

RAND

*Adjusting Physician
Payment for
Malpractice Risk*

*Troyen A. Brennan, Alison J. Eastwood,
Joseph P. Newhouse*

*RAND/UCLA/Harvard Center for
Health Care Financing Policy Research*

The research described in this report was supported by the Health Care Financing Administration, U.S. Department of Health and Human Services, Cooperative Agreement 99-C-98489/9-08.

ISBN: 0-8330-1404-8

RAND is a nonprofit institution that seeks to improve public policy through research and analysis. Publications of RAND do not necessarily reflect the opinions or policies of the sponsors of RAND research.

Published 1993 by RAND
1700 Main Street, P.O. Box 2138, Santa Monica, CA 90407-2138
To obtain information about RAND studies or to order documents,
call Distribution Services, (310) 393-0411, extension 6686

RAND

*Adjusting Physician
Payment for
Malpractice Risk*

*Troyen A. Brennan, Alison J. Eastwood,
Joseph P. Newhouse*

*Supported by the
Health Care Financing Administration,
U.S. Department of Health and Human Services*

**RAND/UCLA/Harvard Center for
Health Care Financing Policy Research**

Preface

The research described in this report was supported by the Health Care Financing Administration under Cooperative Agreement No. 99-C-98489/9-08. The Health Care Financing Administration does not necessarily endorse the findings of this work. The authors would like to thank Peter Jacobson and Daniel Relles for helpful comments on an earlier draft; they greatly improved the report's readability. Naturally, the authors are responsible for any remaining shortcomings.

Contents

Preface	iii
Tables	vii
Summary	ix
1. INTRODUCTION	1
2. DATA	2
Claims	2
Volume of Procedures	2
Procedural Codes	3
3. METHODOLOGY	4
4. INITIAL RESULTS	5
Initial Frequencies of Volume Data	5
Initial Frequencies of Claims Data	6
Invasiveness of Procedures	8
5. ESTIMATING THE PROBABILITY OF A CLAIM	9
Probability of a Claim for Individual CCPT Codes	11
Probability of a Claim for CCPT Code Groups	13
Probability of a Claim for Invasive and Noninvasive CCPT Code Groups	14
Probability of a Claim for Invasive and Noninvasive Procedures	15
6. CONCLUSIONS	16
Appendix	
A. CONSTRUCTION OF NEW PROCEDURAL CODES	19
B. CCPT CODE VALUES, LABELS, AND CONSTITUENT CPT CODES	21

Tables

1. CCPT Codes for Which There Was No Volume	5
2. Frequency of CCPT Codes by Volume (Grouped)	5
3. Distribution of Annual Volume by CCPT Code Group	6
4. Frequency of Claims by Year and Age of Patient	7
5. Frequency of Claims by CCPT Code Group	7
6. Distribution of Claims by CCPT Code Groups	7
7. Volume and Claims by CCPT Code Group and Invasiveness	8
8. Frequency of Claims by Age and Year for the Years 1985–1990	9
9. Frequency of Claims by CCPT Code Group for the Years 1985–1990	10
10. Distribution of Claims by CCPT Code Groups for the Years 1985–1990	10
11. CCPT Codes with Claims but No Volume	11
12. Statistics of Claims per 100,000 Procedures by CCPT Code	11
13. CCPT Codes with the Highest Claims Rate	12
14. CCPT Codes with the Lowest Claims Rate	12
15. Statistics of Claims per 100,000 Procedures by CCPT Code, with High Outliers Excluded	12
16. Proportion of Claims per 100,000 procedures, by CCPT Code	13
17. Proportion of Claims per 100,000 Procedures, by CCPT Code Group and Invasiveness	15
18. Proportion of Claims per 100,000 Procedures by Severity	15
A.1. Structure of CCPT Codes	20

Summary

In this report we define aggregations of Current Procedure Terminology (CPT) codes for the purpose of testing whether the risk of a malpractice claim varies by procedure. Using a data set of claims from one large teaching hospital from the 1985–1990 period, we show that malpractice risk differs not only by specialty but also by whether the procedure is invasive. Although our estimates are necessarily imprecise, they suggest an order-of-magnitude difference in the risk of a claim according to the invasiveness of the procedure within specialty. Medicare reimbursement policy only recognizes between-specialty variance in malpractice risk but not within-specialty variance according to invasiveness. We suggest it should.

1. Introduction

The current Medicare reimbursement system for physician services does not distinguish among procedures in the degree of malpractice risk. This raises the possibility that at the margin physicians may avoid or unduly favor certain procedures if the malpractice risk varies across procedures. Our aim in this report is to assess the degree to which this risk varies and thus whether changes in the payment system may be warranted.

We proceed by estimating the probability of a claim in various groupings of procedures that we devised. Our measures of claims and volume of procedures in each group come from one hospital. Moreover, measures of claims come from different years than measures of volume, and so our estimates should be treated as suggestive. Nonetheless, the data show a much greater likelihood of a claim if the procedure was invasive.

2. Data

The data used in this project came from the Brigham and Women's Hospital in Boston, Massachusetts ("the Brigham"). The data collected were malpractice claims filed against the hospital and the volume of procedures carried out in various departments in the hospital.

