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Improvement and persistent disparities in completion lymph node dissection: Lessons from the National Cancer Database

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Abstract

Background: Completion lymph node dissection (CLND) is recommended for melanoma patients with positive sentinel lymph node biopsies (SLNB); however, 50% do not undergo CLND. We sought to determine CLND trends over time, and factors contributing to variability.

Methods: The NCDB was queried for patients undergoing wide local excision (WLE), with or without SLNB and CLND. Cohorts were created based on demographic/socioeconomic variables and era of treatment (Era 1: 2003–07, Era 2: 2008–12). Univariate and multivariate analyses identified factors associated with performance of or trends in CLND.

Results: 122 849 underwent WLE with SLNB. Of 24 267 (19.8%) with +SLNB, 13 594 (56.0%) continued to CLND. In multivariate analyses, Medicaid (OR 0.78; $P = 0.04$) or Medicare (OR 0.79; $P < 0.01$) in Era 1 and patients without insurance in Era 2 (OR 0.78; $P = 0.01$) underwent less CLND. In both eras, Blacks (OR 0.45; $P < 0.01$, OR 0.59; $P < 0.01$), head/neck lesions (OR 0.72; $P < 0.01$, OR 0.66; $P < 0.01$) and lower extremity lesions (OR 0.75; $P < 0.01$, OR 0.72; $P < 0.01$) underwent less CLND. However, Blacks experienced greatest increase in CLND usage (+9.2%).

Conclusions: CLND usage continues to be low and racial/socioeconomic disparities persist. Until the results of MSLT-2 become available, continued focus on understanding poor adherence to, and improving rates of CLND is necessary.

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CONFLICT OF INTEREST

The authors have no disclosures or conflicts of interests to report.

NCDB DISCLOSURE

The National Cancer Data Base is a joint project of the Commission of Cancer (CoC) of the American College of Surgeons and the American Cancer Society. The CoC's NCDB and the hospitals participating in the CoC NCDB are the source of the de-identified data used herein; they have not verified and are not responsible for the statistical validity of the data analysis or the conclusions derived by the authors.

Keywords

completion lymph node dissection; disparities; melanoma; NCDB; sentinel lymph node biopsy

1 INTRODUCTION

In July 2012, the American Society of Clinical Oncology (ASCO) and the Society for Surgical Oncology (SSO) issued their first evidence-based clinical practice guideline on the use of sentinel lymph node biopsy (SLNB) and completion lymph node dissection (CLND) for patients with melanoma.¹ Based on these professional recommendations, patients with intermediate-thickness melanomas (Breslow thickness, 1–4 mm) of any anatomic site and a positive SLN should undergo CLND.¹ This current algorithm is based on data that has shown sentinel lymph node to be highly prognostic and an accurate staging test, with cited false negative rates for SLNB as low as 0–2%.¹ CLND has been shown to achieve optimal regional disease control.^{2,3} Patients undergoing CLND have a 10% nodal recurrence rate as opposed to patients with positive SLNB who did not undergo CLND that had a 15% incidence of nodal recurrence at the original site of dissection.^{4,5}

Despite these recognized benefits, the usage of CLND has hovered historically at 50%.⁶ Some have questioned the need to perform CLND for patients with a positive SLN, citing lack of evidence of disease-specific survival benefit and the risk of increased morbidity and cost incurred by the patient.^{1,5,7} About 80% of patients with a positive SLNB will have no further detection of additional nodal disease by CLND, and these patients may receive no oncologic benefit from a procedure associated with high complication rates.⁸ Attempts have been made to risk-stratify patients with positive SLNB based on primary tumor and sentinel node(s) tumor burden characteristics, but reliable determination of non-sentinel node disease is still elusive.^{9,10}

