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Thyroid Cancer Presentation and Treatment in the United States

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Abstract

Introduction—Thyroid cancer incidence is rising in the United States. Although overall thyroid cancer survival is high, prognostic stratification schemes have been developed to better delineate patients with poor prognoses.

Methods—A random sample that included 1,003 adult papillary thyroid cancer patients diagnosed in 2006 and reported to the National Cancer Institute's Surveillance Epidemiology and End Results (SEER) program had their medical records re-abstracted and additional risk factor data collected. The distribution of patient demographics, medical histories, tumor characteristics and treatment modalities were assessed. Logistic regression was used to assess factors associated with total thyroidectomy (total, subtotal or near total) and radioiodine therapy. All analyses were conducted stratified by the Age, Metastases, Extent and Size (AMES) low/high risk classification.

Results—Receipt of total thyroidectomy was associated with family history of thyroid disease/cancer and larger tumor size among low-risk patients and smaller tumor size among high-risk patients. Among low-risk patients, the receipt of radioiodine was associated with family history of thyroid disease/cancer, larger tumor size, total thyroidectomy and positive lymph nodes. Among high-risk patients, the receipt of radioiodine was associated with intermediate tumor and hospital sizes.

Conclusions—This study provides insight into the patterns of papillary thyroid cancer care in the general population. The findings from this study indicate adherence to guideline recommendations in that family history of thyroid disease/cancer, in addition to tumor characteristics, does appear to inform treatment practices, especially among low-risk patients.

Keywords

Thyroid cancer; papillary carcinomas; epidemiology; treatment; thyroidectomy; radioiodine

Introduction

Thyroid cancer currently has the fastest-increasing incidence rate of all cancers in the United States.¹ Incidence rates have increased from 4.9/100,000 in 1975 to 13.8/100,000 in 2010.² The greatest increase has been observed among the smallest tumors leading some to

conclude that the increase is due to improved diagnostics resulting in over-diagnosis.^{3, 4} However, others conclude that additional causes should be explored because improved diagnostics have been estimated to account for only 50% of the increase in incidence.^{5, 6}

The American Cancer Society reported that 62,980 new thyroid cancer cases would be diagnosed in 2014;¹ the vast majority of these new cases were expected to be diagnosed among women and individuals younger than 65 years. Incidence rates are notably high among Asians, twice as high among whites as blacks and are slightly higher among non-Hispanic whites than Hispanic whites.^{2, 5, 7} Although the distribution of histology varies by race and ethnicity, the predominant (80%) histology among all racial and ethnic groups is papillary adenocarcinoma.² The majority (68%) of thyroid cancers are localized, confined to the thyroid capsule but not beyond, at diagnosis, resulting in a 98% overall 5-year relative survival.² However, this is not the experience of all patients and treatment-related morbidity (e.g., hypocalcemia and laryngeal nerve paralysis) is not insignificant, especially given the uncertain clinical relevance of many small tumors and the often young age at diagnosis. Various risk classification schemes have, thus, been developed to better inform treatment decisions.⁸ The AMES classification, which takes into account patient age, metastasis status, and tumor extent and size, was selected to stratify patients in the current study because all relevant information was available and because it was able to sufficiently stratify risk into two categories.^{9, 10} The low risk group consists of young patients (women ≥ 50 ; men ≥ 40) with no metastases and older patients with intrathyroid papillary tumors that are ≤ 5 cm. The high risk group consists of young patients with metastases and older patients who have metastases, extrathyroid papillary tumors or tumors ≥ 5 cm. Based on the AMES risk classification, the 20-year survival rates have been predicted to be 98% among the low risk group and 54% among the high risk group.⁹