Claims

The claims data consist of two sets. The first covers all claims for patients aged 65 years or more filed against the Brigham between 1975 and 1991, a total of 57 claims. The second covers all claims for all patients under the age of 65 filed against the Brigham between 1985 and 1990. We initially attempted to distinguish the elderly to inform Medicare payment policy, but ultimately we could not compute probabilities for the elderly alone. There are 96 claims for the under 65; however, we exclude 9 because they duplicate claims in the first set. Thus, the final data set contains 144 claims. These are claims filed as opposed to claims paid. (Some of these claims have not been resolved, and we did not wish to lose data.)

Volume of Procedures

The procedure data were obtained from seven departments at the hospital, namely:

1. Anesthesiology,
2. Obstetrics and gynecology,
3. Ambulatory psychiatry,
4. Medicine,
5. Surgery,
6. Orthopedic surgery, and
7. Radiology.

Each department provided volumes by procedural codes for a given time period (in the majority of cases FY 1990/91). However, some departments gave data

over different time periods, and not all procedural codes were from the same coding system. Therefore, the data were edited and adjusted to ensure valid comparison across departments.

Procedural Codes

The original basis for categorizing the different procedures was Current Procedure Terminology (CPT) codes. We began with an aggregation of those codes to 189 groups. However, once the data had been collected, it became clear that a still more aggregated coding system would be required to assess the risk of a claim, because many of the 189 groups had no claims or very few claims. We therefore further collapsed the CPT codes into larger groupings.

Our general strategy was to group the CPT codes according to two generic criteria, the specialty of the provider and the anatomical site. Within orthopedics, for instance, we grouped CPT codes by operative site, using upper extremity, back, and lower extremity headings. We then disaggregated these headings into subcategories, for example, for upper extremity we considered wrist, forearm, elbow, and shoulder as separate categories.

Details of the new coding system are given in Appendix A. The new codes are named the CCPT codes (collapsed CPT codes) and were formulated by Dr. Brennan. The 189 primary CCPT codes can be further collapsed to 31, and even further to 7 categories. The seven broadest categories are: medicine, anesthesiology, surgical, gynecology, radiology, oncology, and laboratory. These are labeled the CCPT code groups. At a higher level of detail, the codes can be categorized into further subgroups, although not all groups have the same number of subgroups. The CCPT codes also distinguish invasive and noninvasive procedures.

3. Methodology

Our aim is to determine the proportions of procedures that result in claims. The major empirical problem in doing so is the sparsity of the data, which restricts the ability to identify rates for individual procedures. A further issue with our data is that the proportions of claims to volume are calculated with data from different sources. Given these facts, our aim is to identify a level of aggregation that will enable us to detect differences among classes with reasonable precision.

We first examine the raw frequencies of both the claims and volume data, to determine which category groupings permit estimating the probability of a claim with reasonable accuracy. The probability is estimated by examining the ratio of claims filed to volume of a procedure.

4. Initial Results

Initial Frequencies of Volume Data

Of the 189 CCPT codes, 8 have no procedures in any year (Table 1).¹ For the other CCPT codes, when all data are annualized and pooled (although these data come from different years), there are over one million procedures. The volume of procedures varies across the different CCPT codes; 2 of the 181 CCPT codes with positive procedures have only one procedure and 10 have over 10,000 procedures. Table 2 gives details of the distribution of volume.

Table 1
CCPT Codes for Which There Was No Volume

CCPT Code	Group	Subgroup	Subsub-group	Code Label
1100051	Medicine	Medical care	—	Rest home domicile or custodial care
1300071	Medicine	Other medical	—	Physical therapy
1300101	Medicine	Other medical	—	Simple catheter placement/venipuncture
2000112	Anesthesia	—	—	Radiological procedures
3810082	Surgical	Neurosurgery	General	Neurostimulators
5200032	Radiology	Angiography	—	Other radiology invasive procedures
6000011	Oncology	—	—	X-ray therapy procedures
7000041	Laboratory	—	—	Autopsy

Table 2
Frequency of CCPT Codes by Volume (Grouped)

Volume (Units)	Frequency of CCPT Codes	Percentage of CCPT Codes
1 - 9	12	6.6
10 - 99	31	17.1
100 - 499	49	27.1
500 - 999	32	17.7
1,000 - 4,999	37	20.4
5,000 - 9,999	10	5.5
10,000+	10	5.5
Total	181	100.0

¹Radiation oncology is referred to as oncology in this report; no volume data were obtained from the radiation oncology department.

Because of the number of the CCPT codes (189), we do not show the volume of procedures for each, but instead show the distribution for the 7 highest level CCPT groups (Table 3). Medicine accounts for the largest proportion (41 percent), and medicine, surgery, and radiology together account for 95 percent of all volume. Oncology has no volume and both gynecology and laboratory account for only 1 percent of total volume each.

Initial Frequencies of Claims Data

There are 144 claims in the data set, of which 116 occurred in the years 1985–1990. Table 4 shows the distribution of the claims by year and age of patient. The claims fall into 54 of the 189 CCPT codes. The number of claims in each of those 54 codes varies from 1 to 23, with about half of them having a single claim. Table 5 gives the distribution of claims across the CCPT codes with one or more claims.

From Table 5 it can be seen that only 4 of the CCPT codes have more than 5 claims. This, along with the fact that 135 of the 189 CCPT codes (71 percent) have no claims at all, highlights potential problems in using CCPT codes to calculate the probability of a claim. To derive useful results from these data, therefore, some further aggregation of codes is necessary.

