Published in final edited form as:
J Clin Epidemiol. 2006 January ; 59(1): 53–60. doi:10.1016/j.jclinepi.2005.06.002.

Information on chemotherapy and hormone therapy from tumor registry had moderate agreement with chart reviews

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Abstract

Background—Surveillance, Epidemiology, and End Results (SEER) cancer registries provide accurate information on cancer surgery and radiation, but the validity of registry data on chemotherapy and hormone therapy for breast cancer has not been well studied. We validated the registry data for chemotherapy and hormone therapy against an independent medical chart review.

Methods—We identified 1,228 women diagnosed with breast cancer at age > =65 in 1993–1999 in the New Mexico SEER Tumor Registry and completed medical chart reviews.

Results—Overall, there was moderate agreement between these two databases on chemotherapy that was received within 6 months of diagnosis. The observed agreement was 96.0%, with a kappa of 0.72 (95% confidence interval: 0.64–0.79). The sensitivity of the registry data for chemotherapy was 70.7% and the specificity was 98.2%. The positive predictive value of the registry data for chemotherapy was 77.8%. The sensitivity of the registry data for hormone therapy was 59.7%, and the specificity was 89.5%. The observed agreement for hormone therapy was 80.0%, with a kappa of 0.52 (0.46–0.57).

Conclusion—Agreement on chemotherapy and hormone therapy between the New Mexico SEER Tumor Registry and chart reviews was moderate. The preferred approach would be to combine data from different sources to obtain more complete information.

Keywords

Breast cancer; Chemotherapy; Hormone therapy; Tumor registry; SEER; Chart review

1. Introduction

The National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) tumor registries provide excellent information for estimating cancer incidence, mortality, and treatment trends; for identifying unusual changes over time; and for promoting studies designed to identify factors amenable to cancer control interventions [1–3]. The SEER data have been extensively used to study the pattern and quality of radiation therapy and surgery for breast

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cancer [4–13], including a number of studies that specifically involved validation of information on cancer radiation therapy and surgery in SEER registries [14–17]. Little research has been conducted on the use of cancer chemotherapy using SEER data [18–24] because the SEER program does not release the information on chemotherapy in the Public Use Database due to concern about whether this information is complete. The validity of the SEER data for chemotherapy and hormone therapy has not been well studied.

Mariotto and colleagues reported that the SEER data on chemotherapy was slightly underreported, and this underreporting was constant over time from 1975 to 1999 with respect to findings from the National Cancer Institute's study on the Patterns of Care (POC) [18]. Harlan et al. [21] reported that the sensitivity of the SEER data for chemotherapy for breast cancer was 78% compared to the POC data collected in 1991 and 1995. Because there was only a small number of cases in the POC study, no reliable information was reported on the validity of information on chemotherapy for breast cancer for each individual SEER registry. Because more cancer care has moved to outpatient or community settings, researchers face challenges in the completeness of the treatment information collected from tumor registries that are mainly based on hospital records [24–26]. Tumor registry data should be enhanced by promoting collection of data from all places of care and by linkage to other population-based data such as nationwide Medicare insurance data [26].

We conducted an independent medical chart review specifically on chemotherapy and hormone therapy for 1,228 women diagnosed with breast cancer at age 65 or older from 1993 to 1999 in the state of New Mexico. This independent medical chart review was used as a “gold standard” to validate existing data from the New Mexico Tumor Registry on chemotherapy and adjuvant hormone therapy that was originally collected as part of the SEER effort. This report presents the findings of this external validation.

2. Methods

We used two independent data sources in this study: the existing New Mexico SEER Tumor Registry data, and the current medical chart review data.

