verified and does not vary with the volume or value of business generated. For example, an incentive fee based on achievement of objectively verifiable clinical quality improvement metrics should be acceptable. In 2009, CMS proposed a new Stark Law exception[28] for incentive plans/shared service plans. However, the exception was never finalized.

G. False Claims Act.

Co-management agreements can also lead to liability under the False Claims Act (FCA). Liability under the FCA occurs when (1) a person or entity knowingly presents, or causes to be presented, a false or fraudulent claim for payment or approval; (2) knowingly makes, uses, or causes to be made or used, a false record or statement material to a false or fraudulent claim; or (3) conspires to commit a violation of any of certain provisions of the False Claims Act (including the two listed above). Violations of the FCA are punishable by penalties of not less than $5,500 and not more than $11,000 per claim, plus treble damages for the amount of damages the government sustains. FCA actions can be based on Anti-Kickback Statute and/or Stark Law violations. If a claim that a hospital submits to Medicare was improperly induced or violated the Stark Law, then it may also be a false claim.

H. Civil Monetary Penalties Law.

A co-management structure that incentivizes behavior to reduce costs could run afoul of the Civil Monetary Penalty (CMP) statute[29]. The CMP statute prohibits a hospital from knowingly making a payment, directly or indirectly, to a physician as an inducement to reduce or limit services to a Medicare or Medicaid beneficiary. A physician who knowingly accepts payment in violation of the CMP could be fined up to $2,000 for each such individual with respect to whom the payment is made. In addition, violators face potential exclusion from federal and state heath-care programs.

Since 2001, the Office of Inspector General (OIG) has issued favorable advisory opinions on gainsharing and performance-based compensation arrangements, and recently issued Advisory Opinion No. 12-22 specifically addressing a co-management arrangement.

I. Advisory Opinion No. 12-22.

Recently, the OIG issued new guidance on co-management agreements in an advisory opinion. On Jan. 7, 2012, the OIG published Advisory Opinion No. 12-22, which addressed a co-management agreement between a hospital and physicians that was designed to align incentives by offering compensation based on quality, service, and cost cost-saving measures. This is the first time the OIG has specifically addressed a co-management arrangement of this nature, but the OIG's analysis mirrors concepts from other advisory opinions regarding gainsharing and performance-based compensation arrangements. The OIG analyzed the arrangement under both the CMP and the Anti-kickback Statute. The OIG concluded that the agreement could constitute improper

[28] 73 Fed. Reg. 38502, 38604-05.
[29] 42 U.S.C. § 1320a-7a.

payment to either reduce or limit services or induce referrals under the CMP law; however, the OIG did not impose any sanctions due to several safeguards in the arrangement. These safeguards included the following:

i. Both the fixed fee and incentive fees under that arrangement reflected fair market value as supported by an independent, third-party valuation. Further, the arrangement provided that the physician group would provide substantial services to earn the fees.

ii. The fee paid to the physician group did not increase as a result of an increase in the number of patients treated at or referred to the hospital. Further, the incentive fee was capped at a certain amount each year and did not fluctuate based on the number of patients treated.

iii. The physician group agreed that the compensation received under the arrangement would be distributed to its member physicians pro rata based upon the amount of ownership interest in the group practice and not in any way based upon individual participation under the arrangement.

iv. The physicians agreed that they would not (a) stint on care of patients; (b) increase referrals to the hospital; (c) cherry-pick healthy patients with desirable insurance for treatment at the hospital; or (d) accelerate patient charges to earn the performance fee.

v. The hospital used an independent utilization review body to review the cost-savings measures implemented under the arrangement. In addition, the employee satisfaction, patient satisfaction, and quality components of the arrangement were monitored on multiple levels by a performance improvement committee, a peer review committee, the medical executive committee, and the hospital's board of directors.

vi. The arrangement allowed for flexibility in physician decision-making. The arrangement encouraged physicians to efficiently manage the use of supplies and products, but did not limit or restrict the physicians' abilities to offer patient services or have access to any supply or device that a physician considered clinically appropriate for patient care. In addition, the hospital used an independent, third-party utilization review body to analyze the clinical appropriateness of procedures performed in the facility. Further, the cost-savings benchmarks were based on the "aggregated performance" of the physician group so that earning the incentive fee was not dependent upon meeting a specific standard for each particular patient.

vii. The performance measures were very detailed and based on national standards, independent utilization reviews, and employee and patient satisfaction measures.

viii. The physician group could not receive the incentive fee if it did not satisfy the baseline measure for the various components so that the physician group was not rewarded for maintaining the status quo.

ix. The term of the arrangement was limited to three years.

x. The hospital notified patients and their families in writing of the arrangement prior to patients' receiving services.

VI. CONCLUSION

While the ASC industry has experienced tremendous growth over the past three decades, that growth has slowed in recent years. One factor contributing to the slowing growth may be the recent trend of hospital acquisitions of ASCs and their conversions to HOPDs. These types of transactions are appealing to hospitals and physicians for a number of reasons, including increased reimbursement for hospitals, and less risk for physicians. However, the result of these transactions is an increase in cost to Medicare, patients and other payors. Further, they involve a complex set of regulatory issues that physicians and hospitals must navigate. Physicians and hospitals should pay careful attention to structuring these transactions, especially in light of the OIG's focus on them in this year's work plan.