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Insurance Status and Hospital Payer Mix Are Linked With Variation in Metastatic Site Resection in Patients With Advanced Colorectal Cancers

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Abstract

Background—Despite substantially improved survival with metastatic site resection in colorectal cancers, uptake of aggressive surgical approaches remains low among certain patients. It is unknown whether financial determinants of care, such as insurance status, play a role in this treatment gap.

Objective—We sought to evaluate the effect of insurance status on metastasectomy in patients with advanced colorectal cancers.

Methods—Using the National Cancer Data Base Participant User File, incident cases of colorectal cancer metastatic to the lung and/or liver with diagnosis from 2010 – 2013, were identified. Controlling for patient, tumor, and hospital characteristics, hierarchical regression was used to examine associations between hospital payer mix and metastatic site resection.

Results—We identified 42,300 patients in our cohort with mean age 64 years. Metastatic site resection occurred in 12.3% of all patients. Adjusting for patient and hospital fixed effects, we found that patients who were uninsured or on Medicaid were 38% less likely to undergo metastasectomy (OR, 0.62; 95% CI, 0.56 – 0.66). Patients in hospitals treating a high percentage of uninsured or Medicaid patients were less likely to undergo metastasectomy, even after controlling for individual patient insurance status.

Limitations—The study was limited by its retrospective design and the granularity and accuracy of the National Cancer Data Base.

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Conclusion—Differences in insurance status and hospital payer mix are associated with differences in rates of metastatic site resection in patients with colorectal cancer that is metastatic to the lung and/or liver. There is a need for improved access to metastatic site resection for individual patients who are uninsured or who have Medicaid insurance, and for all patients who seek care at hospitals treating a large proportion of uninsured or Medicaid patients. Remedies for individual patients could include improved access to private insurance through employment or individual plans or improved reimbursement from Medicaid for this procedure. Strategies for patients at low-performing hospitals include selective referral to centers that perform metastectomy more frequently when appropriate.

Keywords

Insurance; colorectal neoplasms; neoplasm metastasis; survival; utilization; clinical oncology; colorectal surgery; liver; lung

Introduction

In recent years, substantial advances have been made in systemic therapy for patients with metastatic colorectal cancers.¹ Despite this, surgical resection of metastatic sites of disease remains the only potentially curative therapy.^{2–5} Five-year survival rates of 40% and as high as 54% in selected patients have been reported with pulmonary and liver metastasectomy.^{6–8} Although improved survival has been demonstrated with metastatic site resection, uptake of aggressive surgical approaches remains low among certain patients.⁹

To this end, it is unknown whether financial determinants of health, such as insurance status, play a role in this treatment gap. Costly aspects of care such as readmission following colorectal surgery have been shown to be high in patients with non-private insurance.¹⁰ Additionally, there is evidence that privately insured patients have a higher likelihood of receiving more costly therapies.¹¹ Perhaps hospitals that treat more uninsured and underinsured patients are not incentivized to provide access to metastatic site resection for these patients, because of the potential increased costs and lack of reimbursement for this care. If better insurance predicts increased likelihood of metastasectomy, this finding would suggest that efforts aimed at improving long-term outcomes should be focused on increasing access to curative surgery for uninsured and underinsured patients. Conversely, if there is no evidence of an independent effect of insurance status, then efforts to improve utilization of resection should be aimed at other aspects of care, such as dissemination of guidelines regarding the appropriateness of resection to providers who care for these patients and increased use of multidisciplinary tumor boards across hospitals. It is unclear whether insurance status plays a role in the variation in use of metastatic site resection across hospitals in patients with colorectal cancers.

Given this, we sought to evaluate the effect of insurance status on utilization of lung and/or liver metastasectomy in patients with advanced colorectal cancers. Our study includes data from hospitals across the United States, in an attempt to understand trends in resection across hospitals, based on patient insurance status and hospital payer-mix. We hypothesized that hospitals treating a large proportion of uninsured and Medicaid patients would be

significantly less likely than hospitals treating more patients with private insurance or Medicare, to frequently perform metastatic site resection, independent of other patient- and hospital-related factors.