Although surgery is the primary treatment for thyroid cancer,¹¹⁻¹³ variations in the extent of surgery and the associated survival times have been observed. Analyses of the Surveillance, Epidemiology and End-Results (SEER) data published in 2005 and 2010 found similar survival among patients with papillary adenocarcinoma who received total thyroidectomy compared to those who received lobectomy.^{14, 15} However, a 2007 study conducted within the National Cancer Data Base (NCDB) observed better survival among those who received total thyroidectomy.¹⁶ Additionally, although guidelines recommend post-surgical radioiodine treatment for papillary adenocarcinoma when there is primary tumor size of > 4 cm., gross extrathyroidal extension, extensive vascular invasion, known or suspected distant metastases or known or suspected residual tumor,^{12, 13} receipt of radioiodine has been shown to vary by patient, provider and tumor characteristics.^{17, 18}

The National Cancer Institute (NCI) conducts annual Patterns of Care (POC) studies to evaluate the administration of cancer therapies across the United States by collecting additional data on a random sample of cancer patients reported to the SEER registries. For the current study, POC data were used to examine treatment provided to patients diagnosed with papillary thyroid cancer in 2006 with vital status follow-up through 2010. The aims of the study were to identify factors associated with the receipt of total thyroidectomy (total, subtotal or near total) and radioactive iodine (I-131) among individuals diagnosed with papillary thyroid cancer. All analyses were conducted stratified by the AMES risk

classification because it was hypothesized that assigned risk would affect treatment decisions.

Methods

Data source

Data from the POC study of thyroid cancer diagnosed in 2006 were included for the current analysis. Patients were eligible for the POC study if they were diagnosed with histologically confirmed thyroid cancer and were at least 20 years old at diagnosis. Patients were ineligible if they had a previous diagnosis of cancer, other than non-melanoma skin, were diagnosed with multiple concurrent primaries or were ascertained at autopsy or on death certificate only. Eligible patients were first stratified by SEER registry (the metropolitan areas of San Francisco/Oakland, San Jose/Monterey, Seattle, Atlanta, Detroit, Los Angeles County and the states of Connecticut, Iowa, New Mexico, Utah, Kentucky, Louisiana, New Jersey and the remainder of the state of California), age, sex, and race/ethnicity. A random sample (n=1233) was then drawn from each stratum.

SEER data are mainly obtained from hospital records. Adjuvant therapy is often provided in an out-patient setting, therefore, supplemental data was obtained for the POC study. Briefly, hospital medical records were re-abstracted for demographic data, tumor characteristics and treatment information. Additional data was abstracted regarding thyroid cancer risk factors (e.g. family history of thyroid disease/cancer, personal history of goiter, medical radiation to head and/or neck and environmental radiation) and comorbidities. Each patient's treating physician was also asked to verify the thyroid cancer therapies and to provide the name and address of any other physician who may have treated the patient. Any additional physicians were then contacted. The primary abstractor from each registry attended a central training to assure consistency of abstracting and coding. Each SEER registry obtained institutional review board approval, as required, prior to initiating the POC study.

Study population

Patients were eligible for the current analyses if they had histologically confirmed papillary thyroid cancer (International Classification of Diseases for Oncology third edition (ICD-O-3): 8050, 8052, 8260, 8340-8344). Patients with non-papillary histologies (n=202) and patients with papillary thyroid cancer who did not have sufficient information to determine their AMES-risk group (n=28) were excluded.

Variables of interest

Demographics, tumor characteristics and personal/family medical history were determined based on hospital medical records. If ethnicity was unavailable the patient's surname was used to determine Hispanic ethnicity. All comorbid conditions listed in the medical record at the hospital where the most definitive treatment was received were recorded and centrally coded at NCI. Comorbidity score, excluding thyroid cancer, was calculated based on the Charlson comorbidity index.¹⁹ Tumor stage was classified based on the American Joint Committee on Cancer 7th edition.²⁰ Lymph node status was classified as 1) none examined or unknown if examined (n=3), 2) none positive and 3) at least one positive. Presence of a

residency training program and number of beds at the hospital where the patient had their most definitive treatment were determined according to data from the American Hospital Association Annual Survey of Hospitals.²¹ The extent of surgery was categorized as thyroidectomy (total, subtotal, near total), lobectomy (partial lobectomy, lobectomy and/or isthmusectomy) and none. Surgical margins were classified as free of tumor, tumor at margins and unknown. The receipt of radioiodine (I-131), non-iodine radiotherapy and chemotherapy were determined via physician verification. Vital status and occurrence of thyroid-specific deaths were assessed through December 31, 2010.