The New Mexico Tumor Registry is a state-wide, population-based tumor registry established in 1966, and has been part of the SEER program since 1973 [1–3]. The registry ascertains all newly diagnosed (incident) cancer cases from multiple reporting sources such as hospitals, outpatient clinics, laboratories, private medical practitioners, nursing/convalescent homes/ hospices, autopsy reports, and death certificates [1–3,27]. New Mexico residents who are diagnosed and treated at facilities outside the state are identified through data exchange with surrounding state registries in Colorado, Arizona, Utah, and Texas, as well as information from the New Mexico Bureau of Vital Records and Health Statistics and pathology laboratories and hospitals that operate close to New Mexico Borders [28]. The information on chemotherapy and hormone therapy was collected in all SEER registries, although it has not been released in the SEER Public Use Data Set because of concern about whether it is complete. The SEER program has a well-structured data collection system, and provides details on how therapy information was collected [27]. In brief, after patients with cancer were notified to the registry from the hospitals and pathology laboratories, and after case screening and ascertainment procedures, the SEER abstractors reviewed medical charts for information on the first course of therapy (surgery, radiotherapy, chemotherapy, and hormone therapy) [27]. In our study, we obtained the information on chemotherapy and hormone therapy for cases diagnosed with breast cancer from 1993 to 1999 from the New Mexico Tumor Registry that was already collected in the registry database as part of the SEER effort before our validation study started in 2001.

Because the major goals of our original proposal were to compare an independent medical chart review with Medicare claims and tumor registry for chemotherapy, we only studied women diagnosed with breast cancer at age 65 or older and linked with their Medicare claims files. The data abstractors were then instructed to complete the medical chart reviews for these cases, but were blinded to the status of the currently existing tumor registry data on cancer treatment.

The data collection form was designed and tested on first 20 cases. After a few minor modifications, the abstract form was finalized and comprised of three pages. The first page, which was to be kept all the time in the New Mexico Tumor Registry for confidentiality, included case identification (ID) number, name, social security number, name and address of the diagnosing facility, and if different, the names and addresses of the facility that provided surgery, radiation therapy, chemotherapy, and hormone therapy. The second page contains ID number, date of birth, date of breast cancer diagnosis, age at diagnosis, chemotherapy treatment (yes or no), type of chemotherapy, and date of therapy. Finally, the abstractor recorded where the chemotherapy information was obtained from, covering one or more data sources of medical charts documenting this therapy such as from hospitals, oncologists' offices, radiology departments, or other physicians' offices. The third page collected information on hormone therapy for breast cancer. The data format on hormone therapy were similar to that collected on chemotherapy (described above). The data collection was conducted in March 2001 through February 2003.

The Institutional Review Boards of the University of Texas Medical Branch and the University of New Mexico, and the Committee for the Protection of Human Subjects at the University of Texas Health Science Center at Houston approved this study.

We sought to complete data abstraction forms for a target sample of 1,241 subjects. This sample size was determined to achieve a 0.05 level of precision and an estimated sensitivity at 0.9. We identified 3,282 women from the New Mexico Tumor Registry who were diagnosed with stage I–IV breast cancer at age 65 years or older between 1993 and 1999. Of these women, 1,733 were successfully linked with their Medicare files as part of our previous study on the external validation of Medicare claims for chemotherapy [29]. Excluded were women who did not have full coverage of both Medicare Part A and Part B, or who were members of health maintenance organizations in the year of diagnosis.

The data abstractor sorted the 1,733 eligible cases according to the hospitals where a breast cancer diagnosis was made. Although these cases were not randomly selected for medical chart reviews, the data abstractor worked through the list of cases according to the order of the identification number, and aimed to review medical charts for as many cases as possible during her visit to the hospital or to the oncologist's office across the state of New Mexico. If the medical records were not available during the visit, the data abstractor attempted to complete the abstraction form at the next visit, and so on until we reached the target sample size of 1,241. Of these 1,241 subjects, 13 had incomplete abstraction forms because of missing items, leaving 1,228 cases for the final analysis. We compared the 1,228 cases with chart reviews to the 492 eligible cases without chart reviews, and found no significant difference in the distribution of age between the two groups. However, those without chart reviews had a significantly higher proportion (77.6%) of having been diagnosed earlier in our study periods, that is, 1993–1996, compared to 41.8% among those with chart reviews.