The 54 CCPT codes for which there are claims are spread through the seven groupings (Table 6), although the spread is not very even. As with the volume, the largest number of claims is for medical procedures and surgery. The proportion of claims that relate to gynecology and to a lesser extent anesthesia is much higher than the proportion of volume related to those areas (14 percent and 8 percent compared to 1 percent and 3 percent, respectively). Also the proportion of claims related to radiology is lower than the proportion of volume

Table 3
Distribution of Annual Volume by CCPT
Code Group

Group	Label	Units	Percentage
1	Medicine	491,454	41.1
2	Anesthesia	34,577	2.9
3	Surgery	435,475	36.4
4	Gynecology	11,303	0.9
5	Radiology	208,876	17.5
6	Oncology	0	0.0
7	Laboratory	13,434	1.1
Total		11,195,119	100.0

Table 4
Frequency of Claims by Year and Age of Patient

Year	Age 65+		Age 0-64		All Ages	
	No.	%	No.	%	No.	%
1976	1	1.8	—	—	1	0.7
1978	3	5.3	—	—	3	2.1
1979	5	8.8	—	—	5	3.5
1980	3	5.3	—	—	3	2.1
1981	1	1.8	—	—	1	0.7
1982	3	5.3	—	—	3	2.1
1983	7	12.3	—	—	7	4.9
1984	4	7.0	—	—	4	2.8
1985	4	7.0	2	2.3	6	4.2
1986	5	8.8	7	8.0	12	8.3
1987	11	19.3	10	11.5	21	14.6
1988	3	5.3	21	24.1	24	16.7
1989	4	7.0	23	26.4	27	18.8
1990	2	3.5	24	27.6	26	18.1
1991	1	1.8	—	—	1	0.7
Total	57	100.0	87	100.0	144	100.0

Table 5
Frequency of Claims by CCPT Code Group

No. of Claims	Frequency of CCPT Codes	Percentage of CCPT Codes
1	28	51.9
2	14	25.9
3	1	1.9
4	5	9.3
5	2	3.7
7	1	1.9
8	1	1.9
17	1	1.9
23	1	1.9
Total	54	100.0

Table 6
Distribution of Claims by CCPT Code Group

Group	Label	Claims	Percentage
1	Medicine	64	44.4
2	Anesthesia	11	7.6
3	Surgery	44	30.6
4	Gynecology	20	13.9
5	Radiology	3	2.1
6	Oncology	2	1.4
7	Laboratory	0	0.0
Total		144	100.0

(2 percent and 18 percent, respectively). There are no claims for laboratory, and oncology and radiology account for only a small percentage of total claims (1 percent and 2 percent, respectively). This points toward problems in estimating rates for even high-level groupings, let alone subgroups or CCPT codes.

Invasiveness of Procedures

Table 7 compares the proportion of invasive and noninvasive procedures by CCPT code group for volume and claims, a question at the core of our work.² Although only 12 percent of the procedures are invasive (as determined by the CCPT coding), 60 percent of the claims relate to invasive procedures. As can be seen from the table, the distribution across invasive and noninvasive procedures is different for claims and volume. The most obvious variation within a group occurs for surgery; here, the percentage of noninvasive procedures is much higher for volume than for claims, and conversely the percentage of invasive procedures is much higher for claims than for volume. Noninvasive surgical procedures account for 31 percent of all volume but only 3 percent of claims, whereas invasive surgical procedures account for only 6 percent of volume but 28 percent of claims. Also of interest are the figures for invasive gynecological procedures (1 percent of volume compared to 13 percent of claims) and noninvasive radiological procedures (16 percent of volume compared to 1 percent of claims).

Table 7
Volume and Claims by CCPT Code Group and Invasiveness

Group	Invasiveness	Volume		Claims	
		No.	%	No.	%
Medicine	Noninvasive	476,680	39.9	50	34.7
Medicine	Invasive	14,774	1.2	14	9.7
Anesthesia	Noninvasive	—	—	—	—
Anesthesia	Invasive	34,577	2.9	11	7.6
Surgery	Noninvasive	365,181	30.6	4	2.8
Surgery	Invasive	70,294	5.9	40	27.8
Gynecology	Noninvasive	547	0.0	1	0.7
Gynecology	Invasive	10,756	0.9	19	13.2
Radiology	Noninvasive	195,880	16.4	1	0.7
Radiology	Invasive	12,996	1.1	2	1.4
Oncology	Noninvasive	—	—	2	1.4
Laboratory	Noninvasive	13,434	1.1	—	—
Total	Noninvasive	1,051,722	88.0	5.8	40.3
Total	Invasive	143,397	12.0	86	59.7
Overall total		1,195,119	100.0	144	100.0

²There are no invasive procedures for CCPT code groups 6 (oncology) or 7 (laboratory).

5. Estimating the Probability of a Claim

Our aim is to examine the proportion of procedures that result in claims for different CCPT codes. From the initial analyses, it is clear that there are not enough data to be able to estimate the probability of a claim for each CCPT code; furthermore, even grouping the CCPT codes will not necessarily be sufficient to obtain adequate data in each class.

As mentioned above, we hoped to carry out a separate analysis on the subset of claims relating to patients aged 65 years or more. However, this has not been possible, not only because of the relatively small number of claims, but also because of difficulties in evaluating the denominator for this situation. The volume data are for all patients; it is not possible to identify the proportion relating only to patients aged 65 or over.

