Association Between the Availability of Medical Oncologists and Initiation of Chemotherapy for Patients With Stage III Colon Cancer

By Chun Chieh Lin, PhD, MBA, and Katherine S. Virgo, PhD, MBA

American Cancer Society; and Emory University, Atlanta, GA

Abstract

Purpose: Although the number of medical oncologists (MOs) has steadily increased over time, and adjuvant chemotherapy provides significant survival benefit for patients with stage III colon cancer, many patients still do not receive chemotherapy. Uneven geographic distribution of MOs may contribute to decreasing access to cancer care. This study explored the association of MO availability by hospital service area (HSA) of patient residence and access to chemotherapy treatment.

Methods: Using the linked SEER-Medicare database, the study identified 9,262 patients who were age ≥66 years and underwent colectomy for stage III colon cancer diagnosed from 2000 to 2005. MOs were identified by physician specialty codes. HSAs are geographic areas that are relatively self-contained with respect to routine hospital care. Multivariate logistic regression was used to investigate the association between MO availability by HSA of patient residence and initiation of chemotherapy.

Results: Within 3 months after colectomy, 5,622 patients (60.7%) initiated chemotherapy. Adjusting for clinical and patient characteristics, patients residing in an HSA with ≥ one MO had an increased likelihood of initiating chemotherapy within 3 months after colectomy compared with those living in areas with no MOs (one to two MOs: OR, 1.451 [$P < .01$]; three to eight MOs: OR, 1.497 [$P < .01$]; ≥ nine MOs: OR, 1.322 [$P < .01$]).

Conclusion: Results suggest that the availability of ≥ one MO within the HSA in which a patient resides was associated with greater access to chemotherapy after surgery.

Introduction

Adjuvant chemotherapy is an effective treatment for patients with stage III colon cancer,[1-4] even for those age ≥66 years.[1,5] However, a significant proportion of patients do not receive chemotherapy.[6-12] Patients who are older,[7,8,10,13] female,[8,14] African American,[9,12,13] and not currently married[9,13] and who live in poverty areas[15] are less likely to receive chemotherapy after colectomy. Being seen by a medical oncologist has also been shown to predict chemotherapy receipt.[9,13,16,17] Studies have shown that patients who saw a medical oncologist were significantly more likely to receive chemotherapy.[13,17,18] Even though an American Society of Clinical Oncology (ASCO) study of the oncologist workforce[19] found that supply and demand were balanced in the past decade, nearly one third of patients with stage III colon cancer still did not see a medical oncologist.[20] In addition, uneven geographic distribution of medical oncologists may decrease the likelihood of accessing cancer care.[21] Thus, the purpose of this study was to determine the association between medical oncologist availability within the hospital service area (HSA) of patient residence and initiation of chemotherapy treatment.

Methods

Data Sources

The population-based National Cancer Institute SEER-Medicare linked data set, an integrated cancer registry and claims data set, was the primary data source. The SEER registries cover the states of Connecticut, Hawaii, Iowa, New Mexico, Utah, Kentucky, Louisiana, New Jersey, and California, as well as the metropolitan areas of Detroit, Atlanta, Seattle, and rural Georgia, capturing approximately 28% of the US population. Medicare claims files are linked to SEER data through an algorithm involving a match of social security number, name, sex, and date of birth. Medicare data include inpatient, outpatient, physician service, and durable medical equipment claims files. The linked SEER-Medicare data set has been widely used to examine patterns of care, evaluate adherence to practice guidelines, estimate treatment costs, and address disparities. To distinguish medical oncologists from other physician specialties, the American Medical Association (AMA) Masterfile was linked with Medicare claims. The AMA Masterfile includes current and historical data for more than 1 million residents, physicians, and students in the United States. This data set provides detailed information regarding each physician's primary specialty, secondary specialty, and practice office location.