The categorization of receipt of chemotherapy in this analysis was either “yes” or “no” from medical charts and the original tumor registry, regardless of number of records of chemotherapy in medical charts. The sensitivity and specificity of the New Mexico Tumor Registry data for chemotherapy was evaluated using the medical chart review as the reference. The sensitivity

of the tumor registry for chemotherapy was defined as the percentage of cases receiving chemotherapy according to medical chart reviews that were also identified by the tumor registry as receiving chemotherapy. Specificity was defined as the percentage of cases identified by medical records as not receiving chemotherapy that were identified by the tumor registry as also not receiving chemotherapy. The sensitivity and specificity of the tumor registry for hormone therapy were similarly defined.

A simple kappa statistic and 95% confidence intervals were calculated to quantify the degree of agreement on the receipt of chemotherapy as well as hormone therapy between the two databases by adjusting for chance agreement. The kappa statistic greater than 0.75 represents excellent agreement beyond chance and values between 0.40–0.75 represent fair to good agreement beyond chance [30]. The concordant rate or observed agreement rate (i.e., number of cases agreed on the receipt of chemotherapy or hormone therapy over the total number of cases) were also calculated. The above analyses were repeated using different time periods of chemotherapy or hormone therapy that was given after diagnosis and recorded in medical chart reviews, for example, within 6 months or after 6 months of diagnosis. Because SEER registries usually collect primary treatment data within 4 months and adjuvant therapy (chemotherapy or hormone therapy) within 6 months [31,32], our main comparisons between the registry data and chart review were analyzed using data collected within 6 months of diagnosis. The analyses were also stratified for patient age, tumor stage, receipt of hormone therapy, year of diagnosis, and whether patient was alive or died at the time of chart review. The multivariable logistic regression was also performed for the risk of being discordant using PROC LOGISTIC. All computer programming and analyses were completed using the SAS system (version 8.2) [33].

3. Results

Table 1 presents comparisons between independent medical chart reviews and existing tumor registry data on chemotherapy for breast cancer that was received within 6 months of diagnosis. Of the 99 cases that received chemotherapy within 6 months of diagnosis according to medical chart reviews, 100% were reviewed from hospital records, 32% had records from at least two different sites, 19% from three sites, and 1% from all four sites (hospital, oncologist's office, radiation department, and other physician's office). The agreement rate between these two databases was 96.0%, with a kappa of 0.72 (0.64–0.79) (Table 1). The sensitivity of the tumor registry data for chemotherapy was 70.7% and the specificity was 98.2%. The positive predictive value of the tumor registry data for chemotherapy was 77.8%. When reanalyzed our data including cases with therapy received after 6 months of diagnosis, 108 subjects aged 65 or older received chemotherapy according to the medical chart reviews. The general agreement between medical chart reviews and the tumor registry data on chemotherapy was 95.4%, with a kappa of 0.69 (0.62–0.77).

Table 2 presents comparisons between the medical chart reviews and the existing tumor registry data on adjuvant hormone therapy (mostly tamoxifen) for women with breast cancer in New Mexico. Medical chart reviews captured many more patients who received hormone therapy than did the tumor registry. Compared to the medical chart review data on hormone therapy that was recorded within 6 months of diagnosis, the sensitivity of tumor registry data for hormone therapy was 59.7%, and the specificity was 89.5%. When including those with hormone therapy received after 6 months of diagnosis, 421 (34.3%) of women diagnosed with breast cancer at age 65 or older received hormone therapy according to the medical chart reviews, compared to 322 (26.2%) subjects by the New Mexico Tumor Registry. The general agreement was 79.5% and the kappa was 0.52 (0.47–0.57).