Statistical analysis

Sample weights, defined as the inverse of the sampling proportion for each sampling stratum, were applied in order to obtain estimates that reflected all thyroid cancers diagnosed within the participating SEER areas in 2006. Black, Hispanic, Asian/Pacific Islanders (API), and American Indian/Alaska Native (AI/AN) patients were oversampled to obtain more stable estimates. Due to small numbers API and AI/AN patients were combined into 'Other' race. To account for the complex sample design and to correctly calculate the standard errors, all analyses were performed using SAS (version 9.3; SAS Institute Inc., Cary, NC) and SAS-callable SUDAAN (version 10.0.1; Research Triangle Institute, Research Triangle Park, NC).

Differences in patient demographic, tumor and health characteristics were evaluated using the chi-square test. The extent of surgery and receipt of radioiodine to treat papillary thyroid cancer was then assessed via multivariate logistic regression models. Variables that were associated with the treatment outcomes ($p < 0.10$) during bivariate analyses and remained significant ($p < 0.05$) in the regression model were retained and reported. All analyses were conducted stratified by the AMES risk classification.

Results

The current analysis included 1,003 papillary thyroid cancer patients (low risk: 834 and high risk: 169). As expected, the low-risk group included patients that were younger, had less advanced tumors and had better prognoses (Table 1). Patients in the low-risk group were also less likely to be male, to have had a history of environmental radiation exposure and to have been treated at a hospital with an approved residency program. As of December 31, 2010, 2.2% of the low-risk group and 17.7% of the high-risk group had died. Thyroid cancer accounted for an estimated 6.9% and 72.4% of the deaths among individuals in the low- and high-risk groups, respectively (data not shown).

Overall treatment

Regardless of risk group, surgery was the most common therapy and total thyroidectomy was the most common type of surgery (Table 2). Total thyroidectomy was, however, less common among low-risk patients (86.1%) than high-risk patients (89.9%; $p=0.03$). Among those who had surgery, low-risk patients (76.3%) were more likely to have clear surgical margins compared to high-risk patients (54.3%; $p<0.01$). The majority of patients, regardless of risk group, received radioiodine (I-131). However, radioiodine was less common among

low-risk patients (63.0%) compared to high-risk patients (77.9%; $p<0.01$). The administration of radiotherapy and chemotherapy was also less common among low-risk patients ($p<0.01$).

Total Thyroidectomy

Among low-risk patients, bivariate analyses indicated that receipt of total thyroidectomy versus partial thyroidectomy was associated with younger age, having a family history of thyroid disease/cancer, having a larger tumor size and being treated at a hospital with 200-299 beds and an approved registry program (Table 3). In multivariate analyses, having a family history of thyroid disease/cancer (odds ratio (OR):4.48; 95% confidence interval (CI): 1.69-11.93) and having a tumor $>1\text{cm}$ (OR range: 3.51-3.76) remained significantly associated with having a total thyroidectomy. When stratified by tumor size, multivariate analyses indicated that the association between receipt of total thyroidectomy and family history of thyroid disease/cancer remained significant among patients with tumors $<1\text{cm}$ (OR: 5.53; 95% CI: 1.12-27.25) and 1cm (OR: 4.22; 95% CI: 1.16-15.38; data not shown).

Among high-risk patients, bivariate analyses indicated that receipt of total thyroidectomy was associated with younger age, insurance other than Medicare only, history of goiter, and smaller tumor size. Multivariate results were not reported because tumor size was the only variable that remained significant during multivariate modeling. As of December 31, 2010, bivariate analyses also revealed that total thyroidectomy was associated with better prognosis.