Study Population

The study selected all patients in SEER who underwent colectomy for first primary invasive stage III colon cancer (International Classification of Disease for Oncology, Third Edition, codes: C18.0 to C18.9), were diagnosed during 2000 to 2005, were age ≥66 years at diagnosis, and had full Medicare coverage in Parts A and B and were not enrolled in a health maintenance organization during month of diagnosis, 12 months preceding diagnosis, or 6 months after diagnosis. Colectomy for colon

cancer was identified from Medicare claims data using International Classification of Disease, Ninth Edition, Clinical Modification, diagnosis codes and procedure codes, Common Procedure Terminology codes, and Berenson-Eggers Type of Service codes (Table 1). For each patient identified from SEER, all Medicare claims within 12 months preceding and 6 months after the diagnosis date in SEER were examined to identify treatment received. Patients who did not have a diagnosis month on file were excluded because it was unclear whether they received treatment within the study time frame. The few patients who received chemotherapy while residing in more than one HSA during the study period were excluded to eliminate the potential for HSA misclassification. In addition, patients ascertained from death certificates or autopsy records as well as patients who survived <6 months after diagnosis were excluded because they were less likely to have undergone standard treatment. The final study population consisted of 9,262 patients.

Measures

The primary outcome was initiation of chemotherapy within 3 months of colectomy for colon cancer. Initiation of chemotherapy was defined as the presence of at least one claim indicating receipt of chemotherapy in the inpatient, outpatient, physician service, or durable medical equipment files at any time within 3 months after colectomy. Table 1 also lists detailed codes used to identify initiation of chemotherapy.

Medical oncologists were identified using two methods: one, using Medicare outpatient and physician claims and the AMA Masterfile; and two, using Medicare physician claims alone. First, physicians who administered chemotherapy at least once in Medicare outpatient and/or physician claims during the study period were selected. These physicians were then matched to the AMA Masterfile using the unique physician identification number to identify their primary and secondary specialties. Any physician with either a medical oncology or hematology/oncology primary or secondary specialty in the AMA Masterfile was considered a medical oncologist. The second method of identifying medical oncologists used the two-digit performing physician specialty code available in the Medicare physician claims. Any physician who administered chemotherapy at least once in Medicare physician claims during the study period and had one of the following specialty codes was considered a medical oncologist: medical oncology (90), hematology/oncology (83), multiple specialties (70), or internal medicine (11). The latter two specialty codes were included in our definition of medical oncologist because Medicare claims only record one specialty per physician. In both instances, more specific physician specialty codes could not be identified; however, chemotherapy was administered. Internal medicine was considered appropriate because physicians are required to become board certified in internal medicine before applying for certification in medical oncology.

HSAs, defined by the Dartmouth Atlas of Health Care,[22] are geographic areas where medical resources are distributed and used based on the analysis of travel patterns between counties

Table 1. Codes Used to Identify Patients Undergoing Colon Resection Surgery and Receiving Chemotherapy

Code	Condition/Procedure/Regimen
Colon resection surgery	
ICD-9-CM	
Diagnosis	
153 to 153.9	Colon cancer
Procedure	
17.3 to 17.39	Colectomy—laparoscopy
45.7 to 45.79	Colectomy—open
45.8 to 45.83	Intra-abdominal colectomy
CPT-4	
44140 to 44160	Colectomy—open
44204 to 44212	Colectomy—laparoscopy
BETOS	
P1B	Major procedure—colectomy
Chemotherapy	
HCPCS	
J0640	Injection—leucovorin calcium 50 mg
J8520, WW089, WW090, WW091	Capecitabine 150 mg
J8521, WW093, WW094, WW096	Capecitabine 500 mg
J9035	Injection—bevacizumab 10 mg
J9050	Carmustine 100 mg
J9190	Fluorouracil 500 mg
J9201	Gemcitabine hydrochloride 200 mg
J9206	Irinotecan 20 mg
J9303	Injection—panitumumab 10 mg
J9263	Oxaliplatin 0.5 mg
Q0083-Q0085	Chemotherapy administration
G0355-G0363	Chemotherapy administration
CPT-4	
96400 to 96549	Chemotherapy administration
ICD-9-CM	
Diagnosis	
V58.1	Encounter for antineoplastic chemotherapy and immunotherapy
V66.2	After chemotherapy
V67.2	Cancer chemotherapy follow-up
Procedure	
99.25	Injection or infusion of cancer chemotherapeutic substance
99.28	Injection or infusion of biologic response modifier as antineoplastic agent
Revenue center	
0331	Chemotherapy administration—injection
0332	Chemotherapy administration—oral
0335	Chemotherapy administration—intravenous
BETOS	
O1D	Chemotherapy

