Care transitions between hospitals are associated with treatment delay for patients with muscle invasive bladder cancer

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Abstract

Background—Hypothesizing that changing hospitals between diagnosis and definitive therapy (care transition) may delay timely treatment, our objective was to identify the association between care transitions and treatment delay ≥ 3 months in patients with muscle invasive bladder cancer (MIBC).

Methods—Using the National Cancer Database, all patients with stage ≥ II urothelial carcinoma treated from 2003–2010 were identified. A care transition was defined as a change in hospital from diagnosis to definitive course of treatment (diagnosis to RC or start of neoadjuvant chemotherapy). Logistic regression models were used to test the association between care transition and treatment delay.

Results—Of 22,251 patients, 14.2% experienced a treatment delay of ≥ 3 months, and this proportion increased over time (13.5% [2003–2006] versus 14.8% [2007–2010], p=0.01). 19.4% of patients undergoing a care transition experienced a delay to definitive treatment compared to 10.7% of patients diagnosed and treated at the same hospital (p<0.001). The proportion of patients experiencing a care transition increased over the study period (37.4% [2003–2006] versus 42.3%

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[2007–2010], p<0.001). Following adjustment, patients were more likely to experience a treatment delay when undergoing a care transition (OR 2.0 [CI 1.8–2.2]).

Conclusions—Patients with MIBC who underwent a care transition were more likely to experience a treatment delay of 3 months. Strategies to expedite care transitions at the time of hospital referral may be a means to improve quality of care.

Keywords

bladder cancer; radical cystectomy; care transition; quality; treatment delay

Introduction

Patients often travel great distances for centralized surgical care[1] and are at risk to be temporarily taken out of their usual healthcare system. Improvement of provider care coordination at the time of "care transitions", loosely defined as movement between health care practitioners and care settings as needs change during the course of a chronic or acute illness,[2] are a priority of contemporary health care reform. While the majority of current research and interventions have focused on the transition between inpatient and outpatient care for longitudinal management of chronic illnesses, the impact of interruptions in care coordination when patients change providers and hospitals for complex surgical care has been inadequately studied.

In Medicare beneficiaries, high surgical volume is associated with reduced mortality and improved outcomes for numerous cancers at the national level,[3] and has been proposed as a surrogate for care quality. Regionalization of complex cancer operations and high-risk surgical procedures to high volume providers may provide one mechanism to curtail potentially avoidable expenses which has been championed by the media and advocacy organizations such as a the Leap Frog Group.[4] However, widespread centralization of surgical care could result in a large proportion of patients changing hospitals and healthcare systems, exacerbating existing access disparities, and overwhelming the resources of tertiary and quaternary referral centers.[5] Confirming these concerns, as caseloads at specialized centers have increased over the past decade, wait times for cancer treatment in 8 common solid organ malignancies have increased.[6]

Bladder cancer, the second most common genitourinary malignancy in the United States and one of the most expensive from diagnosis to death,[7] represents a targetable area for quality improvement. Radical cystectomy (RC) with urinary diversion in conjunction with administration of neoadjuvant or adjuvant chemotherapy,[8] is the gold standard for treatment of muscle invasive bladder cancer (MIBC) with 5-year survival rate of 62%–80%.[9] The time from cancer diagnosis to treatment reflects availability of hospital resources and efficiency of overall care,[6, 10] and greater than 3 months delay in the receipt of RC has been associated with decreased disease specific and overall survival.[11, 12] Hypothesizing that care transitions at the time of referral for RC may delay timely treatment in patients with muscle invasive bladder cancer, our objective was to examine the association between care transitions and treatment delay 3 months using a large national tumor registry.

Patients and Methods

Cohort Definition

A program of the American College of Surgeons, Commission on Cancer, and American Cancer Society, the National Cancer Data Base (NCDB), a national cancer registry established in 1989, serves as a comprehensive clinical surveillance resource for cancer care in the United States. The NCDB compiles data from more than 1,500 commission-accredited cancer programs in the United States and Puerto Rico and captures approximately 70% of all newly diagnosed cancer cases.

All patients with urothelial carcinoma of the bladder were identified based on *International Classification of Diseases for Oncology, 3rd Edition (ICD-O-3)* site codes (8120, 8121, 8122, 8123, 8124, 8130, 8131, 8132). Our analytic cohort was restricted to adults 18 to 90 years of age undergoing RC for analytic stage II–IV disease during 2003–2010. Patients with non-urothelial histologic type, stage I or unknown stage, or second primary cancers were excluded. Patient socioeconomic characteristics were provided using census tract data. Co-morbidity burden was determined using the Charlson-Deyo classification and categorized as 0, 1, or 2.