Radioiodine

Among low-risk patients, bivariate analyses indicated that receipt of postsurgical radioiodine was associated with younger age, insurance other than Medicare only, family history of thyroid disease/cancer, having a more advanced tumor (e.g., stage, size, and lymph node status), receipt of total thyroidectomy and positive tumor margins (Table 4). Multivariate analyses revealed that receipt of radioiodine was more likely among patients who had a family history of thyroid disease/cancer (OR: 1.89; 95% CI: 1.00-3.63), had tumors $>1\text{cm}$ (OR range: 2.86-3.65), received a total thyroidectomy (OR: 5.47; 95% CI: 2.61-11.46) and had positive lymph nodes (OR: 3.41; 95% CI: 1.57-7.42). When stratified by tumor size, multivariate analyses indicated that the association between receipt of radioiodine and family history of thyroid disease/cancer remained significant among patients with tumors $<1\text{cm}$ (OR: 3.71; 95% CI: 1.38-9.93) but not among those with tumors $<1\text{cm}$ (OR: 1.09; 95% CI: 0.41-2.91; data not shown).

Among high-risk patients, bivariate analyses indicated that receipt of postsurgical radioiodine varied significantly by age, race/ethnicity, insurance status, history of goiter, comorbidity level, tumor stage and size, hospital bed size and hospital residency program status. Multivariate analyses indicated that significant differences remained by tumor size (1.0-3.9 cm versus $<1\text{cm}$: OR: 11.83; 95% CI: 2.03-68.86) and hospital bed size (200-399 versus <200 : OR: 10.45; 95% CI: 2.09-52.23). As of December 31, 2010, bivariate analyses also revealed that postsurgical radioiodine was associated with better prognosis in high-risk patients.

Discussion

The majority of patients with papillary thyroid cancers undergo total thyroidectomy; high-risk patients were slightly more likely to undergo total thyroidectomy than low-risk patients. Among patients who undergo surgery, the majority have clear tumor margins. Clear margins were, however, more common among low-risk patients. Roughly two-thirds of low-risk patients and three-fourths of high-risk patients also received radioiodine. Family history of thyroid disease/cancer and extent of disease were the strongest predictors for treatment modality among low-risk patients. Among high-risk patients, tumor size and hospital characteristics were the strongest predictors. Significant variation in vital status was observed by treatment modality only among high-risk patients.

Regardless of risk-group status, the receipt of total thyroidectomy was found to be associated with greater extent of disease, which has previously been observed.^{14, 15} However, in contrast to these previous studies, patient demographics (i.e., age and sex) were not found to be associated with receipt of total thyroidectomy. To the best of our knowledge, the association between extent of surgery and family history of thyroid disease/cancer has not previously been assessed. The current data also indicated that this association was not dependent on tumor size. Family history of thyroid disease/cancer remained significantly associated with receipt of total thyroidectomy among low-risk patients when analyses were stratified by size (<1cm and ≥1cm; data not shown). Given a personal or family history of thyroid disease/cancer among low-risk patients, it is possible that the treating physician and/or the patient decided more aggressive therapy was warranted. Although total thyroidectomy is recommended for all high-risk patients, not all high risk patients in the current study underwent this procedure. During multivariate analyses the only variable that remained significantly associated with receipt of total thyroidectomy was tumor size. It cannot be ruled out though that the receipt of total thyroidectomy among high-risk patients may have also depended on other variables (e.g., age and comorbidity index) but that such associations were not significant in the current study due to insufficient statistical power.

In agreement with previous studies,^{17, 18} the receipt of postsurgical radioiodine was also associated with greater extent of disease regardless of risk-group status (e.g., size > 1 cm and/or positive lymph nodes). Total thyroidectomy was also found to be associated with receipt of radioiodine among low-risk patients in the current study, which was expected given that total thyroidectomy is recommended prior to radioiodine therapy.^{11, 12} In contrast to the study by Haymart *et al.*,¹⁷ which was restricted to patients who had undergone total thyroidectomy, in the current study, patient demographics (age, sex and race/ethnicity) were not associated with receipt of radioiodine. Although previous studies have found annual thyroid case volume to be associated with receipt of total thyroidectomy,^{17, 18} this variable was not available for assessment in the current study. In the current study, intermediate hospital bed size was found to be associated with receipt of radioiodine but only among high-risk patients. To the best of our knowledge this is the first study to report the association between family history of thyroid disease/cancer and radioiodine. When stratified by tumor size this association was observed only among patients who had tumors ≥1 cm. Again, a positive history of thyroid disease/cancer may prompt the treating

physician(s) and/or the patient to opt for more aggressive therapy when the patient is otherwise considered low-risk.