Abbreviations: BETOS, Berenson-Eggers Type of Service; CPT-4, Current Procedural Terminology, Fourth Edition; HCPCS, Healthcare Common Procedure Coding System; ICD-9-CM, International Classification of Diseases, 9th Edition, Clinical Modification.

for routine hospital care. Each HSA covers one or more zip code areas. Thus, by using the zip code–HSA crosswalk table created by the Dartmouth Atlas, the number of medical oncologists available in an HSA was identified by the zip code where the oncologists practiced and aggregated at the HSA level. Medical oncologists may practice in multiple office locations. In this study, approximately 15% of medical oncologists practiced in more than one HSA. Because there was no information to permit distinguishing between a change in practice location as of a specific date versus a multiple-location practice, the study considered these oncologists accessible in multiple practice locations. Therefore, if a medical oncologist practiced in multiple HSAs, he or she was included in the total number of medical oncologists available in every HSA in which he or she practiced. These calculations were performed before applying exclusion criteria.

Once the number of medical oncologists in an HSA was calculated, HSAs were categorized into quartiles, where the bottom quartile represented HSAs with the fewest medical oncologists and the top quartile represented HSAs with the most medical oncologists. The bottom quartile (Q1) consisted of HSAs with no medical oncologists; in the second quartile (Q2), the number of medical oncologists ranged from one to two; in the third quartile (Q3), three to eight; and in the top quartile, ≥ nine. By linking the oncologist and postexclusion patient files, it was then possible to identify the number of medical oncologists in the HSA in which each patient resided.

Patient demographic information (age at diagnosis, sex, race, marital status), clinical information (comorbidity, positive lymph nodes), socioeconomic status (neighborhood income level), and other information (region of residence, year of diagnosis, SEER registry area) were obtained from the SEER data. Medicaid eligibility was determined by state buy-in monthly variables from the Medicare denominator file.[23] The Charlson comorbidity score was determined based on diagnosis and procedure codes in Medicare claims between the 12-month period before diagnosis and the month of diagnosis.

Statistical Analyses

First, the sociodemographic and clinical characteristics of the study population were examined overall for the medical oncologist workforce quartiles: no medical oncologist available, one to two medical oncologists in an HSA, three to eight in an HSA, and ≥ nine in an HSA. χ^2 tests were used to determine if a statistically significant difference existed, with significance set at $P < .05$. Logistic regression was used to estimate the likelihood of initiating chemotherapy within 3 months of colon cancer surgery, clustering by HSA and adjusting for patient demographic characteristics, clinical information, socioeconomic status, year of diagnosis, and geographic location. Odds ratios (ORs) and 95% CIs are reported. To understand whether 3 months after colon cancer surgery was a reasonable cutoff point, sensitivity analyses were conducted to examine the likelihood of initiating chemotherapy within 6 months of colon cancer surgery. Two-sided P values are reported and considered statistically significant at the .05 level. All statistical analyses were performed with SAS version 9.2 (SAS Institute, Cary, NC).

Results

Of the 16,971 patients diagnosed with first primary stage III colon cancer during the study time frame (2000 to 2005), patients who were ascertained from death certificates at autopsy (n = 4), did not have continuous Medicare Parts A and B enrollment without health maintenance organization enrollment during the 12 months before and 6 months after diagnosis (n = 5,657), did not survive ≥6 months (n = 1,355), resided in more than one HSA during the study period (n = 152), did not have positive nodes (n = 133), did not have colectomy within 3 months of diagnosis (n = 358), and received chemotherapy before colectomy (n = 42) were excluded from the analysis. Table 2 lists the characteristics of 9,262 patients diagnosed with stage III colon cancer between 2000 and 2005 who met all eligibility criteria for the study. Overall, patients were white (82.08%) and female (58.22%), had no Medicaid eligibility (82.24%), resided in a neighborhood with an income level of ≥$30,000 (82.83%), and resided in an HSA with ≥ nine medical oncologists available (65.56%). Chemotherapy was initiated within 3 months after colectomy for 60.7% of the study population. There were significant differences between patients who resided in an HSA with varying levels of medical oncologist workforce availability ($P < .01$). Patients residing in an HSA with no medical oncologists were more likely to be white ($P < .001$) and live in the Midwest or South ($P < .001$) compared with those residing in areas with ≥ one medical oncologist. Income levels in these neighborhoods were more likely to be <$30,000 ($P < .001$).

