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Is There Evidence for Systematic Upcoding of American Society of Anesthesiologists Physical Status Coincident with Payer Incentives? A Regression Discontinuity Analysis of the National Anesthesia Clinical Outcomes Registry

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Abstract

Background—Modifications in physician billing patterns have been shown to occur in response to payer incentives, but the phenomenon remains largely unexplored in billing for anesthesia services. Within the field of anesthesiology, Medicare's policy not to provide additional reimbursement for higher American Society of Anesthesiologists (ASA) Physical Status scores contrasts with the practices of most private payers, and this pattern of reimbursement introduces a change in billing incentives once patients attain Medicare eligibility. We hypothesized that, coincident with the onset of widespread Medicare eligibility at age 65, a discontinuity in reported ASA Physical Status scores would be observed after controlling for the underlying trend of

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increasing ASA Physical Status scores with age. This phenomenon would manifest as a pattern of upcoding of ASA Physical Status Scores for patients below the age of 65 that would become less common in patients age 65 and older.

Methods—Using data on age, gender, ASA Physical Status scores, and type of surgery from the National Anesthesia Clinical Outcomes Registry (NACOR), we used a quasi-experimental regression discontinuity design to analyze whether there was evidence for a discontinuity in reported ASA Physical Status scores occurring at age 65 for the non-deferrable anesthesia services accompanying hip, femur, or lower leg fracture repair.

Results—A total of 49,850 records were analyzed. In models designed to detect regression discontinuity at age 65, neither the binary variable “age = 65” nor the interaction term of age*age = 65 was a statistically significant predictor of the outcome of ASA Physical Status score. The statistical inference was unchanged when ASA Physical Status scores were reclassified as a binary outcome (1–2 vs. 3–5) and when different bandwidths around age 65 were used. To test the validity of our study design for detecting regression discontinuity, simulations of the occurrence of deliberate upcoding of ASA Physical Status scores demonstrated the ability to detect deliberate upcoding occurring at rates exceeding 2% of eligible cases of patients under age 65 years.

Conclusions—We found no evidence for a significant discontinuity in the pattern of ASA Physical Status scores coincident with Medicare eligibility at age 65 for the non-deferrable conditions of hip, femur, or lower leg fracture repair. Our data do not support the presence of fraudulent ASA Physical Status scoring among NACOR contributors. If deliberate upcoding of ASA Physical Status scores is present in our data, the behavior is either too rare or too insensitive to the removal of payer incentives at age 65 to be evident in the present analysis.

Introduction

Modifications in physician billing practices occur in response to payment incentives, sometimes independently from measurable changes in the actual care being delivered.^{1,2} Ideally, such changes reflect improvements in physician billing compliance that lead to a decrease in the amount of unrealized compensation for appropriately delivered care. However, prior investigators have suggested that associations between billing practices and payment incentives are not always explainable by increased billing fidelity. For example, the occurrence of billing patterns consistent with deliberate upcoding – possibly in pursuit of higher reimbursements – has been rigorously demonstrated in a forensic analysis of general outpatient office visits covered under Medicare Part B.³ Additionally, the phenomenon of “code creep” has been observed, in which encounters that are reimbursed according to care intensity sometimes manifest an otherwise unexplained trend increase in reported care intensity over time.^{4,5}

Within the field of anesthesiology, private United States (US) insurers typically reimburse for intraoperative anesthesia services as a function of the sum of base units, modifiers for intensity of care delivered, and time units; with the per-unit dollar conversion varying depending on negotiated contracts between payers and provider groups. Care intensity is determined, in part, by a modifier that accounts for increasing American Society of Anesthesiologists (ASA) Physical Status scores recorded by the primary anesthesia

provider.⁶ Under the typical arrangement, conventional intraoperative care for patients considered to have a more severe comorbid burden (i.e. ASA Physical Status scores of 3–5) commands additional reimbursement as compared to care for relatively healthy patients scored as ASA Physical Status 1 or 2. This payment model with a step increase for patients above ASA Physical Status 2, though common among private payers, contrasts with reimbursements under Medicare, in which no increases in anesthesiology payments are offered for higher ASA Physical Status scores.