Although this study had strengths, namely that it was conducted using a population-based sample that oversampled minority groups and ascertained personal and family medical history, it also had limitations. Although our results indicate that a family history of thyroid disease/cancer was associated with treatment modality choices among low-risk patients, based on how the data were abstracted it is not possible to delineate family history of thyroid disease from family history of thyroid cancer. It is unlikely that these patients truly had a familial syndrome; however, we believe that our findings provide incentive to further investigate the influence of family medical history on papillary thyroid cancer treatment choices. Additionally, while we were not able to ascertain physician and/or patient treatment preferences, we were able to investigate factors associated with treatment received. It is also possible that residual confounding by unmeasured factors, including physician type (e.g., endocrinologist or surgeon) and indication for surgery, may also have influenced our findings. Finally, the small sample size among the high-risk group often resulted in imprecise multivariate parameter estimates. In conclusion, this study provides insight into the patterns of papillary thyroid cancer care, in the general population. The findings from this study indicate adherence to guideline recommendations in that family history of thyroid disease/cancer, in addition to tumor characteristics, does appear to inform treatment practices.

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Table 1

Demographic, clinical and non-clinical characteristics among patients diagnosed with papillary thyroid cancer stratified by AMES-risk group¹, Patterns of Care Study 2006.

Characteristic	AMES risk-group ¹				p ⁴
	Low		High		
	N ²	% ³	N ²	% ³	
Age at diagnosis					
20-44	408	47.6	15	2.4	<0.01
45-54	171	27.2	31	21.2	
55-64	127	15.6	45	39.1	
65-74	79	7.2	34	21.6	
75+	49	2.4	44	15.8	
Sex					
Men	280	19.1	94	35.4	<0.01
Women	554	80.9	75	64.6	
Race/Ethnicity					
Non-Hispanic white	353	70.3	64	73.6	0.13
Non-Hispanic black	120	4.6	26	5.9	
Hispanic	175	14.4	50	14.4	
Other	186	10.7	29	6.0	
Marital Status					
Married/Living as	516	67.9	98	54.4	0.06
Other	318	32.1	71	45.6	
Insurance status					
Private/HMO/Military	669	86.3	116	72.3	<0.01
Any Medicaid	84	8.0	24	7.7	
Medicare only	30	1.4	20	13.4	
Unknown	51	4.3	9	6.6	
Family history of thyroid disease/cancer					
No, unknown	740	87.1	153	79.2	0.32
Yes	94	12.9	16	20.8	
History of goiter					
No, unknown	611	71.7	125	68.8	0.76
Yes	223	28.3	44	31.2	
History of radiation exposure to head and/or neck					
No, unknown	821	97.4	~	97.5	0.89
Yes	13	2.6	~	2.5	
History of environmental radiation exposure					
No, unknown	~	99.8	~	98.9	0.05
Yes	~	0.2	~	1.1	
Charlson comorbidity index					