To address this incomplete understanding of CLND utility, the Multicenter Selective Lymphadenectomy Trial II (MSLT-II) study was designed to determine whether at-risk melanoma patients derive survival benefit from CLND after a positive SLNB. This data will be critical in helping patients and clinicians weigh the benefits and risk of CLND. Until MSLT-II results become available, CLND should be considered standard of care and the decision to forego CLND should be based on factors such as patient comorbidities, preference and risk tolerance.^{3,11,12}

Though CLND was considered the standard of care prior to the ASCO/SSO guideline, a 50% rate of CLND following a positive SLNB points to nonadherence that was present before 2012. Due to the increasing incidence of melanoma and continued widespread lack of access and non-adherence to recommended oncologic care, the patient characteristics associated with undergoing and forgoing CLND after a positive SLNB deserve further study.^{6,13} This study aims to determine if certain patient factors were significant in this determination. We queried the American College of Surgeons National Cancer Data Base (NCDB) to determine trends in CLND over time, and whether certain patient-specific factors impact the likelihood of CLND.

2 METHODS

2.1 Data acquisition and study population

The NCDB is a program of the American College of Surgeons, the Commission on Cancer (CoC), and the American Cancer Society, and contains information on over 21 million patients.¹⁴ Access to the melanoma participant user file (PUF) was secured through an application process, allowing delivery of de-identified patient-level data that does not identify hospitals, health care providers or patients.¹⁵ Following appropriate Institutional Review Board approval from the University of Cincinnati, we identified all patients with invasive melanoma, of all stages and treatment type.

The melanoma PUF was queried for patients with pathologic stage I-III melanoma undergoing wide local excision (WLE), with or without SLNB, with or without CLND using PUF variables “TNM_PATH_STA-GE_GROUP,” “REGIONAL_NODES_EXAMINED,” “REGIONAL_NO-DES_POSITIVE,” “DX_DEFSURG_STARTED_DAYS” respectively.¹⁶ Patients with clinically positive nodes were excluded from this study. Patients diagnosed with melanoma from 2003 to 2012 were identified and then divided into two study eras: 2003–07 (Era 1) and 2008–12 (Era 2). 2007 was chosen as the cutoff of Era 1 as the 5-year melanoma-specific survival and disease-free survival data from MSLT-I had become available in 2006–07.¹⁷ This data may have caused changes in the use of SLNB and subsequently CLND between 2008 and 2012. Subsets were then created based on demographic, socioeconomic and other patient factors as described below. Currently, the variable “Scope of the Regional Lymph Node surgery 2012” indicates whether nodes are taken from a biopsy, sentinel node, node dissection or combinations of these. However this variable was incorrect before 2012, necessitating the method described previously to find our cohort of patients.

2.2 Statistical analysis

Univariate and multivariate analyses were performed to determine which patient-specific factors were associated with CLND utilization after a positive SLNB. Factors examined in the models included age (1–39, 40–59, 60–90 years), sex, race (white, Black, Asian, other), median household income, education level (percentage of high school graduates), insurance status (private, uninsured, Medicaid, Medicare, other), pathologic group stage (stage I-III), lesion location (head/neck, lower extremity, trunk, upper extremity, other/NOS), Breslow thickness (0.01–0.74 mm, 0.75–0.99, 1.00–4.00, 4.01–9.80, >9.80), and facility type (academic, community cancer program, comprehensive community cancer program, other). Odds ratios with 95% confidence intervals were generated, with a level of statistical significance set to $P < 0.05$.

Nominal categorical variables were tested for significance using Pearson’s chi-square test. Ordinal categorical variables were similarly tested using the Mantel-Haenszel chi-squared test. Differences between CLND and SLNB groups were analyzed using the log-rank test. Univariate and multivariate analysis was performed using logistic regression to identify predictors of CLND and SLNB. Random intercept hierarchical models were used in all analyses to account for the clustering effects of the center where the patients underwent their

surgery. All statistical analyses were performed using JMP Pro 11 and SAS 9.4 (SAS Institute, Cary, NC).