Taking advantage of the large and sudden increase in the percent of the United States population covered by Medicare that is known to occur at age 65⁷ and the associated loss of financial incentives for coding ASA Physical Status as greater than 2 that also occurs at age 65, we designed a quasi-experimental study to determine if there was evidence for systematic upcoding of ASA Physical Status in response to payer incentives that ceases at age 65 using a regression discontinuity design.^{8–10} A quasi-experimental study typically refers to any study method seeking to infer causal relationships in the absence of random assignment.^{11,12} As further described below, the regression discontinuity design has been commonly used in the social sciences to observe changes in an outcome (in this case: ASA Physical Status rankings) that occur on either side of a relatively sharp cut-point (in this case: the proportion of patients insured by Medicare at age 65). We hypothesized that, coincident with the onset of widespread Medicare eligibility, a discontinuity in ASA Physical Status scores would be observed in the case of the non-deferrable conditions of hip, femur, or lower leg fracture repair. Such discontinuity would be observed after controlling for the underlying trend of increasing ASA Physical Status scores with increasing age as well as any gender effects.

Methods

This study analyzed a broadly available, de-identified database that does not contain identifiable health information, and was therefore exempt from IRB approval. With assistance from the Anesthesia Quality Institute (AQI), data were abstracted from the National Anesthesia Clinical Outcomes Registry (NACOR) Participant User File 2014, Quarter 1. The NACOR dataset has been used previously in several reports describing national anesthesia usage patterns and outcomes.^{13–15} We limited our analysis to patients age 50–79 undergoing surgery for the treatment of a fractured hip, femur, or lower leg because these are overwhelmingly non-deferrable conditions.⁷ This group was identified based on the presence of Clinical Classification Software (CCS) codes 146 or 147. CCS codes, formerly known as Clinical Classifications for Health Policy Research,¹⁶ are used to identify clinically relevant diagnostic groups in a variety of health services research contexts, and have been shown to compare favorably to other widely used diagnostic and comorbidity classification systems.^{17,18} The full extraction schema for the present data analysis, including an accounting of missingness, is illustrated in Figure 1.

Regarding the non-deferrable nature of the repair of hip, femur, and lower leg fractures, this was desirable because prior research has identified that, among conditions that are deferrable, a large increase in the number of care visits occurs in the United States at age 65 in response to Medicare eligibility, and partially in response to the decline in the percent of

the population that is uninsured.⁷ In Figures 2 and 3, we demonstrate the importance of using a non-deferrable condition within the NACOR dataset in the present analysis as follows: Figure 2 shows the number of patients by age and ASA Physical Status score within our dataset undergoing the *non-deferrable* repair of a hip, femur, or lower leg fracture (CCS codes 146 or 147), while Figure 3 demonstrates the number of patients by age and ASA Physical Status score within NACOR undergoing the *deferrable* procedure of cataract repair (CCS 15). As can be seen for deferrable conditions, a large step increase in the number of patients undergoing cataract surgery enters the market after the onset of Medicare eligibility at age 65 (Figure 3). The step increase in the number of people seeking treatment for this deferrable condition raises the likelihood that the characteristics of people seeking cataract repair at age 65 and older will be systematically different from those of people under age 65 undergoing the same procedure. Indeed, the literature suggests that patients who defer their healthcare usage until the age of 65 are typically those who previously lacked insurance and for whom out-of-pocket expenses correspondingly decrease substantially after Medicare enrollment.^{19,20} As out-of-pocket costs increase for many employer-sponsored plans, other cost-conscious patients also may defer surgeries when possible until the onset of Medicare coverage. If we included a surgical procedure that could be deferred until age 65, this situation would violate an important assumption of our regression discontinuity design which requires that, other than the dramatic shift in payer mix at age 65 that has been previously described⁷ and the known gradual increase in ASA Physical Status scores that occurs with age and gender, the distribution of the population of patients slightly older than 65 who undergo the surgical procedure should not systematically differ from that of patients slightly younger in respect to unmeasured factors that determine their ASA Physical Status scores. To the extent that the above assumption holds, the degree of regression discontinuity in ASA physical status scores associated with Medicare eligibility may reflect the degree of systematic upcoding that occurs in response to payer incentives and that stops in the absence of such incentives. If patients on either side of the age 65 threshold are reasonably similar in respect to unobserved characteristics that would affect the outcome of ASA Physical Status, the resulting quasi-experimental population sample would share important characteristics with what is desired in samples produced from a randomized clinical trial.²¹