Characteristic	AMES risk-group ¹				p ⁴
	Low		High		
	N ²	% ³	N ²	% ³	
0	686	80.1	113	74.5	0.32
>1	148	19.9	56	25.5	
Tumor stage					
Stage I	695	84.1	13	12.1	<0.01
Stage II	56	4.9	6	1.6	
Stage III	53	7.0	72	45.4	
Stage IV	17	2.5	68	37.3	
Unstaged	13	1.4	10	3.5	
Tumor size					
<1 cm or no mass found	282	34.5	10	9.0	<0.01
1.0-3.9cm	476	59.0	91	65.9	
4.0+cm	64	5.4	55	21.1	
Unknown	12	1.0	13	4.1	
Number of lymph nodes examined					
0	462	50.7	61	34.8	0.10
1-2	165	21.9	41	28.2	
3-4	70	9.2	~	7.9	
5-9	57	7.5	17	9.9	
10+	70	9.0	36	17.8	
Unknown	10	1.8	~	1.3	
Nodal status					
None examined, unknown	462	50.7	61	34.8	0.02
None positive	183	25.7	28	22.6	
At least one positive	189	23.6	80	42.5	
Hospital bed size					
Unknown, out patient only, < 200 beds	162	22.2	39	17.7	0.18
200-299 beds	171	21.5	28	12.3	
300-399 beds	144	17.4	27	27.0	
400+ beds	357	39.0	75	43.1	
Approved residency training program					
No/Unknown	345	42.1	64	24.7	<0.01
Yes	489	57.9	105	75.3	
Vital Status (December 31, 2010)					
Alive	813	97.8	134	82.3	<0.01
Dead	21	2.2	35	17.7	

¹ According to the Age, Metastases, Extent and Size (AMES) risk classification.⁹

² Unweighted sample size.

³ Weighted percentage.

⁴ Chi-square p-value comparing low vs. high risk groups.

[~] Due to small cell size, exact numbers were suppressed.

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Table 2

Treatment among patients diagnosed with papillary thyroid cancer stratified by AMES risk-group¹, Patterns of Care Study 2006.

Treatment	AMES risk-group ¹		p ³
	Low % ²	High % ²	
Surgery			
None	0.2	1.4	0.03
Partial lobectomy, lobectomy and/or isthmusectomy	13.7	8.7	
Total, subtotal, near total thyroidectomy	86.1	89.9	
Surgical margins ³			
Margins free of tumor	76.8	54.3	<0.01
Tumor at margins	13.3	38.7	
Unknown, not stated	10.0	7.0	
Radioiodine (I-131)			
No/Unknown	37.0	22.1	<0.01
Yes	63.0	77.9	
Radiotherapy			
No/Unknown	97.6	89.7	<0.01
Yes	2.4	10.3	
Chemotherapy			
No/Unknown	100.0	98.0	<0.01
Yes	0.0	2.0	

¹ According to the Age, Metastases, Extent and Size (AMES) risk classification.⁹

² Weighted percentage.

³ Chi-square p-value comparing low vs. high risk groups.

⁴ Among patients who underwent surgery.

Table 3

Factors associated with total thyroidectomy¹ for the treatment of papillary carcinomas among patients who underwent surgery stratified by AMES risk-group², Patterns of Care Study 2006.

Characteristic	AMES risk-group ²						
	Low					High	
	No % ³	Yes % ³	p ⁴	OR ⁵	95% CI	No % ³	Yes % ³ p ⁴
Age at diagnosis							
20-44	11.9	88.1	0.03			6.4	93.6 0.02
45-54	12.0	88.0				3.1	96.9
55-64	17.1	82.9				4.9	95.1
65-74	22.8	77.2				10.9	89.1
75+	19.7	80.3				24.8	75.2
Sex							
Men	11.7	88.3	0.29			12.0	88.0 0.30
Women	14.2	85.8				7.2	92.8
Race/Ethnicity							
Non-Hispanic white	14.1	85.9	0.06			9.2	90.8 0.26
Non-Hispanic black	23.7	76.3				4.9	95.1
Hispanic	10.4	89.6				11.2	88.8
Other	11.2	88.8				3.7	96.3
Marital Status							
Married/Living as	14.0	86.0	0.80			8.4	91.6 0.81
Other	13.1	86.9				9.5	90.5
Insurance status							
Private/HMO/Military	13.6	86.4	0.53			8.1	91.9 0.03
Any Medicaid	15.1	84.9				10.0	90.0
Medicare only	20.8	79.2				15.7	84.3
Unknown	11.2	88.8				2.1	97.9
Family history of thyroid disease/cancer							
No/Unknown	15.2	84.8	<0.01	1.00	ref	9.2	90.8 0.85
Yes	3.7	96.3		4.48	1.69-11.93	7.8	92.2
History of goiter							
No/Unknown	14.0	86.0	0.76			11.6	88.4 0.02
Yes	13.1	86.9				3.0	97.0
Charlson comorbidity index							
0	13.2	86.8	0.52			7.9	92.1 0.20
1	15.8	84.2				11.8	88.2
Tumor Stage							
Stage I	14.2	85.8	~			1.1	98.9 ~
Stage II	13.7	86.3				0.0	100.0