Methods

Data Source and Study Population

The National Cancer Data Base (NCDB) Participant User File (PUF) is a joint project of the American College of Surgeons Commission on Cancer (CoC) and the American Cancer Society. Data represent nearly 70% of all newly diagnosed patients with cancer from greater than 1,500 CoC-accredited hospitals in the United States. Data are collected using standardized coding schemata and have been described previously.^{12, 13} All patients 18 years were identified with a clinical diagnosis of Stage IV cancer of the colon, rectosigmoid, or rectum diagnosed from 2010 – 2013 using the *International Classification of Diseases for Oncology 3rd Edition* site codes (C180; C182–189; C199; C209; C260) and histology codes (8000–1; 8010; 8012; 8020–1; 8041; 8140–5; 8210–1; 8220–1; 8260–3; 8480–1; 8490; 8510; 8560). We included only patients recorded in the NCDB to have metastatic lung and/or liver involvement.

Exclusions

Our cohort initially included 58,137 patients. We then excluded patients younger than 65 with Medicare (likely covered due to disability or chronic renal failure, n=2,745), patients with a record of more than one primary malignancy (n=9,368), those marked as having unknown or other government insurance status (n=1,334), those for whom distant site resection status was not known (n=1,523), and those that, including the patients that remained, would be from very low volume hospitals (<10 remaining patients per hospital, n=867). Following these exclusions, we were left with a cohort of 42,300 patients for further analysis.

Measures

We chose to group Medicaid patients with uninsured patients for three main reasons. First, these patients have been shown to have similar survival outcomes, which are significantly worse than those with private insurance and Medicare for a variety of cancers, even independent of socioeconomic factors.¹⁴ Second, there is evidence that privately insured patients have a higher likelihood of receiving more costly therapies like complex surgery.¹¹ Third, many patients who present for treatment without insurance are then subsequently enrolled in state-based Medicaid programs during their hospitalization. Because of this, it is difficult to separate out uninsured and Medicaid patients, and these groups appear to run together with regard to access and outcomes, reflecting different coverage and access to care than Medicare or private insurance patients.

First, we identified clinical and demographic characteristics of our patient population and hospital-level factors. These included age, sex, race, and comorbidities as defined by the Charlson-Deyo comorbidity index.¹⁵ Hospital factors included geographic region of facility as well as facility type (Community vs. Academic/Research vs. Other).

We compared characteristics between patients who were uninsured or had Medicaid coverage and those with private insurance or Medicare using χ^2 analysis for categorical variables and Student's *t* test for continuous variables. Unadjusted and adjusted rates of metastasectomy were compared using multivariable logistic regression. We created five regression models to better understand the distribution of variance in use of metastasectomy. First a bivariate logistic regression model was created with metastasectomy as the dependent variable and insurance status as the lone independent variable. Then, a model was created including patient and tumor characteristics (age, tumor site, comorbidities, race, and ethnicity). To account for hospital-level clustering, robust standard errors for clustering by hospital were used.

Next, to determine the effect of uninsured patients and Medicaid patients receiving care in hospitals different from those where patients with private insurance or Medicare may receive care, we used two independent methods: mixed effects hierarchical modeling and stratification.

First, we determined the effect of individual hospitals where patients received care using mixed-effects hierarchical modeling. These models allow for adjustment for patient and hospital-level factors as fixed effects, while also examining clusters (hospital in our case) for their contribution to overall variance in metastasectomy as random effects. Using this approach, we can calculate intra-class correlation, to estimate the differences in the rates of metastasectomy that are owing to variations in where patients received treatment. This technique begins with the creation of an empty model, in which the proportion of total variance in use of metastasectomy by hospital without adjustment for patient factors can be determined. We then created two additional models: one adjusting for patient-level factors, which were the same as those used in the initial multivariable regression analysis described above, and one adjusting for hospital- and patient-level factors. If all significance were to attenuate in this model, then all differences based on insurance status would be due to the adjusted-for patient factors and hospital factors.

Next, we stratified hospitals into quintiles, based on the proportion of uninsured and Medicaid patients treated. Hospitals in the first quintile treated the lowest proportion of uninsured and Medicaid patients on average. Conversely, hospitals in the fifth quintile treated the highest proportion of uninsured and Medicaid patients. Then we compared the risk-adjusted probability of metastasectomy among patients who were uninsured or had Medicaid and those with private insurance or Medicare within these five strata.

All statistical analyses were conducted using Stata version 13 (StataCorp LP, College Station, TX). All tests were 2-sided with significance set at a *P* value of less than 0.05.