Table 3 summarizes the results of logistic regression for initiation of chemotherapy. Adjusting for all other factors, patients residing in an HSA with one to three medical oncologists were 1.451 times more likely to initiate chemotherapy within 3 months after colon resection compared with those who lived in areas with no medical oncologists (95% CI, 1.137 to 1.853; $P = .0028$). Patients residing in an HSA with four to eight medical oncologists were 1.497 times more likely to initiate chemotherapy relative to those lived in areas with no medical oncologists (95% CI, 1.186 to 1.89; $P < .001$). Patients residing in an HSA with ≥ nine medical oncologists were 1.322 times more likely to initiate chemotherapy than those in areas with no medical oncologists (95% CI, 1.077 to 1.623; $P = .0077$). In addition, patients who were age >70 years ($P < .001$), were African American ($P < .01$), were currently not married or had unknown marital status ($P < .001$), had a comorbidity score of ≥ one ($P < .001$), were dually eligible for Medicare and Medicaid ($P < .001$), and were diagnosed more recently (ie, 2005; $P < .05$) had a decreased likelihood of initiating chemotherapy within 3 months after colectomy.

Sensitivity analyses were conducted to examine the impact of lengthening the chemotherapy initiation period from 3 to 6 months after colectomy. Redefining the dependent variable to include patients initiating chemotherapy within 6 months after colectomy did not change our results.

Table 2. Study Population Demographic and Clinical Characteristics

			No. of Medical Oncologists in HSA								
	Total		None		One to Two		Three to Eight		≥ Nine		
Characteristic	No.	%	No.	%	No.	%	No.	%	No.	%	*P*
Total	9,262	100.0	651	7.03	884	9.54	1,655	17.87	6,072	65.56	
Age at diagnosis, years											.37
67-70	1,803	19.47	125	19.2	186	21.04	334	20.18	1,158	19.07	
71-75	2,178	23.52	151	23.2	209	23.64	395	23.87	1,423	23.44	
76-80	2,234	24.12	171	26.27	217	24.55	356	21.51	1,490	24.54	
81-85	1,846	19.93	120	18.43	163	18.44	357	21.57	1,206	19.86	
≥ 86	1,201	12.97	84	12.9	109	12.33	213	12.87	795	13.09	
Race/ethnicity											< .001
White	7,602	82.08	564	86.64	752	85.07	1,431	86.47	4,855	79.96	
Black	735	7.94	46	7.07	50	5.66	82	4.95	557	9.17	
Hispanic	417	4.5	23	3.53	56	6.33	67	4.05	271	4.46	
Other	508	5.48	18	2.76	26	2.94	75	4.53	389	6.41	
Sex											.13
Male	3,870	41.78	276	42.4	398	45.02	666	40.24	2,530	41.67	
Female	5,392	58.22	375	57.6	486	54.98	989	59.76	3,542	58.33	
Marital status											< .001
Married	4,631	50.0	329	50.54	457	51.7	816	49.31	3,029	49.88	
Not married	4,258	45.97	289	44.39	372	42.08	764	46.16	2,833	46.66	
Unknown	373	4.03	33	5.07	55	6.22	75	4.53	210	3.46	
Medicaid status											.08
No Medicaid	7,617	82.24	531	81.57	721	81.56	1,365	82.48	5,000	82.35	
Medicaid before and after diagnosis	1,420	15.33	101	15.51	139	15.72	242	14.62	938	15.45	
Medicaid before or after diagnosis*	225	2.43	19	2.92	24	2.71	48	2.9	134	2.21	
Comorbidity score											.28
0	4,332	46.77	307	47.16	421	47.62	729	44.05	2,875	47.35	
1	2,777	29.98	196	30.11	262	29.64	506	30.57	1,813	29.86	
≥ 2	2,153	23.25	148	22.73	201	22.74	420	25.38	1,384	22.79	
Income											< .001
≤ $20,000	317	3.42	34	5.22	43	4.86	49	2.96	191	3.15	
$20,001-$25,000	494	5.33	40	6.14	73	8.26	90	5.44	291	4.79	
$25,001-$30,000	779	8.41	134	20.58	86	9.73	153	9.24	406	6.69	
≥ $30,001	7,672	82.83	443	68.05	682	77.15	1,363	82.36	5,184	85.38	
Initiated chemotherapy within 3 months after colectomy											.008
No	3,640	39.3	291	44.7	328	37.1	623	37.64	2,398	39.49	
Yes	5,622	60.7	360	55.3	556	62.9	1,032	62.36	3,674	60.51	
Diagnosis year											.41
2000	1,502	16.22	101	15.51	134	15.16	251	15.17	1,016	16.73	
2001	1,552	16.76	108	16.59	137	15.5	306	18.49	1,001	16.49	
2002	1,609	17.37	119	18.28	143	16.18	293	17.7	1,054	17.36	
2003	1,629	17.59	118	18.13	161	18.21	263	15.89	1,087	17.9	
2004	1,478	15.96	100	15.36	147	16.63	268	16.19	963	15.86	
2005	1,492	16.11	105	16.13	162	18.33	274	16.56	951	15.66	
Survival time, months											.52
6-12†	999	9.78	64	9.83	86	9.72	191	11.54	658	10.84	
13-24	1,484	16.02	116	17.82	159	17.99	268	16.19	941	15.5	
25-36	1,966	21.23	148	22.73	200	22.62	364	21.99	1,254	20.65	