Based on case volume and access to cancer-related services and specialists, the NCDB classifies hospitals as unknown, community (100–500 new cancer cases per year), comprehensive community (>500 cases per year), and teaching/research (academic) centers defined by either National Cancer Institute designation or medical school affiliation. Using previously described methods,[3, 13, 14] annual RC hospital volume status (by tercile) was determined by dividing the total number of RC's performed at each hospital over the study period by the number of years the hospital reported any bladder cancer cases. Distance between the patient's residence and the hospital of record was defined by mile quintiles using zip code centroid location to determine residence and hospital latitude and longitude. The NCDB requires reporting of dates of initial cancer diagnosis (defined by the first clinical or histologic confirmation), as well as treatment initiation and treatment completion dates for the index surgery and neoadjuvant chemotherapy. Neoadjuvant chemotherapy was defined as systemic treatment received prior to RC using initiation of therapy date. Using these data time to treatment was defined as time from diagnosis to either index surgery or initiation of neoadjuvant chemotherapy to avoid penalizing hospitals in which pre-operative chemotherapy is preferentially administered.[15] Treatment delay was defined as 3 months from diagnosis to treatment. While the facility reporting each case to the NCDB is the hospital in which a patient receives the first course of definitive therapy, the NCDB also requires reporting if diagnosis and definitive treatment were performed at differing hospitals. Using these data, a care transition was defined as a change in hospital from diagnosis to definitive treatment.[6]

Statistical Analyses

Trends in care transition and delay to definitive treatment were assessed during the period 2003–2010 using Chi-square tests. Patient demographic and clinical characteristics were compared between those experiencing a care transition and those who did not by using Chi-

square tests. Adjusting for year, age, gender, race, ethnicity, volume, distance, payer group, Charlson-Deyo score, income, education, tumor grade, analytic stage, urban/rural status, and facility type and location, we examined the association between care transition and delay in receipt of definitive therapy using multivariable logistic regression. To account for clustering within hospitals, we calculated robust standard errors using Generalized Estimating Equations. All statistical analyses were performed using SAS software (version 9.3).

Results

We identified 22,251 patients (mean age 67.6 ± 10.7 years, 74.0% male) with stage ≥ II urothelial carcinoma undergoing RC from 2003–2010. The majority of patients had Medicare (56.1%) or private insurance (33.4%), and were treated at comprehensive community (43.7%) or academic health centers (44%). On final pathology, 38% of patients had stage II disease, 32% had stage III disease, and 30% had stage IV disease. A minority (12%) of the sample underwent neoadjuvant chemotherapy, and this proportion increased from 6% to 23% over the length of the study period.

Forty percent of the cohort experienced a care transition between diagnosis and treatment hospital. Characteristics of patients with and without care transitions, differed with respect to gender, ethnicity, race, age, income, education, co-morbidity, tumor stage, tumor grade, facility location, and hospital volume status (all p values<0.001); there were no significant differences in payor group/insurance status (p=0.069) (Table 1). Following adjustment, male gender (OR 1.07 [CI 1.03–1.11]), African American race (OR 0.86 [CI 0.75–0.99]), Medicare (OR 0.83 [CI 0.69–0.99] or unknown/no (OR 0.75 [CI 0.64–0.88]) insurance status, and treatment at an academic center (OR 2.28 [CI 1.8–2.8]) were associated with care transitions (Table 2). The proportion of patients experiencing a care transition increased over the study period from 37.4% (2003–2006) to 42.3% (2007–2010), (p<0.001) (Figure 1) (+1.1% per year, p<0.001). Moreover, high volume hospitals more often treated patients who experienced a care transition (71.2%) compared to both low (18.2%) and intermediate (31.3%) volume hospitals respectively (p<0.001) (Figure 2).