Results

Out of 42,300 patients studied, 5,190 (12.3%) underwent metastatic site resection. Of patients with private insurance or Medicare, 4,442 (12.8%) underwent metastatic site resection. Of those without insurance or with Medicaid coverage, 748 (9.7%) underwent

resection. Rate of distant site resection varied dramatically across hospitals from 10.1% to 58.9%, with a mean of 12.3%.

Basic characteristics of the study cohort are displayed in Table 1. Due in large part to the population of Medicare patients over age 65, mean age was statistically significantly higher in the group of patients with private insurance/Medicare (66.5 vs. 54.7 years; $P<0.001$). The proportion of male patients was higher in the uninsured/Medicaid group (58.8% vs. 53.1%; $P<0.001$). Black patients (25.9% vs. 13.4%; $P<0.001$) and patients with Spanish/Hispanic ethnicity (13.4% vs. 4.8%; $P<0.001$) were more common in the uninsured/Medicaid group. In the uninsured/Medicaid group, fewer patients had primary tumors in the colon (66.0% vs. 72.8%; $P<0.001$) and more patients had primary tumors in the rectum (23.3% vs. 18.3%; $P<0.001$) and rectosigmoid (10.7% vs. 8.9%; $P<0.001$). Patients had less comorbidities in the uninsured/Medicaid group with Charlson-Deyo score of zero in 80.8% vs. 74.3% ($P<0.001$). A higher proportion of patients from South/Southeastern United States (19.1% vs. 15.2%; $P<0.001$) and a lower proportion of patients from the Great Lakes/Midwest (19.7% vs. 25.0%; $P<0.001$) were in the uninsured/Medicaid group. There was a statistically significantly higher proportion of patients treated at academic/research hospitals in the uninsured/Medicaid group compared with the private insurance/Medicare group (38.9% vs. 29.9%; $P<0.001$). Patients were more likely to undergo liver rather than lung metastasectomy. Additionally, more patients with poor insurance had both lung and liver metastases together than those with private insurance or Medicare. However, despite these differences, for patients with liver metastases only, rates of resection were still statistically significantly lower for uninsured and Medicaid patients (11.9% vs. 15.4%; $P<0.001$).

Results of our regression analyses are shown in Table 2. Uninsured/Medicaid patients were 27.0% less likely to undergo metastasectomy (odds ratio [OR], 0.73; 95% confidence interval [CI], 0.66 – 0.82). After controlling for patient factors, uninsured/Medicaid patients were 43% less likely to undergo metastasectomy (OR, 0.57; 95% CI, 0.51 – 0.64).

To incorporate hospital-level effects, we built hierarchical regression models. Our empty model demonstrated that an estimated 18.0% (95% CI 15.9% – 20.2%) of variation in use of metastasectomy was due to the hospital at which a patient seeks treatment. Subsequently adjusting for patient- and hospital-level fixed effects, we found that patients who were uninsured/Medicaid covered were 38% less likely to undergo metastasectomy (OR, 0.62; 95% CI, 0.56 – 0.66).

Next, we stratified hospitals into quintiles, based on the proportion of uninsured and Medicaid patients treated. Variation in payer-mix across hospital quintiles is shown in Figure 1. There was over 8-fold variation, with 4.6% of patients in the first quintile uninsured or with Medicaid coverage and 39.3% of patients in the fifth quintile uninsured or with Medicaid coverage.

Following this stratification into hospital quintiles, we performed multivariable logistic regression with metastatic site resection as our dependent variable. We used our regression model to evaluate the probability of resection for patients treated within each hospital quintile by insurance status. This is portrayed in Figure 2. After adjusting for hospital payer

mix, patients who were uninsured or with Medicaid insurance had 42% lower odds of distant site resection overall (OR, 0.58, 95% CI: 0.52 – 0.65, $P<0.001$). In all quintiles, patients who were uninsured or covered by Medicaid, were statistically significantly less likely to undergo distant site resection. However, the effects of being treated at a hospital with higher or lower proportion of patients who are uninsured or covered by Medicaid, appear to extend beyond individual patients. For example, if a patient who is uninsured or covered by Medicaid seeks treatment at a hospital in the lowest quintile, thus treating the lowest proportion of uninsured or Medicaid patients, this patient's probability of undergoing distant site resection is higher than if this same patient were to seek care at a hospital in the highest quintile of proportion of uninsured or Medicaid patients (9.3% probability vs. 7.1%, $P<0.05$). Conversely, a patient with private insurance or Medicare seeking care at a hospital with a high proportion of patients who are uninsured or insured by Medicaid is less likely to undergo distant site resection than if that same patient were to seek care at a hospital treating a low proportion of patients who are uninsured or covered by Medicaid (11.5% probability vs. 14.8%, $P<0.05$). Thus, the effects of hospital payer-mix on probability of resection appear to extend beyond individual patient insurance coverage.