Therefore, we focus attention on all claims. Unfortunately, the claims for patients aged under age 65 are available only for the six-year period 1985–1990. Consequently, 28 claims are excluded from the analysis (116 are included); the claims excluded are from 1976–1984 and 1991 for patients over 65 years of age, representing 20 percent of all claims. Excluding these claims reduces the amount of data available but has little effect on the distribution of the claims. Tables 8, 9 and 10 are revised versions of Tables 4, 5 and 6, respectively. Comparison of these tables shows that the changes do not qualitatively change the distribution of the claims.

Table 8
Frequency of Claims by Age and Year
for the Years 1985–1990

Year	Age 65+		Age 0–65		All Ages	
	No.	%	No.	%	No.	%
1985	4	13.8	2	2.3	6	5.2
1986	5	17.2	7	8.0	12	10.3
1987	11	37.9	10	11.5	21	18.1
1988	3	10.3	21	24.1	24	20.7
1989	4	13.8	23	26.4	27	23.3
1990	2	6.9	24	27.6	26	22.4
Total	29	100.0	87	100.0	116	100.0

Table 9
Frequency of Claims by CCPT Code Group
for the Years 1985–1990

No. of Claims	Frequency of CCPT Codes	Percentage of CCPT Codes
1	33	63.5
2	10	19.2
3	2	3.8
4	2	3.8
5	1	1.9
7	2	3.8
14	1	1.9
16	1	1.9
Total	52	100.0

Table 10
Distribution of Claims by CCPT Code Group
for Years 1985–1990

Group	Label	Claims	Percentage
1	Medicine	47	40.5
2	Anesthesia	9	7.8
3	Surgery	38	32.8
4	Gynecology	20	17.2
5	Radiology	1	0.9
6	Oncology	1	0.9
7	Laboratory	0	0.0
Total		116	100.0

Another problem is that the claims and volume data relate to different time periods. The volume data are for July 1990 onward (with the majority being fiscal year 1990/1991), whereas the claims data are for 1985–1990. It would be hoped that volumes will not change significantly over a few years, but it is likely that there will be some variation (although discharge data from the Brigham suggests that there has been a great deal of stability in the total number of patient discharges). This variation will be further compounded by the fact that to compare six years of claims, the annual volumes are multiplied by six, and not all the volumes represent a year's worth of experience. Thus, any random variation in that year will be overemphasized. In fact, some claims in the data relate to CCPT codes for which there are no volume. This occurs for three CCPT codes, two of which are in the medicine group and "other medical procedures" subgroup and the third is in the oncology group (Table 11):

Table 11
CCPT Codes with Claims but No Volume

CCPT Code	Label	No. of Claims
1300071	Physical therapy	1
1300101	Simple catheter placement/venipuncture	4
6000011	XRT procedures	2

Notwithstanding these problems, different approaches can be used to calculate the probability of a claim.

Probability of a Claim for Individual CCPT Codes

Two analyses were carried out: The first included any CCPT code where there are no claims as having zero claims; the second excluded these observations from the analysis so that the values for CCPT codes where claims are present can be examined in more detail. The first method provides the overall proportion of claims per procedure, since having no claims is information, not missing data. However, 71 percent of CCPT codes have no claims and these data points swamp the calculations.¹ We reach the same policy conclusions with both types of analyses; thus, this is a type of robustness test.

Table 12 provides details of statistics obtained from the calculation of the proportion of claims per 1000,000 procedures by both methods outlined above.

Table 12
Statistics of Claims per 100,000 Procedures by CCPT Code

Statistic	CCPT Codes with Zero Claims	
	Included	Excluded
N	181	49
Mean	178.24	658.39
Standard deviation	1775.14	3390.27
Median	0	24.66
Upper quartile	2.54	60.10
Lower quartile	0	10.11
Minimum	0	0.05
Maximum	23333.33	23333.33

¹As already mentioned, 181 of the 189 CCPT codes have volume data, but only 49 of these 181 codes have claims. It should be recalled that 7 claims are excluded from the calculations, because they relate to CCPT codes for which there are no volume, which accounts for the difference between the 52 code groups shown in Table 9 and the 49 groups.

Excluding the CCPT codes with zero claims compresses the distribution of the estimated proportions. The maximum value is very large in comparison with all other values, and this influences the statistics. In fact, there are three outliers, with much higher proportions than the other values (Table 13):

Table 13
CCPT Codes with the Highest Claims Rate

Claims per 100,000 Procedures	CCPT Code	Label
23333.33	1100041	Skilled nursing facility care
4761.90	4200022	Ectopic pregnancy/other
2380.95	3210052	Musculoskeletal system surgery—replantations

At the other extreme, there are two outliers with very small proportions (Table 14):

Table 14
CCPT Codes with the Lowest Claims Rate

Claims per 100,000 Procedures	CCPT Code	Label
0.048	3900011	General ophthalmologic services
0.116	5100011	General diagnostic radiology procedures

The proportions are calculated again, excluding the three high outliers. The results are given in Table 15.

Table 15
Statistics of Claims per 100,000 Procedures by CCPT Code with High Outliers Excluded

Statistic	CCPT Codes with Zero Claims	
	Included	Excluded
N	178	46
Mean	10.03	38.80
Standard deviation	28.31	44.83
Median	0	23.00
Upper quartile	0.12	47.76
Lower quartile	0	9.59
Minimum	0	0.48
Maximum	183.15	183.15

As can be seen from Table 15, omitting the outliers significantly reduces the variation in the proportions, and the mean values are greatly reduced. However,

for many of the CCPT codes identified there is only one claim, which makes reliability of the proportion of claims to procedures questionable. Consequently, we collapse the CCPT codes further, and examine the distinction between invasive and noninvasive procedures.