Continued on next page

Table 2. (Continued)

			No. of Medical Oncologists in HSA								
	Total		None		One to Two		Three to Eight		≥ Nine		
Characteristic	No.	%	No.	%	No.	%	No.	%	No.	%	P
37-48	1,427	15.41	96	14.75	136	15.38	250	15.11	945	15.56	
49-60	1,211	13.07	77	11.83	113	12.78	208	12.57	813	13.39	
≥ 60	2,175	23.48	150	23.04	190	21.49	374	22.6	1,461	24.06	
Region											< .001
West	3,648	39.39	180	27.65	342	38.69	595	35.95	2,531	41.68	
Northeast	2,336	25.22	84	12.9	202	22.85	521	31.48	1,529	25.18	
Midwest	1,521	16.42	141	21.66	148	16.74	201	12.15	1,031	16.98	
South	1,757	18.97	246	37.79	192	21.72	338	20.42	981	16.16	
Registry at diagnosis											< .001
San Francisco	352	3.8	−‡	—	23	2.6	116	7.01	> 210	> 3.45	
Connecticut	654	7.06	17	2.61	32	3.62	119	7.19	486	8.0	
Detroit	748	8.08	−‡	—	29	3.28	> 80	> 4.83	634	10.44	
Hawaii	141	1.52	−‡	—	−‡	—	30	1.81	91	1.5	
Iowa	773	8.35	140	21.51	119	13.46	117	7.07	397	6.54	
New Mexico	227	2.45	29	4.45	51	5.77	32	1.93	115	1.89	
Seattle	444	4.79	28	4.3	> 15	> 1.7	−‡	—	395	6.51	
Utah	231	2.49	25	3.84	28	3.17	30	1.81	148	2.44	
Atlanta and rural Georgia	251	2.71	15	2.31	18	2.03	19	1.15	> 195	> 3.21	
San Jose	174	1.88	−‡	—	15	1.7	−‡	—	158	2.6	
Los Angeles	664	7.17	−‡	—	28	3.17	> 35	> 2.11	590	9.72	
Greater California	1,415	15.28	79	12.14	169	19.12	346	20.91	821	13.52	
Kentucky	803	8.67	113	17.36	87	9.84	241	14.56	362	5.96	
Louisiana	703	7.59	118	18.13	87	9.84	78	4.71	420	6.92	
New Jersey	1,682	18.16	67	10.29	170	19.23	402	24.29	1,043	17.18	

* Medicaid eligible before diagnosis and Medicaid eligible after diagnosis were combined for confidentiality reasons but were analyzed as separate groups.
† Survival times of 6 months and 7-12 months were combined for confidentiality reasons but were analyzed as separate groups.
‡ To protect confidentiality, small cell sizes are suppressed.