An additional assumption of our study design is that age data and the ASA Physical Status groupings of 1 or 2 versus 3, 4, and 5 in the study database accurately reflect the actual clinical data submitted by providers for reimbursement, and that the dataset was minimally contaminated by unanticipated subsets of patients with leg fractures that could theoretically be deliberately deferred until the attainment of Medicare eligibility. Accordingly, the AQI advised that case inclusion should be limited to the following target facilities: university hospitals, large community hospitals (over 500 beds), medium community hospitals (100–500 beds), small community hospitals (less than 100 beds), and attached surgery centers. This excluded specialty hospitals, freestanding surgery centers, pain clinics, and surgeon offices, as these facilities would not be likely to treat significant numbers of non-deferrable leg fractures. To the extent that such facilities may treat leg fractures, clinical experience would suggest that the excluded population is likely to represent a markedly different group of patients as compared to those treated in the acute care hospitals and attached facilities that were included.

Statistical Analysis

Data for age and ASA Physical Status (ASAPS) scores from the above target facilities were extracted for analysis. To assess for regression discontinuity in ASAPS scores, we created a dichotomous variable of age ≥ 65 years as the indicator variable of discontinuity. We then estimated the effect of this variable on the level of ASAPS scores by ordinal logistic regression, including the following independent variables in the primary model: age centered at 65 years, age ≥ 65 , gender, and the first-order interaction between centered age and age ≥ 65 . Due to a paucity of ASA Physical Status 5 patients and their likely heterogeneity with the remainder of the sample, we discarded this group of 25 patients prior to analysis. We confirmed graphically that the proportionality assumption was not violated. The logit of the ASAPS score was shown to be linearly associated with age, and polynomials in age were not considered in the final ordinal logistic regression analyses.

The significance of the regression coefficient for the age ≥ 65 variable was used to decide whether or not there was a discontinuity effect of Medicare eligibility on ASA scores. Second, in order to address the possibility that “gaming the system” is present primarily in private practices where physician salaries may be more directly affected by billing productivity as compared to university systems, we conducted the same primary analysis in the two sub-groups of University hospitals and in non-university hospitals. All data analyses were performed using SAS v9.3 (Cary, NC), and a two-sided p-value <0.05 was considered statistically significant.

Sensitivity Analyses

To reduce the potential impact of age at the two tails of its distribution on the ASAPS scores, the primary analysis was limited to patients whose ages ranged from 50 to 79 years. As a sensitivity analysis, we refit the ordinal logistic regression analyses to observations within a smaller bandwidth of 5 and then 10 years to either side of age 65 (i.e. ages 60 to 69 and ages 55 to 74). Second, we also fit a simpler logistic regression model in which we recoded the multilevel ASA score outcome into a binary variable (i.e., ASA 1–2 vs. 3–4). Third, we sought to measure whether the extent of discontinuity varied among different facilities and regions. We therefore modified the primary ordinal regression analysis to include the region of the country and the specific facility identity as random effects. For this third sensitivity analysis, we included only the subset of facilities that performed at least 100 cases each. For this model, we used the SAS PROC GLIMMIX Procedure, in which a random intercept effect was modeled to take into consideration the hierarchical structure of our data (i.e., patients were treated at different anesthesia facilities nested in different US regions). Last, in order to test the validity of our study design for detecting regression discontinuity at the age 65 Medicare threshold, we conducted simulations of various rates of occurrence of deliberate upcoding of ASA Physical Status scores for eligible cases under age 65 in the dataset. The simulations used the same logistic regression model as in the second sensitivity analysis above, but enriched the dataset with increasing proportions of randomized upcoding ranging from 0.5% to 4% of eligible cases. At each level of upcoding prevalence, 1000 independent iterations of the simulation were performed, and the p-value ($\pm 95\%$ CI) of the age ≥ 65 variable was calculated.