Probability of a Claim for CCPT Code Groups

Both radiology and oncology (CCPT code groups 5 and 6) have only one claim (Table 10); however, oncology has no volume and so this group could not be included in the calculations. Therefore, there is only one group for which the number of claims is very small. The next lowest CCPT code group is anesthesia, which has 9 claims (Table 10). The proportion of claims per 100,000 procedures is estimated for each of the CCPT code groups. The results are given in Table 16.

From Table 16, it can be seen that gynecology has by far the highest proportion of claims per procedure (29.5 per 100,000 procedures). At the other extreme, laboratory has no claims and radiology has well under one claim per 100,000 procedures (0.08). These last two results may be affected by the lack of data, but it appears that there is substantial variation between the different CCPT code groups. The average proportion for all 6 CCPT code groups included in the calculations is 6.16 claims per 100,000 procedures, with a standard deviation of 11.54. Restricting attention to those CCPT codes for which there are claims substantially reduces the amount of volume data used in the calculations (since only 49 of the 181 CCPT codes for which there are volume data have claims). These calculations use 667,085 procedures, compared to 1,195,119 for the previous calculations. A comparison of the distribution of procedures by CCPT code group for both cases shows that when the CCPT codes for which there are

Table 16
Proportion of Claims per 100,000 Procedures, by CCPT Code

Group	Definition	CPT Codes with Zero Claims	
		Included	Excluded
1	Medicine	1.59	6.82
2	Anesthesia	4.34	12.31
3	Surgery	1.45	1.63
4	Gynecology	29.49	35.61
5	Radiology	0.08	0.12
6	Oncology	—	(a)
7	Laboratory	0.00	(b)

^aCannot be calculated, because there are no volume data.

^bCannot be calculated, because there are no claims data.

no claims are excluded, the medicine CCPT code group has proportionately fewer procedures, whereas surgery and to a lesser extent radiology have proportionately more procedures.

The pattern for the proportion of claims calculated excluding CCPT codes with no claims is similar to that when all CCPT codes are included (Table 16), but the variation between CCPT code groups is more marked. Once again, gynecology has the highest proportion, 35.6 claims per 100,000 procedures, and radiology has the lowest proportion, 0.1 claims per 100,000 procedures. The radiology group and the surgery group stay at similar levels in the two analyses relative to the other groups. However, this may simply reflect the fact that more of the CCPT codes in these groups have volume data and so are not excluded from the analysis.

Probability of a Claim for Invasive and Noninvasive CCPT Code Groups

Procedures are categorized according to CCPT code group and invasiveness. Not all of the 10 possible categories have volume data (Table 7). Additionally, when CCPT codes for which there are no claims are excluded, the increases in the rates for various groupings are mainly in the noninvasive rather than the invasive procedures. This reflects the greater frequency of claims for invasive procedures compared to noninvasive.

Table 17 shows the estimated proportion of claims per 100,000 procedures with zero-claim codes included and excluded. From the table, it can be seen that the proportion of claims per 100,000 procedures is markedly higher for invasive than noninvasive procedures within the medicine and surgery CCPT code groups. For gynecology, both invasive and noninvasive proportions have about the same rates, which are much higher than rates in any of the other CCPT code groups. For the other groups, no real comparison can be made between invasive and noninvasive rates because of lack of data. Tests of whether the rates for invasive and noninvasive procedures differ for medicine and surgery reject the null hypothesis of no difference ($t = 3.0$ and 5.8 , respectively, $p < .01$).

Table 17
Proportion of Claims per 100,000 Procedures by CCPT
Code Group and Invasiveness

Group	Invasiveness	CCPT Codes with Zero Claims	
		Included	Excluded
Medicine	Noninvasive	1.29	5.73
Medicine	Invasive	11.28	23.04
Anesthesia	Noninvasive	—	—
Anesthesia	Invasive	4.34	12.31
Surgery	Noninvasive	0.14	0.14
Surgery	Invasive	8.30	16.43
Gynecology	Noninvasive	30.47	30.47
Gynecology	Invasive	29.44	35.93
Radiology	Noninvasive	0.09	0.12
Radiology	Invasive	—	—
Oncology	Noninvasive	—	(a)
Laboratory	Noninvasive	—	—

^aCannot be calculated, because there are no volume data.

Probability of a Claim for Invasive and Noninvasive Procedures

All procedures that are coded as invasive were combined together and compared with all procedures coded as noninvasive. Once again, we calculated the proportion of claims per 100,000 procedures both including and excluding CCPT codes with zero claims. Table 18 gives details of the results. As can be seen from Table 18, invasive procedures have a much higher proportion of claims per 100,000 procedures ($p < .01$).

Table 18
Proportion of Claims per 100,000 Procedures, by Severity

Invasiveness	CCPT Codes with Zero Claims	
	Included	Excluded
Invasive	8.485	19.087
Noninvasive	0.681	1.188

6. Conclusions

Our work is clearly preliminary. We define a set of classifications that we believe on an a priori basis are reasonably homogeneous with respect to the risk of a malpractice claim. We do not have enough data available to test the homogeneity of these categories; that remains for future work. The data gathered by the Harvard Medical Practice Study in New York State might be used for this purpose.

Nonetheless, our data strongly suggest two conclusions:

1. The risk of a claim varies by specialty.
2. The risk of a claim varies within specialty according to whether a procedure is invasive.