Tables 3 through 5 present comparisons between two databases on the receipt of chemotherapy and hormone therapy, stratified by patient age, tumor stage, hormone therapy or chemotherapy (according to chart reviews), year of diagnosis, and the sources of referrals from which the information had been obtained. The sensitivity and specificity of tumor registry data for chemotherapy varied by these factors, but generally had high specificity and low sensitivity rates across the various strata (Table 3). For example, sensitivity for women aged 65–69 (88.2%) was higher than those aged 70–74 (53.5%) or those aged 75 or older (77.3%), and was slightly higher in cases who were still alive (72.7%) than cases who died (66.7%) at the time of medical chart review. Sensitivity was also higher in cases with early-stage cancer, diagnosed in earlier years, or having no hormone therapy. Similar variations in sensitivity and specificity for hormone therapy were also observed, but the overall sensitivity and specificity of the registry data for hormone therapy were lower.

The kappa statistic for the comparison between two databases on chemotherapy was excellent in patients aged 65–69 (0.85) (Table 4). The observed agreement rates on chemotherapy were generally over 92.0%, except for those subjects with stage III–IV cancer who had a significant greater risk of being discordant. The odds ratio of discordance for chemotherapy between the two databases was also significantly greater in those aged 70–74 than those younger patients (Table 4). Patients aged 70–74 were significantly more likely to have discordant information on hormone therapy between the databases than those aged 65–69, as were those with advanced tumor stages (Table 5). The kappa statistics showed poor to good agreement between the two databases on hormone therapy across various strata. Patients who died at the time of chart review seemed to be at a higher risk of being discordant for information on chemotherapy between the two databases, but were significantly less likely to be discordant for information on hormone therapy (Table 5).

4. Discussion

This study addressed the validity of the existing New Mexico SEER Tumor Registry data on chemotherapy and hormone therapy compared to an independent medical chart review. Overall, there was a moderate agreement between the two databases on chemotherapy use. The specificity of tumor registry for chemotherapy was high at 98.2%, but the sensitivity was low at 70.7%. Agreement between the two databases on hormone therapy was poor to moderate, with a sensitivity of 59.7% and specificity of 82.6%.

There are several reasons for the incompleteness of chemotherapy information in the New Mexico SEER tumor registry. First, SEER only requires data on treatments that were initiated within a few months of diagnosis [27]. Adjuvant chemotherapy and hormone therapy are mostly administered after initial primary surgery of breast cancer, so patients may not have been followed up long enough to obtain complete treatment information, particularly on adjuvant hormone therapy, which is often given after a first course of chemotherapy. This could be one of the reasons why the information on cancer surgery or radiation in the SEER registries was more complete, as we and several other investigators demonstrated [15–18]. Second, chemotherapy was often administered at outpatient clinics or at physician's office (usually in medical oncologists' offices). SEER does not require medical oncologists' offices to be checked for chemotherapy administration by the SEER data collectors [26,34,35]. It may be unrealistic for SEER to send registrars to physicians' office to abstract medical records or chemotherapy flow charts on every cancer case, especially in cases when cancer treatment is provided by multiple doctors [26]. However, there appeared to be no significant difference for chemotherapy between cases that were checked at an oncologist's office and those that were not. In contrast, for hormone therapy, discordance between the two databases were more likely when comparing cases that were checked at an oncologist's office with those who were not. Furthermore, although New Mexico residents who were diagnosed and treated at facilities

outside the state can be identified through data exchange with surrounding state registries [27,28], recording of this treatment information in the registry could be significantly delayed. If patients received chemotherapy or hormone therapy in other nonsurrounding state medical facilities, these treatments would be likely to be missed in the tumor registry. In a recent study addressing the validity of the California Cancer Registry for breast cancer therapy compared to chart reviews, the agreement was 90% for chemotherapy and 50% for hormone therapy, and kappa was 0.62 (0.50–0.75) and 0.22 (0.16–0.29), respectively [13]. This study had lower agreement rates in comparison to our study, but it included women with breast cancer of all ages rather than just women aged 65 and older.