3 RESULTS

3.1 Predictors of completion lymph node dissection

Demographics and treatment classifications of the overall study population from 2003 to 2012 are shown in Table 1. In total, 122 849 patients were identified who underwent WLE with SLNB. 19.8% patients had a positive SLNB with 56.0% continuing to CLND overall; Table 1 shows these data separated by study era. Notably, in Era 1, 19.2% of 56 129 patients had a positive SLNB with 55.0% continuing to CLND. In Era 2, 20.3% of 66 720 were positive with 56.8% continuing to CLND. Therefore, the difference in CLND rates between the two eras was +1.8%. Rates of change in CLND usage between eras for patient subsets (Table 2) were also compared using +1.8% as the standard increase in CLND utilization over time.

Univariate and multivariate analyses (Table 3, Figs. 1 and 2) were then performed for both eras to identify patient characteristics associated with a decreased likelihood of undergoing CLND. On univariate analyses, patients 60–90 years old were significantly less likely to undergo CLND when compared with patients 39 years old or younger in both Era 1 and Era 2. Similarly, Black patients underwent CLND less frequently than white patients in both Era 1 and Era 2. Socioeconomic characteristics associated with lower rates of CLND were median income of <\$30 000 and \$30 000–\$34 999, Medicare insurance and patients from areas with >29% people who did not graduate high school. Of tumor-specific factors, patients with head/neck or lower extremity lesions were associated with less likelihood of CLND when compared to patients with truncal lesions.

Subsequently, multivariate analysis demonstrated that a patient's race, insurance status and lesion location were found to be associated with significantly decreased odds of undergoing CLND. Black patients (when compared to white patients) and patients with either head/neck or lower extremity lesions (when compared to trunk lesions) were found, in both eras, to be less likely to undergo CLND. Patients with either Medicaid or Medicare were found to be significantly associated with a lower rate of CLND utilization in Era 1. In Era 2, uninsured patients were less likely to undergo CLND

3.2 Increasing and decreasing utilization of CLND

We then investigated trends in CLND utilization throughout our study period to elucidate any patient-specific features contributing to CLND rates over time. First, we identified factors associated with a relative decrease in use of CLND throughout the study periods (defined as patients with persistently low CLND utilization, characterized by comparatively lower CLND rates by era and <1.8% growth in usage between eras). The first group—patients with persistently low CLND rates that did not increase at the same rates as the overall cohort—consisted of patients with lower median income (<\$30 000 and \$30,000–\$34 999), no insurance and head/neck lesions (Tables 1 and 2).

Conversely, a second subset analysis sought to identify predictors of increased CLND utilization (defined as >1.8% growth in CLND usage between the two eras), though at lower rates than the average overall patient population. This group consisted of 60–90-year-old patients, males, Black patients, those of lower education, Medicaid/Medicare, and lower extremity lesions. Though Black patients had the greatest growth in CLND utilization, they still demonstrated CLND rates far lower than both era average CLND rates.

Finally, we mention some predictors of increased CLND utilization (>1.8% growth) that received CLND at or above the average overall CLND rate (55.0% in Era 1 and 56.8% in Era 2). This group consisted of 40–59 year old patients, females, Asian patients, patients of the highest income bracket (>\$46 000), those of higher education, upper extremity and trunk lesions. This group were not further analyzed for significance as they did not represent a disparity in receiving CLND.

4 DISCUSSION

Completion lymph node dissection is recommended as standard of care for all melanoma patients with positive sentinel nodes per the American Society of Clinical Oncology and the Society of Surgical Oncology guidelines. Despite these recommendations, NCDB analyses from a decade ago have suggested that only half of patients with a positive SLNB underwent CLND.⁶ There is some uncertainty regarding the benefit of CLND, highlighted by the MSLT-II clinical trial assessing this exact question; this study has completed accrual with final results pending.¹¹ In this study, we have shown that CLND continues to be underutilized in melanoma patients with positive sentinel lymph nodes, with only a marginal increase over time. Further, we demonstrated that significant disparities exist in which patient population undergoes CLND.