The first of these points is well known and is recognized by Medicare in its physician reimbursement, since the malpractice reimbursement is specialty-specific.

The second of these points is widely believed to be true but is not recognized by the current Medicare reimbursement system, which does not recognize the differential risk of a procedure within specialty.

Our quantitative estimates of the increase in risk at the procedure level are only suggestive; they are based on a small amount of data from one hospital, and the denominator (volume) is not completely commensurate with the numerator (claims). Nonetheless, they indicate the importance of pursuing this work further, because the risk of a claim for invasive procedures appears to be an order of magnitude higher than for noninvasive procedures. Moreover, the size of the increment may well vary by specialty. Indeed, pending the results of a project designed to obtain better estimates for surgery and medicine, it is worth considering the possibility of loading almost all of the malpractice adjustment on invasive procedures—making the adjustment for such procedures, say, 10 times as large as for noninvasive procedures, while keeping budget neutrality—rather than having the same adjustment factor for invasive and noninvasive procedures, as is now done. The magnitude of the differential between invasive and

noninvasive procedures is uncertain, but overshooting the mark greatly seems unlikely and some adjustment in this direction seems very likely to make payment more closely reflect the malpractice cost a physician will incur.

Appendix

A. Construction of New Procedural Codes

The starting point for the procedural codes is CPT codes. From these CPT codes, a new less-detailed coding system is created, the so-called CCPT codes (collapsed CPT codes). This system is created in such a way that the codes can be further collapsed to more general groupings as necessary. The broadest grouping of the CCPT codes provides 7 categories. Each of these groups may have up to 3 subgroups, and within any final grouping there are a number of related procedures. Also, the severity of any procedure is included in its CCPT code. The CCPT code is 7 digits long and the structure is as follows:

First digit	=	overall group	range: 1-7
Second digit	=	subgroup	range: 1-9
Third digit	=	subsubgroup	range: 1-4
Fourth digit	=	subsubsubgroup	range: 1-4
Fifth and sixth digits	=	unique identifier	range: 1-12
Seventh digit	=	invasive indicator	1 = noninvasive 2 = invasive.

For example, CCPT code 3221032 is the procedural code for shoulder arthrodesis and amputation. The code is in the third group (surgery), the second subgroup (musculoskeletal system surgery), the second subsubgroup (shoulder/arm/wrist/hand), and the first subsubsubgroup (shoulder). It is the third code in this subsubsubgroup and is classified as invasive.

CCPT code 7000031 is the procedural code for microbiological tests. The code is in the seventh group (laboratory) and is the third code in this group. It is classified as noninvasive.

There is only one group for which there are "subsub" and "subsubsubgroups" (surgical procedures), the other groups identify codes at a group or subgroup level. Table A.1 shows the groupings of the CCPT codes, and the actual codes are given below. Overall, the CCPT coding scheme identifies 189 different classes of procedures.

B. CCPT Code Values, Labels, and Constituent CPT Codes

CCPT Code	Label and constituent CPT codes
	group 1: MEDICINE
	subgroup 1: MEDICAL CARE
1100011	Outpatient Medical Services 90000–90170; 90700–90749; 90750–90778
1100021	Inpatient Medical Services 90200–90292; 90600–90699
1100031	Case Management Services 98900–98922
1100041	Skilled Nursing Facility Care 90300–90370
1100051	Rest Home Domicile or Custodial Care 90400–90470
1100061	Psychiatry 90801–90915
1100072	Emergency Department Care 90500–90580
1100082	Critical Care 99150–99199
	subgroup 2: CARDIOLOGY PROCEDURES
1200011	Cardiography 93000–93280
1200021	Echocardiography 93307–93350
1200032	Cardiac Catheterization (Diagnostic) 93501–93562
1200042	Cardiac Catheterization (Therapy) 92953–92984
1200052	EPS Studies 93600–93650
1200062	Other Cardiac Procedures 93720–93799

subgroup 3: OTHER MEDICAL PROCEDURES

1300011	Injections 90780–90799
1300022	Dialysis 90935–90999
1300031	Allergy Testing 95000–95199
1300041	Neurology Procedures 95805–95999
1300052	Chemotherapy Infusion 96400–96549
1300061	Dermatological Procedures 96900–96999
1300071	Physical Therapy 97010–97799
1300081	Special Services and Reports 99000–99090
1300092	Great Vessel Catheter Placement 36010–36299
1300101	Simple Catheter Placement/Venipuncture 36400–36425
1300111	Transfusion/Infusion 36430–36522

group 2: ANESTHESIA PROCEDURES

2000012	Head and Neck 00100–00352
2000022	Chest and Thorax 00400–00580
2000032	Spine and Spinal Cord 00600–00670
2000042	Abdomen 00700–00884
2000052	Perineum 00900–00955
2000062	Pelvis 01000–01190
2000072	Upper Leg 01200–01274