Characteristic	AMES risk-group ²							
	Low					High		
	No % ³	Yes % ³	p ⁴	OR ⁵	95% CI	No % ³	Yes % ³	p ⁴
Stage III	12.7	87.3				9.8	90.2	
Stage IV	0.0	100.0				10.8	89.2	
Unstaged	16.7	83.3				7.6	92.4	
Tumor Size								
<1 cm or no mass found	23.9	76.1	<0.01	1.00	ref	2.8	97.2	<0.01
1.0-3.9cm	7.8	92.2		3.76	1.72-8.19	3.8	96.2	
4.0+cm	6.3	93.7		3.51	1.08-11.37	21.1	78.9	
Unknown	49.5	50.5		0.34	0.06-2.02	50.0	50.0	
Hospital bed size								
Unknown, out patient only, < 200 beds	15.8	84.2	0.02			7.6	92.4	0.14
200-299 beds	6.9	93.1				3.9	96.1	
300-399 beds	15.4	84.6				7.7	92.3	
400+ beds	15.5	84.5				11.5	88.5	
Approved residency training program								
No/Unknown	10.2	89.8	0.03			9.1	90.9	0.90
Yes	16.3	83.7				8.8	91.2	
Vital Status (December 31, 2010)								
Alive	13.8	86.2	0.60			4.3	95.7	0.02
Dead	12.0	88.0				31.3	68.7	

OR: odds ratio; CI: Confidence interval

¹Total, subtotal, near total thyroidectomy compared to partial lumpectomy, lumpectomy and/or isthmusectomy.

²According to the Age, Metastases, Extent and Size (AMES) risk classification.⁹

³Weighted row percentage.

⁴Bivariate Chi-Square test comparing those who did and did not have total thyroidectomy within each risk group.

⁵Logistic regression model adjusted for listed variables; not calculated for the high risk group because tumor size was the only variable that remained significant during multivariate modeling.

~ Statistic not calculated because at least one cell size was zero.

Factors associated with receipt of radioiodine (I-131) among patients diagnosed with papillary carcinoma who underwent surgery, Patterns of Care Study 2006.

Table 4

Characteristic	AMES risk-group ¹											
	Low						High					
	No	Yes					No	Yes				
	% ²	% ²	p ³	OR ⁴	95% CI		% ²	% ²	p ³	OR ⁴	95% CI	
Age at diagnosis												
20-45	33.8	66.2	<0.01				27.7	72.3	<0.01			
45-54	31.3	68.7					4.3	95.7				
55-64	47.8	52.2					15.8	84.2				
65-74	52.0	48.0					25.9	74.1				
75+	46.1	53.9					51.0	49.0				
Sex												
Men	35.8	64.2	0.75				15.3	84.7	0.13			
Women	37.2	62.8					24.3	75.7				
Race/Ethnicity												
Non-Hispanic white	37.3	62.7	0.78				17.0	83.0	<0.01			
Non-Hispanic black	41.0	59.0					34.2	65.8				
Hispanic	35.8	64.2					35.8	64.2				
Other	34.5	65.5					26.3	73.7				
Marital Status												
Married/Living as	38.1	61.9	0.56				16.8	83.2	0.08			
Other	34.5	65.5					26.4	73.6				
Insurance status												
Private/HMO/Military	36.2	63.8	0.03				18.7	81.3	<0.01			
Any Medicaid	41.4	58.6					38.8	61.2				
Medicare only	68.8	31.2					28.2	71.8				
Unknown	33.0	67.0					14.7	85.3				
Family history of thyroid disease/cancer												
No/Unknown	39.2	60.8	0.02	1.00	ref		23.4	76.6	0.18			