Discussion

In this study of patients diagnosed with stage III colon cancer from 2000 to 2005, only 60.19% initiated chemotherapy within 3 months after colon resection surgery, consistent with previous studies.[13,20,24] Uneven geographic distribution of medical oncologists was also shown in this study. Nearly one tenth of patients in this study lived in HSAs without medical oncologists, whereas approximately 65% of patients lived in HSAs with ≥ nine medical oncologists. As anticipated, medical oncologist availability (≥ one) in an HSA was associated with an increased likelihood of chemotherapy initiation after adjusting for other factors. The likelihood of initiating chemotherapy was approximately 1.5 times higher for patients who lived in an HSA with ≥ one medical oncologist than those who resided in areas with no medical oncologists.

Although National Comprehensive Cancer Network guidelines currently recommend colectomy followed by 6 months of adjuvant chemotherapy for patients diagnosed with stage III colon cancer,[25] and chemotherapy after colon resection has been demonstrated to improve survival, with the elderly receiving benefits commensurate with their younger counterparts,[1,5,26] previous studies have shown that older patients are less likely to be referred to medical oncologists for treatment and to receive chemotherapy. Mahoney et al[8] reported that one third of elderly patients who did not receive chemotherapy were never offered this option by their surgeons, one third were considered too old or had significant comorbidities precluding chemotherapy, and the other third were refused chemotherapy.

This study has some limitations. First, some level of coding inaccuracy may exist in claims-based studies, and clinical information is not always as complete as that available from medical record review.[10] Second, most Medicare beneficiaries are age >65 years. Results derived from SEER-Medicare data have limited generalizability to the younger population across the United States. Third, previous studies have suggested that patients are willing to travel farther for specialists than for generalists. Thus, the HSA may not be the most appropriate geographic measure for defining the areas in which patients seek chemotherapy services. Fourth, this study only identified medical oncologists through Medicare outpatient and physician claims but could not do the same

Table 3. Logistic Regression of Characteristics Associated With Initiation of Chemotherapy Within 3 Months of Colon Resection

Characteristic	OR	95% CI	*P*
Age at diagnosis, years			
66-70	1.0		< .001
71-75	0.746	0.63 to 0.884	< .001
76-80	0.37	0.313 to 0.438	< .001
81-85	0.149	0.125 to 0.178	< .001
≥ 86	0.032	0.026 to 0.039	< .001
Race/ethnicity			
White	1.0		
Black	0.682	0.54 to 0.861	.0013
Hispanic	1.064	0.823 to 1.376	.6343
Other	1.219	0.903 to 1.646	.1949
Sex			
Male	1.0		
Female	1.055	0.943 to 1.181	.352
Marital status			
Married	1.0		
Not married	0.594	0.534 to 0.659	< .001
Unknown	0.548	0.417 to 0.721	< .001
Comorbidity score			
0	1.0		
1	0.754	0.674 to 0.843	< .001
≥ 2	0.538	0.473 to 0.611	< .001
Medicaid eligibility			
Not eligible	1.0		
Eligible before diagnosis	0.351	0.214 to 0.578	< .001
Eligible before and after diagnosis	0.602	0.51 to 0.709	< .001
Eligible after diagnosis	0.346	0.222 to 0.541	< .001
Income level			
≤ $20,000	1.0		
$20,001-$25,000	0.916	0.672 to 1.25	.5804
$25,001-$30,000	0.936	0.693 to 1.262	.6632
≥ $30,001	0.966	0.734 to 1.271	.8048
Diagnosis year			
2000	1.0		
2001	0.915	0.773 to 1.082	.2993
2002	0.934	0.778 to 1.122	.4678
2003	1.13	0.949 to 1.347	.1701
2004	0.959	0.806 to 1.141	.6394
2005	0.824	0.692 to 0.981	.0292
SEER registry area			
San Francisco	1.0		
Connecticut	1.283	0.896 to 1.837	.1741
Detroit	1.243	0.903 to 1.711	.1814
Hawaii	1.167	0.801 to 1.7	.422
Iowa	1.103	0.789 to 1.541	.5666
New Mexico	1.025	0.721 to 1.458	.8901
Seattle	1.018	0.685 to 1.513	.9283
Utah	0.911	0.674 to 1.231	.5439
Atlanta	1.09	0.78 to 1.524	.6139
San Jose	1.093	0.738 to 1.618	.6572
Los Angeles	1.641	1.219 to 2.209	.0011
Rural Georgia	1.056	0.372 to 2.998	.9181
Greater California	1.314	0.98 to 1.763	.0682
Kentucky	1.378	1.012 to 1.877	.0417
Louisiana	1.369	1.001 to 1.87	.049
New Jersey	1.393	1.047 to 1.854	.0229
No. of medical oncologists in patient residence HSA			
None	1.0		
One to two	1.451	1.137 to 1.853	.0028
Three to eight	1.497	1.186 to 1.89	< .001
≥ Nine	1.322	1.077 to 1.623	.0077