Results

Description and Representativeness of the Data

A total of 59,559 cases were extracted for the selected surgical procedure and age range. As shown in Figure 1, ASA Physical Status score and age were available for 50,437 eligible cases. The distribution of ASA Physical Status by age is illustrated in Figure 2. Of this group, 587 (1.2%) were removed from the analyses due to missing gender, resulting in a cohort of 49,850 patients with complete data on gender and ASAPS score available for inclusion in the final models.

For the 49,850 included patients, the mean age was 64.2 years (SD 8.6), with a median age of 64 years (IQR 57–72). 62.3% were female, and the modal ASA Physical Status (N=20,940) was 3. Because a very small number of subjects were available who scored as ASA Physical Status 5 (N=25), we removed these 25 patients from the analysis.

Regarding representativeness of the data, the dataset comprised cases from the following types of institutions: university hospitals (N=3,570; 7.2%), large community hospitals > 500 beds (N=14,212; 28.5%), medium community hospitals between 100–500 beds (N=28,461; 57.1%), small community hospitals (N=2,907; 5.8%); and attached surgery centers (N=700; 1.4%). Geographically, the dataset comprised patients from throughout the United States, including the Northeast (N=7,250; 14.5%), the Midwest (N=16,128; 32.4%), the South (N=19,194; 38.5%), and the West (N=7,278; 14.6%).

Analyses of Regression Discontinuity

Three models were tested in the primary ordinal logistic regression: the first using the entire dataset as described above, the second including only university hospitals, and the third including only non-university hospitals. In each of these models, neither the age 65 variable ($p = 0.68, 0.39, \text{ and } 0.51$, respectively) nor the first order interaction term of age 65*centered age ($p = 0.66, 0.99, \text{ and } 0.53$, respectively) were statistically significant predictors of the odds of a change in the ASA Physical Status score outcome when both of these variables were included.

Because of the insignificance of the age*age 65 interaction term, we subsequently excluded this term from our models to determine whether the main effect of the age 65 variable was significant in predicting ASA Physical Status scores. In parallel with the above three models, we again first used the entire dataset (Table 1.1), then included only university hospitals (Table 1.2), and then included only non-university hospitals (Table 1.3). The age 65 variable was again not a significant predictor of ASA Physical Status score ($p=0.71, 0.39, \text{ and } 0.55$, respectively). As shown in Table 1, both age and gender were significant predictors in all three models, with increasing age and female gender both independently associated with increased odds of higher ASA Physical Status scores ($p<0.0001$ for age in the three models and $p<0.0001, p=0.045, \text{ and } p<0.0001$, for gender in the three models, respectively).

Results of Sensitivity Analyses

When multilevel ASA scores were reclassified into a binary outcome for analysis, similar results were found, i.e., the age 65 variable was still found to be a statistically non-significant predictors ($p = 0.30$ and 0.86 , respectively). Restricting the ordinal logistic regression analyses to observations within a narrow bandwidth of 5 or 10 years (i.e., ages 60 to 69 and ages 55 to 74) of the cutoff point did not change the statistical inference for the age 65 (see Table 2). Third, in a random effects model that accounted for regional and facility-specific correlations in ASA Physical Status scoring, the conclusion again remained unchanged (see Table 3).

Collectively, these analyses provide evidence for a lack of significant discontinuity in the pattern of ASA Physical Status scores at age 65 within the present data. In our series of simulations of NACOR data that were deliberately enriched with increasing proportions of randomly upcoded cases, the results demonstrated our ability to detect deliberate upcoding of ASA Physical Status scores occurring at rates exceeding 2% of eligible cases under age 65 years, as indicated by the statistical significance of the age 65 variable illustrated in Figure 4.

Discussion

In this study using the NACOR database, we found no evidence for a significant discontinuity in ASA Physical Status scores in response to Medicare eligibility for the non-deferrable surgical conditions of hip, femur, or lower leg fracture repair. This finding is consistent with the conclusion that, among centers contributing to NACOR, there is no widespread upcoding of ASA Physical Status scores that ceases at age 65 in association with changes in payer incentives. If deliberate upcoding of ASA Physical Status scores is present in our data, the behavior is either too rare or too insensitive to the removal of payer incentives at age 65 to be evident in the present analysis.