In this study, racial and socioeconomic differences in CLND rates were most dramatic, confirming previous reports that poorer, minority populations continue to be relative underutilizers of CLND.¹⁸ While all other patient cohorts in our study had CLND rates of at least 55%, Black patients underwent CLND only 41% of the time from 2008 to 12. One reason for this may be disease presentation as it is well-documented that Black patients present with higher severity of disease compared to white patients.^{19–21} Further complicating the treatment of melanoma in Black patients, previous research has shown that among patients treated with surgery, 10-year melanoma-specific survival was lower in Blacks (73%) than in whites (88%).²² The differences in disease presentation and course of treatment in Black patients contribute to disparities in survival, and special attention to melanoma in minority populations may lead to early detection and ultimately save lives.²⁰

Patient insurance status is another important factor in CLND. Previous data suggest that approximately 1 in 5 Medicare beneficiaries experience some sort of delay in surgery for melanoma.²³ In our study, the Medicare cohort was found to have significantly decreased odds of CLND in the 2003–07 era and continued to receive CLND at a decreased but statistically insignificant rate at the end of our study. As more citizens become eligible for government-issued Medicare as the incidence of melanoma increases, this patient population is at particular risk of non-adherence to recommended care.²⁴ Additionally, patients with no

insurance demonstrated the only decrease in CLND rates over the entire study period compared to all insurance-specific cohorts. This trend clearly indicates a growing disparity in patients without insurance, which needs to be addressed at the policy level.

This study is not able to explain the disparities observed in melanoma treatment, but does identify patient characteristics associated with CLND after a positive SLNB. To better understand underlying drivers of the disparities and trends we have described, focus groups and/or patient interviews would be useful qualitative measures to strengthen our findings. Likely, prospective engagement of patients at-risk of not undergoing CLND will be required for impactful interventions to increase CLND utilization.

Currently, data suggest that there is no significant benefit to disease-specific survival from CLND,^{1,5,7,8} though reduction in locoregional recurrence is clear.^{3,4} The results of the MSLT-II trial may demonstrate that CLND has no associated survival benefit, and just as in breast cancer, may be discouraged as a routine recommendation for patients with positive sentinel lymph nodes.²⁵ Such a scenario would highlight the ongoing need to critically evaluate our surgical practices in an evidence-based fashion; the significant number of patients who will have undergone CLND unnecessarily will be of important historical significance. However, if a survival benefit of CLND is shown, our data should serve as a contemporary reference on which to guide future access and population health improvement initiatives. The utilization of CLND need to increase uniformly, and the disparities identified in this study must be addressed to minimize socioeconomic, racial and disease-specific disparities.

Some limitations merit discussion. CLND is not performed for clinically-positive nodes and these patients were assumed to not have received SLNB or CLND. The retrospective design and use of registry data with its attendant selection bias does not allow for identification of causality. Furthermore, the overall NCDB case capture has been shown to be 67.4%, with coverage varying widely by site; melanoma capture by the NCDB is the lowest at 50.6%.²⁶ Confounding variables surrounding a patient's socioeconomic status such as race, education, insurance, or facility type may exist. For example, Black patients often get acral lentiginous melanoma which may be more aggressive and advanced at diagnosis, thereby impacting the decision for CLND.²⁷ While CLND has been considered the "standard of care" since the advent of sentinel lymph node biopsy, the recommendation for CLND after positive SLNB was updated in 2012 by ASCO and SSO,¹ at the conclusion of our study period. Thus a link between professional society recommendation and our findings cannot be made, though CLND was still considered an appropriate treatment course for a positive node before 2012.²⁸ Lastly, melanoma data captured by the NCDB do not include reasons why a patient did or did not receive CLND; these data will be necessary for addressing the disparities identified in this study.