Continued on next column

Table 3. (Continued)

Abbreviations: HSA, hospital service area; OR, odds ratio.

with inpatient claims. Medicare inpatient claims did not contain attending physician information. The only way to identify the attending physician for inpatient chemotherapy is through linkage to physician claims. If physician claims contain chemotherapy delivery events, and the claim dates are within the patients' hospitalization period, the physicians delivering inpatient chemotherapy can be identified. However, only half of patients who underwent inpatient chemotherapy had corresponding physician claims permitting identification of the physicians who delivered inpatient chemotherapy. Therefore, the number of medical oncologists within an HSA might have been underestimated. In addition, this study did not include information on factors such as physician and health system characteristics or patient preferences, which might influence decisions regarding whether or when to initiate chemotherapy after surgery.

Currently, ASCO predicts there will be a shortfall in the supply of oncology visits equaling 9.5 million by 2020.[27] Although no single strategy will solve the oncology service shortage right away, especially for patients in underserved areas, policy makers and cancer leaders across the country need to start taking actions to close the gap and to ensure that oncology services will be accessible for all patients with need. In the short term, future research should examine whether the results from this study are generalizable to other cancer sites. In the longer term, studies should revisit the current analysis in 5 to 10 years.

Acknowledgment

Supported by American Cancer Society Intramural Research Funding. Presented in part at the 33rd Annual Meeting of the Society of Medical Decision Making, October 22-26, 2011, Chicago, IL.

Authors' Disclosures of Potential Conflicts of Interest

The author(s) indicated no potential conflicts of interest.

Author Contributions
Conception and design: All authors

Data analysis and interpretation: All authors

Manuscript writing: All authors

Final approval of manuscript: All authors

Corresponding author: Chun Chieh "Anna" Lin, PhD, MBA, Health Services Research Program, Intramural Research, American Cancer Society, 250 Williams St NW, Atlanta, GA 30303-1002; e-mail: anna.lin@cancer.org.

DOI: 10.1200/JOP.2012.000627; published online ahead of print at jop.ascopubs.org October 16, 2012.

References

1. Sundararajan V, Mitra N, Jacobson J, et al: Survival associated with 5-fluorouracil-based adjuvant chemotherapy among elderly patients with node-positive colon cancer. Ann Intern Med 136:349-357, 2002

2. Iwashyna T, Lamont E: Effectiveness of adjuvant fluorouracil in clinical practice: A population-based cohort study of elderly patients with stage III colon cancer. J Clin Oncol 20:3992-3998, 2002

3. Jessup JM, Stewart A, Greene FL, et al: Adjuvant chemotherapy for stage III colon cancer. JAMA 294:2703-2711, 2005

4. Zuckerman IH, Rapp T, Onukwugha E, et al: Effect of age on survival benefit of adjuvant chemotherapy in elderly patients with stage III colon cancer. J Am Geriatr Soc 57:1403-1410, 2009

5. Sargent D, Goldberg R, Jacobson S, et al: A pooled analysis of adjuvant chemotherapy for resected colon cancer in elderly patients. N Engl J Med 345: 1091-1097, 2001