While this study has the advantage of using a geographically and institutionally broad data source, our conclusions may not be generalizable to anesthesia practice groups that do not provide data to NACOR. Moreover, while the results do not support a widespread pattern of ASA Physical Status score manipulation, it may of course be possible that there are dubious billing practices among a minority of anesthesia practitioners within NACOR, or that other alterations of billing records could come to light using alternative methods of forensic analysis. Another limitation of our conclusion is that it is possible that a regression discontinuity is not observed simply because anesthesiologists are not aware of the Medicare rules regarding lack of reimbursement for ASA Physical Status scores greater than 2. Although our results are consistent with the conclusion that there is an absence of upcoding among anesthesiologists in response to payer incentives, they are equally consistent with the conclusion that there is a lack of knowledge among anesthesia practitioners regarding which patient bills would be affected by upcoding and which would not. Nevertheless, whether due to virtue, lack of knowledge, or a combination thereof, the lack of an observed regression discontinuity at age 65 supports the notion that anesthesia providers overall are not engaged in duplicitous ASA Physical Status scoring as a response to payer incentives that ceases when such incentives are no longer present. This conclusion remains valid despite the

known inter and intra-observer variability in ASA Physical Status rankings. The present study does not require that ASA Physical Status be objective – merely that providers have control of rating ASA Physical Status and that they may or may not exhibit behaviors that appear to be responsive to payment incentives in the course of these ratings.

Along with its use of a broad and diverse national database, this study has several strengths that stem from the regression discontinuity design itself. Specifically, while unmeasured, or poorly measured, confounding is possible in any study, the pseudo-random population created by the study method mitigates – though does not entirely eliminate – the possibility of such factors. Internal validity still rests on the assumption that, after accounting for the measured variables of age and gender, patients will not significantly differ in characteristics related to ASA Physical Status scores within a reasonable proximity to the age 65 Medicare eligibility threshold. Our choice to limit the dataset to patients undergoing the overwhelmingly non-deferrable procedures of hip, femur, or lower leg fracture repair helps to maintain this assumption.

An important limitation of our study, however, is that as our sample population extends over a larger-than-ideal age range to either side of the age 65 threshold. Particularly at the two tails of the age range, the mechanisms of injury and characteristics of the sample population may differ significantly. For example, younger male patients would be more likely to incur high-velocity traumatic femur fractures while older female patients would be more likely to incur pathologic fractures common among the frail-elderly. Acknowledging this potential source of bias, our analysis mitigated this potential confounder in two ways. First, all models incorporate both age and gender, which should serve to reduce bias due to systematic differences between younger males and older females. Second, the advantage of limiting the data analysis to a small age window on either side of the age 65 Medicare eligibility cutoff (15, 10, and 5 years in our several analyses) is to limit the effect of systematic differences in the populations on either side of the cutoff. In the theoretically ideal regression discontinuity scenario, a large enough dataset with precise ages in months would allow for the comparison of patients at age 64 years and 11 months with patients at age 65 years and 1 month. Although such a dataset was not available to us, future studies using a larger population size would allow for improvements on the present analysis, since sufficient case numbers would enable the analysis to use a narrower window around the age 65 threshold and would enable the detection of a lower prevalence of upcoding, if it indeed were present. In regard to the question of the appropriate tradeoff between a narrower sample window and a smaller sample size, our sensitivity analyses should provide some assurance to the robustness of the conclusion, given that the two models that explored narrower windows around age 65 reached the same conclusion as in our primary analysis.

In conclusion, this study found no evidence to support the presence of systematic upcoding of ASA Physical Status scores in response to payer incentives that disappear in conjunction with widespread Medicare eligibility.

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Figure 1.
Dataset formation from NACOR including numbers of missing data.

Figure 2. ASA Physical Status score distribution by raw number of cases and proportion grouped by age in years for the non-deferrable surgery of hip, femur, or lower leg fracture repair.

Figure 3.

ASA Physical Status score distribution by raw number of cases and proportion grouped by age in years for the deferrable surgery of cataract repair. The discontinuity in case numbers of the population presenting for this deferrable surgery at age 65 coincident with Medicare eligibility is readily seen in the NACOR dataset (Panel 1).