In conclusion, we have shown that CLND following positive SLNB in melanoma continues to be performed at lower than recommended rates. Almost 50% of eligible patients are not undergoing CLND, and despite a marginal 1.8% improvement in CLND utilization over the last decade, significant disparities exist in CLND use. If the MSLT-II trial demonstrates a significant survival benefit to CLND, these disparities require individual and policy-level

attention from the melanoma community, as a means of substantially improving the outcomes for patients afflicted with this challenging disease.

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SYNOPSIS

Previous data suggest that only roughly 50% of melanoma patients with a positive sentinel lymph node receive recommended completion dissection (CLND). We sought to identify any temporal changes and predictors of CLND, and any increasing or decreasing disparities in CLND.

FIGURE 1.

Forest plot of patient predictors of CLND from 2003 to 07. Retrospective data from NCDB was utilized to query for patients with positive SLNB and receipt of CLND. Multivariate analysis conducted on patient characteristics to find associated odds ratios and confidence intervals with significance. Blacks, Medicaid, Medicare, head/neck lesions, lower extremity lesions and overlapping skin lesions were significant predictors of less CLND after positive SLNB. NOS, not otherwise specified; OR, odds ratio; LCL, lower confidence limit; UCL, upper confidence limit

FIGURE 2.

Forest plot of patient predictors of CLND from 2008 to 12. Blacks, no insurance, head/neck lesions, lower extremity lesions and overlapping skin lesions were significant predictors of less CLND after positive SLNB. Similar analyses were run for univariate analyses and multivariate analyses for Era 2. NOS, not otherwise specified; OR, odds ratio; LCL, lower confidence limit; UCL, upper confidence limit

TABLE 1

Patient demographics of study population separated by Era 1 and Era 2

Patient & disease characteristics	Era 1: 2003–07				Era 2: 2008–12			
	(-) SNLB		(+) SNLB		(-) SNLB		(+) SNLB	
	#	(%)	#	(%)	#	(%)	#	(%)
Age (y)								
1–39	6712	1136 (59.5)	772 (40.5)	6340	1166 (59.6)	791 (40.4)		
40–59	17 619	2401 (56.0)	1886 (44.0)	18 890	3032 (58.8)	2126 (41.2)		
60–90	21 048	2379 (52.2)	2176 (47.8)	27 973	3480 (54.4)	2922 (45.6)		
Sex								
Female	19 544	2295 (56.0)	1804 (44.0)	22 295	2984 (58.2)	2141 (41.8)		
Male	25 835	3621 (54.4)	3030 (45.6)	30 908	4694 (55.9)	3698 (44.1)		
Race								
White	44 155	5769 (55.4)	4638 (44.6)	52 024	7495 (57.1)	5633 (42.9)		
Black	248	37 (31.6)	80 (68.4)	259	60 (40.8)	87 (59.2)		
Asian	85	22 (55.0)	18 (45.0)	131	33 (57.9)	24 (42.1)		
Unknown/other	181	33 (60.0)	22 (40.0)	256	26 (38.8)	41 (61.2)		
Median income								
<\$30 000	3631	522 (52.3)	476 (47.7)	4170	712 (53.2)	626 (46.8)		
\$30 000–34 999	6835	940 (53.8)	808 (46.2)	7901	1194 (53.4)	1042 (46.6)		
\$35 000–45 999	11 725	1599 (54.3)	1346 (45.7)	14 097	2098 (57.7)	1540 (42.3)		
>\$46 000	21 023	2543 (56.6)	1949 (43.4)	24 879	3368 (58.5)	2391 (41.5)		
Education (% without HS degree in zipcode)								
>29%	4515	621 (49.8)	627 (50.2)	5190	828 (52.4)	753 (47.6)		
20–28.9%	8599	1187 (54.2)	1003 (45.8)	10 207	1623 (55.8)	1284 (44.2)		
14–19.9%	10 068	1462 (57.4)	1085 (42.6)	12 175	1788 (56.9)	1354 (43.1)		
<14%	20 028	2334 (55.6)	1864 (44.4)	23 468	3132 (58.7)	2207 (41.3)		
Insurance status								
Medicaid	731	234 (52.6)	211 (47.4)	1086	374 (55.8)	296 (44.2)		
Medicare	14 586	1662 (51.9)	1537 (48.1)	19 205	2465 (54.7)	2042 (45.3)		
Private	27 511	3592 (58.1)	2589 (41.9)	30 090	4288 (59.6)	2912 (40.4)		