6. Etzioni DA, El-Khoueiry AB, Beart RW Jr: Rates and predictors of chemotherapy use for stage III colon cancer. Cancer 113:3279-3289, 2008

7. Sundararajan V, Grann VR, Jacobson JS, et al: Variations in the use of adjuvant chemotherapy for node-positive colon cancer in the elderly: A population-based study. Cancer J 7:213-218, 2001

8. Mahoney T, Kuo YH, Topilow A, et al: Stage III colon cancers: Why adjuvant chemotherapy is not offered to elderly patients. Arch Surg 135:182-185, 2000

9. Baldwin LM, Dobie SA, Billingsley K, et al: Explaining black-white differences in receipt of recommended colon cancer treatment. J Natl Cancer Inst 97:1211-1220, 2005

10. Schrag D, Cramer L, Bach P, et al: Age and adjuvant chemotherapy use after surgery for stage III colon cancer. J Natl Cancer Inst 93:850-857, 2001

11. Cronin D, Harlan L, Potosky A, et al: Patterns of care for adjuvant therapy in a random population-based sample of patients diagnosed with colorectal cancer. Am J Gastroenterol 101:2308-2318, 2006

12. White A, Liu CC, Xia R, et al: Racial disparities and treatment trends in a large cohort of elderly African Americans and Caucasians with colorectal cancer, 1991 to 2002. Cancer 113:3400-3409, 2008

13. Luo R, Giordano SH, Freeman JL, et al: Referral to medical oncology: A crucial step in the treatment of older patients with stage III colon cancer. Oncologist 11:1025-1033, 2006

14. McGory M, Zingmond DS, Sekeris E, et al: A patient's race/ethnicity does not explain the underuse of appropriate adjuvant therapy in colorectal cancer. Dis Colon Rectum 49:319-329, 2006

15. VanEenwyk J, Campo JS, Ossiander EM: Socioeconomic and demographic disparities in treatment for carcinomas of the colon and rectum. Cancer 95:39-46, 2002

16. Li X, Butts C, Fenton D, et al: Utilization of oncology services and receipt of treatment: A comparison between patients with breast, colon, rectal, or lung cancer. Ann Oncol 22:1902-1909, 2011

17. Neugut AI, Grann VR: Referral to medical oncologists: Are there barriers at the gate? J Clin Oncol 20:1716-1718, 2002

18. Earle CC, Neumann PJ, Gelber RD, et al: Impact of referral patterns on the use of chemotherapy for lung cancer. J Clin Oncol 20:1786-1792, 2002

19. Status of the medical oncology workforce: The American Society of Clinical Oncology. J Clin Oncol 14:2612-2621, 1996

20. Davidoff AJ, Rapp T, Onukwugha E, et al: Trends in disparities in receipt of adjuvant therapy for elderly stage III colon cancer patients: The role of the medical oncologist evaluation. Med Care 47:1229-1236, 2009

21. Onega T, Duell EJ, Shi X, et al: Geographic access to cancer care in the U.S. Cancer 112:909-918, 2008

22. Dartmouth Atlas of Health Care. http://www.dartmouthatlas.org/tools/downloads.aspx

23. Koroukian SM, Dahman B, Copeland G, et al: The utility of the state buy-in variable in the Medicare denominator file to identify dually eligible Medicare-Medicaid beneficiaries: A validation study. Health Serv Res 45:265-282, 2010

24. Hu CY, Delclos G, Chan W, et al: Assessing the initiation and completion of adjuvant chemotherapy in a large nationwide and population-based cohort of elderly patients with stage-III colon cancer. Med Oncol 28:1062-1074, 2011

25. NIH Consensus Conference: Adjuvant therapy for patients with colon and rectal cancer. JAMA 264:1444-1450, 1990

26. Des Guetz G, Uzzan B, Morere JF, et al: Duration of adjuvant chemotherapy for patients with non-metastatic colorectal cancer. Cochrane Database Syst Rev 1:CD007046, 2010

27. Erikson C, Salsberg E, Forte G, et al: Future supply and demand for oncologists : Challenges to assuring access to oncology services. J Oncol Pract 3:79-86, 2007