Quality and completeness of the current independent medical chart reviews are another important issue. Our two data abstractors are experienced and specially trained SEER data collectors. Patients' charts were abstracted at the hospital where the diagnosis was made. In addition, in half of all cases we abstracted charts from at least two different locations such as oncologists' offices or radiology departments. When the chart noted that the patient had been referred to an oncologist, arrangements were made to visit the appropriate facilities. However, not all patients with breast cancer were referred to oncologists, and two previous studies showed that about 50% of women aged 65 or older with breast cancer did not have consultations with medical oncologists after surgery [36,37]. Older women were substantially less likely to be referred to medical oncologists [36–40]. Even so, it is still possible that some medical charts that contained information on chemotherapy and hormone therapy were not located by our reviewers. If patients were deceased, their medical charts were often stored in off-site storage facilities. Retrieval of these charts was possible, but it took time and a fee was involved. Even if the charts were retrieved, frequently they had already been thinned or contained little to no data on the treatment. Although the sensitivity, kappa, and concordance rates for chemotherapy were lower in cases deceased at the time of chart review compared to those who were still alive, the risk of being discordant was not statistically significant. The possibility that medical charts were less likely to be located for the deceased cases was also not supported by the finding that there was a significantly lower risk of being discordant for hormone therapy in these cases (Table 5). Furthermore, the medical records themselves may have failed to record the fact that chemotherapy was administered, particularly in patients who received such a therapy at the out-of-state facilities. Previous studies showed that medical records often do not completely or accurately represent the care rendered to patients or certain aspects of their diseases, and some specific treatments may not be well documented, especially in the outpatient records [41].

Thus, it may be likely that both tumor registry and chart reviews missed cases with chemotherapy, which may be captured by contacting their oncology physicians or interviewing themselves. According to recommendations from several studies on the validity of information on cancer treatment by us and others [14–17,29,42–47], the preferred approach would be to combine the data from the registry, medical chart reviews, Medicare claims, and information from oncology physicians, whenever possible, because these data sources may compliment each other.

Our study has other limitations. First, we only studied women aged 65 or older who were diagnosed with breast cancer. Hence, the findings may not be applicable to younger women with breast cancer. Second, this study was limited to patients diagnosed with breast cancer. It is still unknown how valid the tumor registry data on chemotherapy is for patients diagnosed with other cancers. Finally, the findings in New Mexico may not be generalizable to other SEER registries or other tumor registries in the United States.

In conclusion, there was moderate to excellent agreement on the information for chemotherapy of breast cancer between the New Mexico Tumor Registry and the medical chart reviews. The

agreement of the information on hormone therapy was poor to moderate between the two databases. Internal validity of the information on chemotherapy and hormone therapy from the tumor registry was good, which was supported by our recent reports using the New Mexico Tumor Registry data on the findings expected according to patient or tumor characteristics and clinical guidelines [20,46]. However, a possible underreporting should be noted when reporting information on cancer chemotherapy and hormone therapy using the SEER tumor registry data. The preferred approach would be to combine several large databases to obtain more complete information on cancer chemotherapy and hormone therapy.

Acknowledgements

This study was supported by a grant from the National Cancer Institute (R01-CA090626). We thank Anna Davidson, James Goodwin, and Dawn Hamilton for their help in initiating this study in New Mexico, and faculty and staff from the New Mexico Tumor Registry and numerous medical facilities across the state of New Mexico for their cooperation in this study.