Due to the finding that patients who are uninsured or covered by Medicaid are more likely to be treated at an Academic/Research institution, and that Academic/Research institutions are more likely to perform metastasectomy, we performed a sensitivity analysis within quintiles, stratifying by hospital type. We found these differences to be amplified in community and comprehensive community cancer centers ($P<0.05$ for odds of resection in quintiles 3–5 vs. 1) and attenuated in Academic/Research hospitals (P not significant for all quintiles vs. 1), which helps to explain this finding.

Finally, given the fact that complications following primary site resection could potentially affect likelihood of metastasectomy, we performed a sensitivity analysis, which included primary site resection as a model covariate. In this analysis, the effect of insurance status remained statistically significant, but was attenuated. The adjusted odds ratio for metastasectomy in those patients with no insurance or Medicaid coverage increased from 0.57 (95% CI: 0.51 – 0.64) to OR 0.68 (95% CI: 0.61 – 0.76).

Discussion

We have shown that 1) there is substantial variation in payer mix across hospitals treating patients with colorectal cancers that are metastatic to the lung and/or liver; 2) if an individual patient is uninsured or has Medicaid insurance, odds of undergoing metastatic site resection are substantially lower than for similar patients with private insurance or Medicare; 3) beyond individual patient insurance status, seeking care at a hospital that treats a large proportion of uninsured and Medicaid patients is associated with decreased probability of undergoing metastatic site resection. These findings suggest that uptake of metastatic site resection for colorectal cancers is limited by access to surgical resection, both between and within hospitals in which a patient seeks care.

We found 8-fold variation in use of metastatic site resection across quintiles of treating hospitals. Additionally, we found significant patient-level variation in use of metastatic site

resection, of which only approximately 16% could be explained by patient health status and tumor characteristics. Notably, a substantial portion of our observed variance could not be explained by differences in the hospital where patients with different insurance coverage received care alone. After adjusting for hospital payer mix, patients who are uninsured or with Medicaid insurance have 42% lower odds of distant site resection overall.

There are several possible explanations for this observed difference. First, patients with poor insurance may have been less likely to choose resection as a treatment, due to personal financial burden. Previous work has shown that surgical resection, perhaps the most expensive single part of treatment for colorectal cancers, can have severe downstream financial effects for individual patients. Cancer patients may substantially alter what care they choose to receive in order to decrease out-of-pocket expenses.¹⁶ In patients with colorectal cancer, patients with higher personal financial burden have been found to have higher rates of complications from surgery, which subsequently leads to even more financial stress for these patients.¹⁷ A significant personal financial burden was almost certainly present for many of the patients in our study who were without insurance or covered by Medicaid. Thus, these things could potentially contribute to the decrease in use of metastatic site resection in this population. Remedies for this would include improving access to employer-based insurance and individual private insurance plans or increasing the proportion of procedure costs that are reimbursed from Medicaid. Second, it is possible that some referring providers, such as primary care physicians, are referring patients less for surgical intervention. Provider education regarding appropriate candidates for distant site resection and the disparity in referral should, in part, help to remedy this.

Our study had several limitations. We chose not to stratify patients with lung and liver metastases separately from patients with either lung or liver metastases only. However, it is unclear how overall survival is affected in patients who had resection of liver and lung metastases compared to those undergoing removal of isolated lung or liver metastases.^{3, 18} We also did not have access to data granular enough to describe the exact location of primary tumors, and this has previously been shown to have an effect on rates and patterns of distant metastases and subsequent survival.^{19, 20} However, we have no reason to suspect that the location of a primary tumor would be different based on insurance status, so this should not have substantially affected our result. Additionally, we did not address episodes of multiple metastatic site resections and the subsequent risks of recurrence and benefit of further resection, which has been shown to be controversial.^{21–23} Also, tumor characteristics, such as the presence of poorly differentiated tumor clusters within a primary lesion, may predict recurrence rates and the value of metastasectomy.²⁴ We did not stratify patients based on whether their metastases occurred metachronously or synchronously, and this has been shown to affect overall survival regardless of treatment.^{23, 25} However, again, we have no reason to believe that this would be different in a non-random fashion based on insurance status. Finally, patients with poor insurance status could present with more severe disease characteristics or comorbidities, and thus have tumors that are less amenable to resection. Related to this, there could also be referral bias, where more resectable patients are referred to hospitals performing more resections, while others stay put, which would make our results regarding hospital variation appear amplified. We attempted to adjust for comorbidities in our model and still found the disparity in resection to be statistically