Characteristic	AMES risk-group ¹											
	Low						High					
	No	Yes	% ²	p ³	OR ⁴	95% CI	No	Yes	% ²	p ³	OR ⁴	95% CI
Yes	21.9	78.1			1.89	1.00-3.63	12.5	87.5				
History of goiter												
No/Unknown	36.2	63.8		0.70			26.6	73.4		<0.01		
Yes	38.7	61.3					9.3	90.7				
Charlson comorbidity index												
0	37.8	62.2		0.35			23.7	76.3		0.02		
1	33.2	66.8					13.6	86.4				
Tumor Stage												
Stage I	40.5	59.5		<0.01			4.8	95.2		~		
Stage II	22.3	77.7					0.0	100.0				
Stage III	13.3	86.7					27.8	72.2				
Stage IV	23.3	76.7					20.2	79.8				
Unstaged	18.5	81.5					7.6	92.4				
Tumor Size												
<1 cm or no mass found	58.3	41.7		<0.01	1.00	ref	48.8	51.2		<0.01	1.00	ref
1.0-3.9cm	25.9	74.1			2.86	1.60-5.10	10.1	89.9			11.83	2.03-68.86
4.0+cm	17.8	82.2			3.65	1.49-8.91	43.2	56.8			1.55	0.17-14.41
Unknown	55.6	44.4			1.70	0.49-5.88	27.7	72.3			3.76	0.27-52.64
Total Thyroidectomy ⁵												
No	77.3	22.7		<0.01	1.00	ref	47.6	52.4		0.11		
Yes	30.5	69.5			5.47	2.61-11.46	18.5	81.5				
Nodal status												
None examined, unknown	48.9	51.1		<0.01	1.00	ref	13.9	86.1		0.12		
None positive	33.0	67.0			1.65	0.80-3.37	36.4	63.6				
At least one positive	15.6	84.4			3.41	1.57-7.42	18.7	81.3				
Surgical margins												
Margins free of tumor	37.4	62.6		0.01			19.9	80.1		0.86		

Characteristic	AMES risk-group ¹									
	Low					High				
	No	Yes				No	Yes			
	% ²	% ²	p ³	OR ⁴	95% CI	% ²	% ²	p ³	OR ⁴	95% CI
Tumor at margins	23.3	76.7				21.1	78.9			
Unknown, not stated, not assessed	51.6	48.4				30.4	69.6			
Hospital bed size										
< 200 beds/Out patient only/Unknown	35.2	64.8	0.40			42.4	57.6	<0.01	1.00	ref
200-299 beds	29.3	70.7				15.1	84.9		10.45	2.09-52.23 [*]
300-399 beds	38.4	61.6				6.1	93.9			
400+ beds	41.5	58.5				23.7	76.3		3.48	0.97-12.57
Approved residency training program										
No/Unknown	36.2	63.8	0.81			35.4	64.6	<0.01		
Yes	37.5	62.5				16.4	83.6			
Vital Status (December 31, 2010)										
Alive	37.2	62.8	0.14			14.6	85.4	<0.01		
Dead	26.1	73.9				52.9	47.1			

OR: odds ratio; CI: Confidence interval

¹ According to the Age, Metastases, Extent and Size (AMES) risk classification.⁹

² Weighted row percentage.

³ Bivariate Chi-Square test comparing those who did and did not have total thyroidectomy within each risk group.

⁴ Logistic regression model adjusted for listed variables.

⁵ Total, subtotal, near total thyroidectomy compared to partial lumpectomy, lumpectomy and/or isthmusectomy.

~ Statistic not calculated because at least one cell size was zero.

* Bed size 200-299 and 300-399 were collapsed due to small numbers.