Figure 4.

Simulation results demonstrating the p-value of the age 65 indicator variable within the logistic regression model at increasing levels of random ASA Physical Status upcoding. Each dot represents the mean p-value for the indicator variable from 1000 simulations at the indicated upcoding prevalence. The 95% confidence intervals of these values were calculated but were so narrow as to be smaller than the dots used in the figure.

Table 1.1

Results of ordinal logistic regression analysis of ASA PS score

	Ordinal Logistic regression (Age [50–79])		
Variables	Estimate	Standard Error	P-value
Gender, female	0.22	0.02	< 0.0001
Age, centered at 65	0.06	0.002	< 0.0001
Age >=65	−0.01	0.03	0.71 ^a

Note: ASA Physical Status = 1 or 2 was the reference level.

^aNo significant effect of the Medicare eligibility cutoff was found for the odds of a patient being scored as an ASA Physical Status 3 or 4.

Table 1.2

Results of ordinal logistic regression analysis of ASA PS score (University hospitals)

	Ordinal Logistic regression (Age [50–79])		
Variables	Estimate	Standard Error	P-value
Gender, female	0.14	0.07	0.045
Age, centered at 65	0.04	0.01	< 0.0001
Age >=65	0.11	0.13	0.39 ^b

Note: ASA Physical Status = 1 or 2 was the reference level.

^b No significant effect of the Medicare eligibility cutoff was found for the odds of a patient being scored as an ASA Physical Status 3 or 4 among University hospitals.

Table 1.3

Results of ordinal logistic regression analysis of ASA score (Non-University hospitals)

	Ordinal Logistic regression (Age [50–79])		
Variables	Estimate	Standard Error	P-value
Gender, female	0.23	0.02	< 0.0001
Age, centered at 65	0.06	0.002	< 0.0001
Age ≥ 65	−0.02	0.04	0.55 ^c

Note: ASA Physical Status = 1 or 2 was the reference level.

^cNo significant effect of the Medicare eligibility cutoff was found for the odds of a patient being scored as an ASA Physical Status 3 or 4 among non-University hospitals.

Table 2

Results of sensitivity analyses.

Variables	Ordinal Logistic regression (Age [60–69])			Ordinal Logistic regression (Age [55–74])			Multiple logistic regression (ASA 3 or above vs. 1 or 2) (Age [50–79])		
	Estimate	Standard Error	P-value	Estimate	Standard Error	P-value	Estimate	Standard Error	P-value
Gender, female	0.27	0.03	< 0.0001	0.26	0.02	< 0.0001	0.20	0.02	< 0.0001
Age, centered at 65	0.06	0.01	< 0.0001	0.06	0.004	< 0.0001	0.06	0.002	< 0.0001
Age >=65	−0.08	0.06	0.20 ^a	−0.07	0.04	0.10 ^b	−0.04	0.04	0.31 ^c

Note: ASA Physical Status = 1 or 2 was the reference level.

^aWidespread Medicare eligibility at age 65 did not significantly affect the odds of a patient receiving an ASA Physical Status score greater than 2 in a model using 5 years of data on either side of the age cutoff.

^bWidespread Medicare eligibility at age 65 did not significantly affect the odds of a patient receiving an ASA Physical Status score greater than 2 in a model using 10 years of data on either side of the age cutoff.

^cWhen ASA Physical Status scores were treated as a binary variable, the overall effect of widespread Medicare eligibility at age 65 remained an insignificant predictor of ASA Physical Status score.

Table 3

Results of random-effect ordinal logistic regression analysis of ASA PS score accounting for facility type and geographical region.

	Ordinal Logistic regression (Age [50–79])		
Variables	Estimate	Standard Error	P-value
Gender, female	0.25	0.02	< 0.0001
Age, centered at 65	0.06	0.002	< 0.0001
Age ≥ 65	0.001	0.04	0.97 ^a

Note: ASA PS= 1 or 2 was the reference level.

^a No significant effect of the Medicare eligibility cutoff was found for the odds of a patient being scored as an ASA Physical Status 3 or 4.