2000082	Knee and Lower Leg 01300–01522
2000092	Shoulder and Upper Arm, Elbow 01600–01782
2000102	Forearm, Wrist and Hand 01800–01860
2000112	Radiological Procedures/Anesthesia 01900–01999

group 3: SURGICAL PROCEDURES

subgroup 1: INTEGUMENTARY SURGICAL PROCEDURES

3100012	Skin and Subcutaneous Tissues 10040–11971
3100022	Skin Repair 12001–13300
3100032	Tissue Transfer Rearrangement 14000–15879
3100042	Pressure Ulcers 15920–15999
3100052	Burns 16000–17999
3100062	Breast Procedures 19000–19499

subgroup 2: MUSCULOSKELETAL SYSTEM SURGICAL PROCEDURES

subsubgroup 1: General

3210011	Simple Biopsy 20000–20220
3210022	Deep Biopsy 20225–20251
3210031	Simple Injections/Removals 20500–20615
3210042	Placement of Pins, Halos 20650–20694
3210052	Replantations 20802–20840
3210062	Bone and Tendon Grafts 20900–20999

subsubgroup 2: Shoulder/Arm/Wrist/Hand Procedures**subsubsubgroup 1: Shoulder**

- 3221012 Invasive Procedures
23000–23491
- 3221022 Fractures
23500–23680
- 3221032 Arthrodesis and Amputation
23800–23929

subsubsubgroup 2: Upper Arm and Elbow

- 3222011 Superficial Procedures
23930–24076
- 3222022 Invasive Procedures
24077–24498
- 3222032 Fracture/Dislocation
24500–24685
- 3222042 Arthrodesis and Amputation
24800–24999

subsubsubgroup 3: Forearm and Wrist

- 3223011 Superficial Procedures
25000–25105
- 3223022 Invasive Procedures
25107–25492
- 3223032 Fracture/Dislocation
25500–25695
- 3223042 Arthrodesis and Amputation
25800–25999

subsubsubgroup 4: Hands and Fingers

- 3224011 Superficial Procedures
26010–26116
- 3224022 Invasive Procedures
26117–26597
- 3224032 Fracture/Dislocation
26600–26785
- 3224042 Arthrodesis and Amputation
26820–26989

subsubgroup 3: Pelvis/Hip/Leg/Foot Procedures**subsubsubgroup 1: Hip**

- 3231011 Superficial or Simple Procedures
26990–27000; 27040–27048
- 3231022 Invasive Procedures
27001–27035; 27049–27187
- 3231032 Fracture/Dislocation
27190–27266
- 3231042 Arthrodesis
27280–27299

subsubsubgroup 2: Femur and Knee Joint

- 3232011 Superficial Procedures
27301–27307; 27323–27328
- 3232022 Invasive Procedures
27310–27320; 27329–27495
- 3232032 Fracture/Dislocation
27500–27570
- 3232042 Arthrodesis and Amputation
27580–27599

subsubsubgroup 3: Calf and Ankle Joint

- 3233011 Superficial Procedures
27600–27604; 27613–27618
- 3233022 Invasive Procedures
27605–27612; 27619–27745
- 3233032 Fracture/Dislocation
27750–27860
- 3233042 Arthrodesis and Amputation
27870–27899

subsubsubgroup 4: Foot

- 3234011 Superficial Procedures
28001–28005; 28043–28045
- 3234022 Invasive Procedures
28008–28035; 28046–28360
- 3234032 Fracture/Dislocation
28400–28675
- 3234042 Arthrodesis and Amputation
28705–28899

subsubgroup 4: General Orthopedics

- 3240012 Complex Casting
29000–29055
- 3240021 Simple Casting
29065–29799
- 3240032 Arthroscopy
29800–29909

subgroup 3: RESPIRATORY SYSTEM PROCEDURES

- 3300011 Simple Pulmonary Procedures
94010–94799
- 3300022 Bronchoscopy
31615–31725
- 3300032 Tracheal Procedures
31750–31899
- 3300042 Thoracic Procedures
32000–32999

subgroup 4: CARDIOVASCULAR SYSTEM SURGICAL PROCEDURES

- 3400012 Pericardial Procedures
33010–33100
- 3400022 Tumor Excision
33120–33130
- 3400032 Pacemaker Services
33200–33261
- 3400042 Heart and Valvular Repair
33300–33492
- 3400052 Coronary Artery Procedures
33500–33530
- 3400062 Other Major Repairs and Transplantation
33542–33999
- 3400072 Great Vessel Procedures/Aneurysm Repair
34001–35910
- 3400082 Other Artery Vein
36600–37799
- 3400092 Splenectomy/Bone Marrow Transplantation Preparation
38100–38999
- 3400102 Other Chest Procedures/Mediastinum
39000–39599

subgroup 5: ENT HEAD/NECK PROCEDURES

3500011	Simple ENT Office Services 92502–92599
3500021	Ear Simple Procedures 69000–69145; 69200–69222
3500032	Ear Invasive Procedure 69150–69155; 69300–69979
3500041	Other ENT Procedures 30000–31614; 40490–41599; 42000–42999
3500052	General Head, Neck Surgery 21010–21116
3500062	Plastic Surgery of the Head and Face 21120–21299
3500072	Facial Fractures 21300–21499
3500081	Simple Neck Procedures 21501–21550
3500092	Invasive Neck Procedures 21555–21899
3500102	Oral Surgery Procedures 41800–41899
3500112	Thyroid/Parathyroid 60000–60520

subgroup 6: GI SURGERY PROCEDURES**subsubgroup 1: Endoscopy**

3610011	Simple Gastroenterological Procedures 91000–91299
3610022	Endoscopy/GI 43200–43272
3610032	Colonoscopy 45300–45385
3610042	Liver/Biliary Procedures/Percutaneous Biopsy 47000–47100
3610052	ERCP 47550–47555