Patient & disease characteristics	Era 1; 2003–07				Era 2; 2008–12			
	(-) SNLB		(+) SNLB		(-) SNLB		(+) SNLB	
	(-) CLND (55.0)	(+) CLND (55.0)	(-) CLND (45.0)	(+) CLND (45.0)	(-) CLND (56.8)	(+) CLND (56.8)	(-) CLND (43.2)	(+) CLND (43.2)
Not insured	1133	277 (56.3)	215 (43.7)	1391	338 (52.3)	308 (47.7)		
Other	343	53 (51.0)	51 (49.0)	597	110 (57.0)	83 (43.0)		
Path stage								
Stage 1	30 879	59 (50.4)	58 (49.6)	34 607	39 (47.6)	43 (52.4)		
Stage 2	13 919	91 (55.8)	72 (44.2)	17 813	87 (53.4)	76 (46.6)		
Stage 3	581	5766 (55.1)	4704 (44.9)	783	7552 (56.9)	5720 (43.1)		
T stage								
Other	16 520	783 (49.8)	788 (50.2)	7387	388 (46.5)	446 (53.5)		
T0	54	19 (29.7)	45 (70.3)	110	38 (34.9)	71 (65.1)		
T1	2069	55 (38.2)	89 (61.8)	12 487	521 (57.8)	381 (42.2)		
T2	15 276	1621 (61.1)	1033 (38.9)	18 440	2032 (61.8)	1254 (38.2)		
T3	7514	1867 (57.9)	1359 (42.1)	9280	2348 (58.9)	1640 (41.1)		
T4	3946	1571 (50.8)	1520 (49.2)	5325	2330 (54.3)	1960 (45.7)		
N stage								
N0	17 165	1189 (60.8)	766 (39.2)	44 356	4036 (61.5)	2527 (38.5)		
N1	79	582 (50.8)	563 (49.2)	120	1406 (54.4)	1179 (45.6)		
N2	67	213 (47.4)	236 (52.6)	172	425 (54.8)	350 (45.2)		
N3	10	96 (42.7)	129 (57.3)	11	284 (50.9)	274 (49.1)		
Location								
Head/neck	8468	911 (52.1)	839 (47.9)	10 637	1203 (50.8)	1165 (49.2)		
Lower extremity	9344	1433 (52.1)	1315 (47.9)	10 511	1817 (54.1)	1540 (45.9)		
Other/NOS	295	40 (24.2)	125 (75.8)	256	45 (27.3)	120 (72.7)		
Trunk	14 466	2315 (58.9)	1614 (41.1)	16 614	2973 (61.3)	1877 (38.7)		
Upper extremity	12 806	1217 (56.4)	941 (43.6)	15 185	1640 (59.1)	1137 (40.9)		
Breslow thickness								
0.01–0.74 mm	11 154	710 (47.6)	782 (52.4)	12 958	787 (48.0)	854 (52.0)		
0.75–0.99 mm	4753	160 (49.8)	161 (50.2)	7252	307 (60.4)	201 (39.6)		
1.00–4.00 mm	17 613	2669 (60.5)	1741 (39.5)	27 327	4314 (61.5)	2701 (38.5)		
4.01–9.80 mm	2348	929 (55.9)	733 (44.1)	4059	1692 (58.0)	1226 (42.0)		

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Patient & disease characteristics	Era 1; 2003–07		Era 2; 2008–12	
	(+) SNLB		(+) SNLB	
	(–) SNLB	(–) CLND (55.0)	(–) SNLB	(–) CLND (56.8)
>9.80 mm	351	159 (45.3)	722	363 (50.8)
Unknown/other	1025	183 (35.5)	883	206 (30.8)