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Table 1

Comparison between current medical chart review and the existing tumor registry data in New Mexico on chemotherapy administration that was received within 6 months of diagnosis

		Tumor registry			
	Chemotherapy categories (row %) [column %]	**No chemotherapy**	**Chemotherapy received**	**Total**	**Agreement rate and kappa (95% CI)**
Chart review	No chemotherapy	1,109 (98.2) [97.5]	20 (1.8) [22.2]	1,129	96.0%
	Chemotherapy received	29 (29.3) [2.6]	70 (70.7) [77.8]	99	0.72 (0.64–0.79)
	Total	1,138	90	1,228	

Table 2

Comparison between current medical chart review and the previous tumor registry in New Mexico on adjuvant hormone therapy that was received within 6 months of diagnosis

		Tumor registry			
	Hormone therapy categories (row %) [column %]	**No hormone therapy**	**Hormone therapy received**	**Total**	**Agreement rate and kappa (95% CI)**
Chart review	No hormone therapy	748 (89.5) [82.6]	88 (10.5) [27.3]	836	80.0%
	Hormone therapy received	158 (40.3) [17.4]	234 (59.7) [72.7]	392	0.52 (0.46–0.57)
	Total	906	322	1,228	

Table 3

Sensitivity and specificity of tumor registry data for chemotherapy and hormone therapy within 6 months of diagnosis compared with medical chart review, stratified by other factors

Characteristics from SEER registry	Number of patients	Chemotherapy		Hormone Therapy	
		Sensitivity (%)[a]	Specificity (%)[b]	Sensitivity (%)[a]	Specificity (%)[b]
All patients	1,228	70.7	98.2	59.7	89.5
Age					
65–69	305	88.2	98.2	66.0	92.1
70–74	365	53.5	98.1	62.2	83.3
75+	558	77.3	98.3	54.1	92.0
Sources of charts documenting therapy					
Oncologist's office					
Yes	308	66.7	98.5	57.1	85.7
No	920	73.0	98.1	61.2	90.4
Radiation Department					
Yes	212	55.6	99.0	64.3	90.6
No	1,016	74.1	98.1	58.4	89.3
Other physician's office					
Yes	251	42.9	99.2	44.7	92.2
No	977	75.3	98.0	63.8	88.8
Tumor stage					
Early stage (I+II)	961	75.0	98.6	60.7	90.6
Late stage (III+IV)	176	69.6	95.4	57.5	84.5
Unstaged (unknown)	91	40.0	98.8	55.2	85.5
Hormone therapy[c]					
Yes	421	64.9	98.4	—	—
No	807	74.2	98.1	—	—
Chemotherapy[c]					
Yes	108	—	—	54.8	81.8
No	1,120	—	—	60.1	90.3
Year of diagnosis					
1993–1996	513	81.0	98.4	61.3	85.4
1997–1999	715	68.0	98.1	58.8	92.7
Status at time of review					
Alive	867	72.7	98.6	55.4	90.0
Died	361	66.7	97.3	71.4	88.3

[a] The sensitivity of tumor registry for therapy was defined as the percentage of cases receiving therapy according to medical chart reviews that are identified by tumor registry as receiving therapy.

[b] Specificity was defined as percentage of cases identified by medical records as not receiving therapy that are identified by tumor registry data as also not receiving therapy.

[c] Information on hormone and chemotherapy was from medical chart reviews.

Table 4

Comparison between tumor registry and medical chart review on chemotherapy that was administered within 6 months of diagnosis: kappa, concordance rate, and adjusted odds ratios of discordance