subsubgroup 2: GI Surgery

3620012	Esophageal Procedures 43000–43136; 43300–43499
---------	---

3620022	Stomach Procedures 43500–43999
3620032	Intestinal Procedures 44005–44960
3620042	Adrenals 60540–60545
3620052	Rectal Procedures Superficial 45000–45100
3620062	Invasive Rectal Procedures 45108–45180; 45500–46999
3620072	Invasive Liver/Biliary Tract Procedures 47120–47534
3620082	Invasive Liver/Biliary Procedures 47600–47999
3620092	Simple Pancreatic Procedures (Biopsy) 48100–48102
3620102	Invasive Pancreatic Procedures 48000–48020; 48120–48999
3620112	Other Abdominal Procedures 49000–49255; 49420–49999
3620122	Laparoscopy 49300–49401
	subgroup 7: URINARY SYSTEM PROCEDURES
3700012	Kidney Procedures 50010–50380
3700021	Simple Procedures 50390–50590
3700032	Ureter Procedures 50600–50940
3700042	Cystoscopy/Endoscopy 50951–50980; 52000–52338
3700052	Bladder Procedures 51000–51597; 51800–51980
3700061	Urodynamics 51600–51797
3700072	TURP 52340–52700
3700082	Urethral Procedures 53000–53899

3700092 Penis Procedures
54000–54450

3700102 Other Urological Procedures
54500–55899

subgroup 8: NEUROSURGICAL PROCEDURES

subsubgroup 1: General Neurosurgery

3810012 Punctures/Burr Holes
61000–61253

3810022 Craniectomy/Craniotomy
61304–61576

3810032 AV Malformation Repairs
61680–61712

3810042 Other Intracranial Procedures
61720–62147

3810052 CSF Shunts
62180–62258

3810062 Spinal Cord Surgery
62268–63780

3810072 Nerve Blocks
64400–64530

3810082 Neurostimulators
64550–64595

3810092 Destruction of Nerves
64600–64818

3810102 Nerve Repair
64830–64999

subsubgroup 2: Back Procedures

3820011 Simple Back Procedures
21920–21930

3820022 Invasive Back Procedures
21935–22230

3820032 Back Fractures
22305–23327

3820042 Back Arthrodesis
22548–22830

3820052 Other Invasive Spinal Procedures
22840–22899

subgroup 9: OPHTHALMOLOGICAL PROCEDURES

- 3900011 General Ophthalmologic Services
92002–92499
- 3900022 Evisceration/Implant
65091–65175
- 3900032 Repair of Eyeball
65205–65290
- 3900042 Corneal Procedures
65400–65775
- 3900052 Anterior Chamber
65800–66770
- 3900062 Lens Repair Including Cataracts
66820–66999
- 3900072 Posterior Segment/Retina
67005–67299
- 3900082 Ocular Adnexa Repair
67311–68899

group 4: GYNECOLOGICAL PROCEDURES**subgroup 1: GYNECOLOGICAL PROCEDURES**

- 4100011 Simple Gynecology Procedures
56000–56441; 57450–57454; 58300–58350
- 4100022 Invasive External Genitalia Procedures
56501–56800
- 4100032 Vaginal Procedures
57000–57020; 57500–57520
- 4100042 Invasive Vaginal/Cervical Procedures
57061–57410; 57530–57820
- 4100052 Dilatation and Curettage
58100–58120
- 4100062 Hysterectomy
58140–58285
- 4100072 Invasive Uterine and Ovarian Procedures
58400–58960
- 4100082 Laparoscopy
58970–58999

subgroup 2: OBSTETRICS

- 4200012 Maternal and Child Care
59000–59050

- 4200022 Ectopic Pregnancy/Other
59100–59160
- 4200032 Antepartum/Delivery
59200–59430
- 4200042 Cesarean Section
59510–59525
- 4200052 Abortion
59812–59899

group 5: RADIOLOGY PROCEDURES

subgroup 1: DIAGNOSTIC RADIOLOGY

- 5100011 General Diagnostic
70010–74775 (with the exception of: 70460–70488; 70491; 70492;
71260–71270; 72126; 72127; 72129; 72130; 72132; 72133; 72142;
72147; 72193; 72194; 73202; 73702; 74160; 74170; 72240–72296)
- 5100022 CT Scanning with Contrast
70460–70488; 70491; 70492; 71260–71270; 72126; 72127; 72129;
72130; 72132; 72133; 72142; 72147; 72193; 72194; 73202; 73702;
74160; 74170
- 5100032 Myelography
72240–72296
- 5100042 Barium Enema
74270–74283
- 5100052 Intravenous Pyelography
74400–74456

subgroup 2: ANGIOGRAPHY PROCEDURES

- 5200012 Radiology
75500–75790
- 5200022 Venography/Lymphangiography
75801–75893
- 5200032 Other Radiology Invasive Procedures
75894–75990

subgroup 3: OTHER RADIOLOGY PROCEDURES

- 5300011 Other Procedures
76000–76089; 76100–76499
- 5300021 Mammography
76090–76098
- 5300031 Diagnostic Ultrasound
76506–76999

5300041 Nuclear Medicine
78000-79999

group 6: RADIATION ONCOLOGY PROCEDURES

6000011 XRT Procedures
77261-77799

group 7 LABORATORY PROCEDURES

7000011 Simple Laboratory Tests
80002-86999

7000021 Noninvasive Vascular Studies
93850-93960

7000031 Microbiological Tests
87001-87999

7000041 Autopsy
88000-88099

7000051 Cytopathology
88104-88299

7000061 Cervical Pathology
88302-89399

MR-272-HCFA