CLND (43.2)
351 (49.2)

TABLE 2
Percentage of CLND after +SLNB in Era 1 and 2 with calculated rate of change between eras

Predictors	2003–07		2008–12		% (% ₂ –% ₁)
	N ₁	% (55.0%)	N ₂	% (56.8%)	
Race					
White	5769	55.4	7495	57.1	1.7
Black	37	31.6	60	40.8	9.2
Asian	22	55.0	33	57.9	2.9
Median income					
<\$30 000	522	52.3	712	53.2	0.9
\$30 000–34 999	940	53.8	1194	53.4	
\$35 000–45 999	1599	54.3	2098	57.7	3.4
>\$46 000	2543	56.6	3368	58.5	1.9
Insurance status					
Private	3592	58.1	4288	59.6	1.5
Medicaid	234	52.6	374	55.8	3.2
Medicare	1662	52.0	2465	54.7	2.7
Not insured	277	56.3	338	52.3	−0.4
Location of primary tumor					
Trunk	2315	58.9	2973	61.3	2.4
Head/neck	911	52.1	1203	50.8	−1.3
Lower extremity	1433	52.2	1817	54.1	2.0
Upper extremity	1217	56.4	1640	59.1	2.7

TABLE 3

Univariate analyses of predictors of CLND separated by Era 1 and Era 2

	Era 1; 2003–2007		Era 2; 2008–2012	
	Odds ratio	95% confidence intervals	P-value	95% confidence intervals
Age vs 0–39				
40–59	0.87	0.78 0.97	<0.01	0.97 1.08
60–90	0.74	0.67 0.83	<0.01	0.81 0.90
Race vs White				
Black	0.37	0.25 0.55	<0.01	0.52 0.72
Asian	0.98	0.53 1.83	0.96	1.03 1.75
Other	1.21	0.70 2.07	0.50	0.48 0.78
Sex vs male				
Female	1.06	0.98 1.15	0.12	1.10 1.18
Insurance vs private				
Medicaid	0.80	0.66 0.97	0.02	0.86 1.01
Medicare	0.78	0.72 0.85	<0.01	0.82 0.88
Not insured	0.93	0.77 1.12	0.43	0.75 0.88
Income vs \$46 000+				
<\$30 000	0.84	0.73 0.96	0.01	0.81 0.91
\$30 000–34 999	0.89	0.80 1.00	0.04	0.81 0.90
\$35 000–45 999	0.91	0.83 1.00	0.05	0.97 1.05
Education vs <14%				
29%	0.79	0.70 0.90	<0.01	0.78 0.87
20–28.9%	0.95	0.85 1.05	0.29	0.89 0.98
14–19.9%	1.08	0.97 1.19	0.15	0.93 1.02
Stage vs Stage 1				
Stage 2	1.24	0.77 2.00	0.37	1.26 2.15
Stage 3	1.21	0.84 1.74	0.31	1.46 2.25
Site vs trunk				
Head and neck	0.76	0.68 0.85	<0.01	0.65 0.72
Lower extremity	0.76	0.69 0.84	<0.01	0.75 0.81

	Era 1; 2003–2007			Era 2; 2008–2012		
	Odds ratio	95% confidence intervals	P-value	Odds ratio	95% confidence intervals	P-value
Upper extremity	0.90	0.81	1.00	0.91	0.83	1.00
Overlapping lesion of skin	0.22	0.16	0.32	0.24	0.17	0.34
Tumor depth vs 0.01–0.74 mm						
0.75–0.99 mm	1.10	0.86	1.39	1.66	1.35	2.03
1–4 mm	1.69	1.50	1.90	1.73	1.56	1.93
4.01–9.79 mm	1.40	1.21	1.61	1.50	1.33	1.69
>9.80 mm	0.91	0.72	1.15	1.12	0.94	1.34
						0.20