significant. While the granularity of this NCDB data is limited, the size of the patient cohort should help to attenuate differences based on resectability alone. Moreover, referral bias would not explain observed within-hospital differences. Additionally, patients with poor insurance status may present with less resectable disease, perhaps due to limited access to surveillance and primary medical care. Thus, we don't truly know the denominator of eligible patients in this cohort. This may differ by insurance status. But, if that is the case, it is because uninsured patients are presenting at an unresectable stage more often, and the message of insurance remains relevant, but with a different causal pathway. Additionally, there may also be some situations in which patients are advised to undergo neoadjuvant therapy or other costly treatments, but they are unable to do so because of lack of coverage. Again, the insurance status remains relevant, but reasons for this relevance may differ. These results are also limited in external generalizability to non-CoC hospitals, as they are not captured in the NCDB data. However, there is no reason to suggest that these differences in access would be any less in these hospitals.

Patient factors may help to explain some of the observed within-hospital differences in probability of resection based on individual insurance status, but they do not fully explain the disparity that is attributable to hospital payer mix that we identified. Even patients with private insurance and Medicare appear to be affected to some extent, when they seek care at hospitals with high rates of uninsured or Medicaid patients. This finding is likely to be related to access to appropriate surgical care, which may be lacking at these hospitals due to financial reasons. Readmission alone after colorectal surgery is associated with \$300 million in healthcare costs annually, and there is incentive for hospitals to perform surgery on patients from whom they will likely receive high reimbursement.²⁶ Previous work has shown that economic stresses cause hospitals to struggle to keep specialty services financially viable.²⁷ It is likely that the financial levers are not in place to support complex surgical care in some hospital settings. Moreover, it appears that reductions in funding to safety net hospitals could also make this limited access to care even more pronounced.²⁸ This is perhaps in part why we found a lower probability of resection for all patients at hospitals treating a higher proportion of uninsured and Medicaid patients. However, as we have shown, this may only explain a small portion of observed variation in use of these procedures.

Conclusion

Differences in individual patient insurance status and hospital payer mix are associated with differences in rates of metastatic site resection in patients with colorectal cancer that is metastatic to the lung and/or liver. This finding implies inequitable care that exists within many individual hospitals, for patients who are uninsured or covered by Medicaid, that remains largely unexplained. Focus groups and survey-based methodology should perhaps be employed to help understand why significant differences in use of metastasectomy exist within certain hospitals. This will be critical in helping to determine if these differences are due to patient preference or some aspect of implicit bias based on insurance status. Regardless, there is a need for improved access to metastatic site resection for patients who are uninsured or who have Medicaid insurance, and for all patients who seek care at hospitals treating a large proportion of uninsured or Medicaid patients. Investment in access

to surgical resection within hospitals, including the ability to refer patients to surgeons appropriately, could help to improve care for poor or disadvantaged patients. This appears to be especially true in community hospitals. As the variation in odds of resection is attenuated in academic/research hospitals, perhaps one solution is to steer vulnerable patients toward care in these settings. But, financial incentives must be in place to support this.

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Synopsis

Utilization of metastatic site resection was compared across strata of hospital payer mix for patients with colorectal cancer and lung or liver metastases. Controlling for hospital and patient factors, individual patient insurance coverage and hospital payer mix were both statistically significantly associated with probability of metastatic site resection.

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Figure 1.
Variation in payer mix across hospital quintiles.

Figure 2. Adjusted mean probability of metastatic site resection by hospital quintile, controlling for age, disease site, race, ethnicity, geographic location and hospital type.

Table 1

Characteristics of patient cohort by insurance status.