Characteristics from SEER registry	Number of patients	Tumor registry compared to medical chart review		
		Simple kappa (95% confidence interval)	% of concordant cases (observed agreement)	Adjusted odds ratio of being discordant (95% confidence interval)[a]
All patients	1,228	0.72 (0.64–0.79)	96.0	—
Age				
65–69	305	0.85 (0.76–0.95)	97.0	1.00 (reference)
70–74	365	0.60 (0.46–0.74)	92.9	2.28 (1.03–5.06)
75+	558	0.70 (0.54–0.85)	97.5	0.66 (0.27–1.60)
Sources of charts documenting therapy				
Oncologist's office				
Yes	308	0.72 (0.59–0.85)	94.8	1.30 (0.66–2.56)
No	920	0.72 (0.62–0.81)	96.4	1.00 (reference)
Radiation Department				
Yes	212	0.64 (0.44–0.85)	95.3	1.34 (0.63–2.83)
No	1,016	0.73 (0.65–0.81)	96.2	1.00 (reference)
Other physician's office				
Yes	251	0.53 (0.27–0.78)	96.0	1.15 (0.55–2.41)
No	977	0.74 (0.69–0.82)	96.0	1.00 (reference)
Tumor stage				
Early stage (I+II)	961	0.73 (0.63-0.83)	97.4	1.00 (reference)
Late stage (III+IV)	176	0.69 (0.56–0.81)	88.6	4.27 (2.17–8.41)
Unstaged (unknown)	91	0.48 (0.04–0.91)	95.6	1.49 (0.48–4.62)
Hormone therapy[b]				
Yes	421	0.69 (0.56–0.82)	95.5	0.94 (0.50–1.77)
No	807	0.73 (0.64-0.82)	96.3	1.00 (reference)
Year of diagnosis				
1993–1996	513	0.73 (0.58-0.87)	97.7	1.00 (reference)
1997–1999	715	0.71 (0.63-0.80)	94.8	1.83 (0.90-3.73)
Status at time of review				
Alive	867	0.75 (0.66–0.84)	96.7	1.00 (reference)
Died	361	0.66 (0.52–0.80)	94.5	1.46 (0.76–2.79)

[a] Odds ratios were derived from the logistic regression model, adjusted for the variables listed in the table.

[b] Information on hormone was from medical chart reviews.

Table 5

Comparison between tumor registry and medical chart review on hormone therapy that was administered within 6 months of diagnosis: kappa, concordance rate, and adjusted odds ratios of discordance

Characteristics from SEER registry	Number of patients	Tumor registry compared to medical chart review		
		Simple kappa (95% confidence interval)	% of concordant cases (observed agreement)	Adjusted odds ratio of being discordant (95% confidence interval)[a]
All patients	1,228	0.52 (0.46–0.57)	80.0	—
Age				
65–69	305	0.61 (0.51–0.70)	83.9	1.00 (reference)
70–74	365	0.46 (0.16–0.56)	76.4	1.66 (1.12–2.47)
75+	558	0.50 (0.42–0.58)	80.5	1.40 (0.95–2.05)
Sources of charts documenting therapy				
Oncologist's office				
Yes	308	0.43 (0.34–0.53)	82.6	1.98 (1.43–2.73)
No	920	0.54 (0.47–0.60)	72.1	1.00 (reference)
Radiation Department				
Yes	212	0.57 (0.46–0.68)	80.2	0.89 (0.60–1.32)
No	1,016	0.50 (0.44–0.56)	79.9	1.00 (reference)
Other physician's office				
Yes	251	0.54 (0.49–0.60)	76.1	1.27 (0.89–1.80)
No	977	0.41 (0.29–0.53)	81.0	1.00 (reference)
Tumor stage				
Early stage (I+II)	961	0.54 (0.48–0.60)	81.6	1.00 (reference)
Late stage (III+IV)	176	0.43 (0.30–0.57)	73.3	1.99 (1.31–3.02)
Unstaged (unknown)	91	0.42 (0.22–0.62)	75.8	1.92 (1.11–3.29)
Chemotherapy[b]				
Yes	108	0.37 (0.17–0.56)	74.1	1.21 (0.74–1.99)
No	1,120	0.53 (0.48–0.58)	80.5	1.00 (reference)
Year of diagnosis				
1993–1996	513	0.47 (0.38–0.55)	78.8	1.00 (reference)
1997–1999	715	0.55 (0.49–0.62)	80.8	0.70 (0.51–0.95)
Status at time of review				
Alive	867	0.48 (0.42–0.55)	78.5	1.00 (reference)
Died	361	0.60 (0.51–0.69)	83.4	0.56 (0.40–0.80)

[a] Odds ratios were derived from the logistic regression model, adjusted for the variables listed in the table.

[b] Information on chemotherapy was from medical chart reviews.