	Total	Private/ Medicare	Uninsured/ Medicaid	P
Mean Age (SD)	64.3 (14.1)	66.5 (13.9)	54.7 (10.4)	<0.001
Sex				<0.001
Male	22,894 (54.1)	18,374 (53.1)	4,520 (58.8)	
Female	19,406 (45.9)	16,244 (46.9)	3,162 (41.2)	
Race				<0.001
White	33,446 (79.1)	28,312 (81.8)	5,134 (66.8)	
Black	6,642 (15.7)	4,654 (13.4)	1,988 (25.9)	
Other	1,851 (4.4)	1,356 (3.9)	495 (6.4)	
Unknown	361 (0.9)	296 (0.9)	65 (0.9)	
Hispanic Ethnicity	2,684 (6.4)	1,654 (4.8)	1,030 (13.4)	<0.001
Disease site				<0.001
Colon	30,266 (71.6)	25,199 (72.8)	5,067 (66.0)	
Rectosigmoid	3,911 (9.3)	3,089 (8.9)	822 (10.7)	
Rectum	8,123 (19.2)	6,330 (18.3)	1,793 (23.3)	
Charlson-Deyo index				<0.001
0	31,918 (75.5)	25,708 (74.3)	6,210 (80.8)	
1	7,625 (18.0)	6,526 (18.9)	1,099 (14.3)	
2	2,757 (6.5)	2,384 (6.9)	373 (4.9)	
Location				<0.001
Atlantic	15,347 (36.3)	12,783 (36.9)	2,564 (33.4)	
Northeast	1,931 (4.6)	1,655 (4.8)	276 (3.6)	
Great Lakes/Midwest	10,164 (24.0)	8,652 (25.0)	1,512 (19.7)	
Mountain/West/Pacific	6,445 (15.2)	5,158 (14.9)	1,287 (16.8)	
South/Southeast	6,731 (15.9)	5,266 (15.2)	1,465 (19.1)	
Unknown	1,682 (4.0)	1,104 (3.2)	578 (7.5)	
Facility Type				<0.001
Community	5,147 (12.2)	823 (10.7)	4,324 (12.5)	
Comprehensive	19,369 (45.8)	16,573 (47.9)	2,796 (36.4)	
Academic/Research	13,332 (31.5)	10,343 (29.9)	2,989 (38.9)	
Integrated Network	2,727 (6.5)	2,241 (6.5)	486 (6.3)	
Other Program	43 (0.1)	33 (0.1)	10 (0.1)	
Unknown	1,682 (4.0)	1,104 (3.2)	578 (7.5)	
Neoadjuvant therapy	3,841 (9.1)	3,236 (9.4)	605 (7.9)	<0.001
Primary Site Resection	20,268 (47.9)	17,002 (49.1)	3,266 (42.5)	<0.001
Metastatic Site Resection	5,190 (12.3)	4,442 (12.8)	748 (9.7)	<0.001
Metastatic Site				<0.001
Liver only	29,966 (70.8)	24,830 (71.7)	5,136 (66.9)	
Lung only	3,409 (8.1)	2,808 (8.1)	601 (7.8)	
Both	8,925 (21.1)	6,980 (20.2)	1,945 (25.3)	

	Total	Private/ Medicare	Uninsured/ Medicaid	<i>P</i>
Resection by Site				
Liver only	4,437 (14.8)	3,826 (15.4)	611 (11.9)	<0.001
Lung only	263 (7.7)	222 (7.9)	41 (6.8)	0.366
Both	490 (5.5)	394 (5.6)	96 (4.9)	0.225

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Table 2

Results of regression analyses.

Model	aOR (95% CI) Metastectomy Uninsured/Medicaid vs. Private insurance/Medicare	P-value	Hospital Residual ICC (95% CI)
<i>Single level models</i>			
Unadjusted	0.73 (0.66 – 0.82)	<0.001	–
Adjusted for patient-level * variables	0.57 (0.51 – 0.64)	<0.001	–
<i>Multi-level models</i>			
Empty model	–	–	18.0% (15.9 – 20.2)
Patient-level * fixed effects	0.64 (0.58 – 0.70)	<0.001	17.4% (15.3 – 19.6)
Patient * +hospital-level ** fixed effects	0.62 (0.56 – 0.68)	<0.001	15.6% (13.6 – 17.9)

* Patient-level variables include age, race, ethnicity, comorbidities, and tumor site;

** hospital-level variables include facility type and geographic region; aOR=adjusted odds ratio; CI=confidence interval; ICC=intra-class correlation (describes proportion of residual variance that is explained by hospital providing care)