Of the cohort, 3156 patients (14.2%) experienced a treatment delay of ≥ 3 months. Evaluating unadjusted trends over time, the proportion of patients experiencing a treatment delay increased from 12.6% to 15.3% over the length of the study period (p=0.01) (Figure 1) (+0.3% per year, p=0.007). Delay to definitive treatment occurred more frequently for those experiencing a care transition (19.4%) compared to patients diagnosed and treated at the same hospital (10.7%) (p<0.001). Following adjustment for potential confounders, patients with care transitions were two times more likely to experience a treatment delay (OR 2.0 [95% CI 1.8–2.2]). Additional covariates associated with treatment delay included male gender (OR 1.1 [CI 1.1–1.2]), African American race (OR 1.5 [CI 1.3–1.7]), Hispanic ethnicity (OR 1.6 [CI 1.3–1.9]), insurance status (Medicaid OR 1.4 [CI 1.1–1.7], Medicare OR 1.2 [CI 1.08–1.34], unknown or no insurance OR 1.3 [CI 1.07–1.54]), treatment facility located in the Northeast (OR 1.52 [CI 1.25–1.85]) or Atlantic (OR 1.36 [CI 1.20–1.54]) regions, and Charlson-Deyo classification ≥ 2 (OR 1.3 [CI 1.08–1.45]). There was a trend

towards treatment delay in patients treated at an academic center (OR 1.20 [CI 1.0–1.5]; p=0.0536) (Table 3).

Discussion

Timeliness of care is one of 6 domains of quality health care defined by the Institute of Medicine and is a proxy for unmeasured aspects of health care efficiency, resource utilization, and handling of excess case volume.[6] In this large all payer sample of hospitals reporting to the NCDB, we observed an increase in the proportion of patients undergoing care transitions over the length of the study period even after accounting for the increased use of neoadjuvant chemotherapy. Our finding that patients with MIBC who transitioned between diagnosis and treatment hospitals were twice as likely to experience a treatment delay of 3 months (OR 2.0 [1.8–2.2]) may provide an actionable target for improving the quality of care coordination at the time of referral for complex oncologic care.

Oncologic treatment is most effective when delivered expeditiously, and recent data support that the timing of RC is critical in the treatment of MIBC.[11, 16–18] Delays in definitive therapy have been associated with pathologic upstaging at the time of RC,[17] and have been shown to adversely impact disease specific[16, 18] and overall[11, 12, 18] mortality. While a number of other characteristics of our cohort such as race, socioeconomic status, payor group, and burden of co-morbidity likely influence treatment delays, we feel that findings of this study highlight how interruptions in care coordination at the time of care transition between hospitals and providers may result in adverse consequences.

Over the past decade, an expanding body of evidence has demonstrated dramatic differences in short term (30 day) peri-operative mortality in patients treated at high versus low volume centers[3]. As a result, experts, policy makers, politicians, and the media champion regionalization of complex procedures to experienced centers.[4] In the UK, the National Institute for Clinical Excellence (NICE), has established the precedent at the national level for regionalizing urologic cancer care (most notably radical prostatectomy and radical cystectomy) to teams who serve populations of one million or more and carry out a cumulative total of at least 50 procedures per year. Further, it is recommended that surgeons with very low procedural volumes (<5/year) transfer surgical care to more experienced high volume colleagues[19]. While similar procedure thresholds and mandates do not currently exist in the United States, recent studies performed at the state and national level have clearly demonstrated that the proportion of patients treated at high and very high volume centers has markedly increased over the past decade.[20] This may be due, in part, to the increasing sub-specialization of providers, changing referral patterns, improved information dissemination, and changes in procedure reimbursement.[21] Further, 47.1% of patients in our sample who received treatment at a high volume hospital underwent a care transition. While the short-term benefits of regionalization of surgical care are indisputable, an untoward effect of regionalization of care may be exacerbation of existing access disparities for the disadvantaged, increased travel burden for patients from rural areas, and overwhelming the existing workforce capacity of referrent centers.[21, 22]

Central to current healthcare reform initiatives is the improvement of coordination between providers, and patients who traverse hospitals and healthcare systems when regionalized for surgical care may represent a population at risk for adverse consequences. Evidence has accumulated that quality and patient safety are compromised during vulnerable care transition periods due to high rates of medication errors, incomplete or inaccurate information transfer, and lack of appropriate follow-up care.[23] While emerging reimbursement mechanisms such as bundled payment programs, accountable care organizations, and patient centered medical homes that create "episodes of care" through incorporation of pre- and post- hospital care periods demonstrate the potential for improving healthcare delivery, there are concerns that "fractured care" due to poor coordination at the time of care transitions may result in over utilization or duplication of services, increased costs, and preventable hospital readmissions.[24] Compared to patients with chronic illnesses who are commonly treated longitudinally within a single health system[25], elderly patients undergoing complex cancer surgery may be more vulnerable to the negative consequences of care transitions, particularly during the immediate post operative period in which the provision of timely and effective outpatient care can help to reduce the risks of re-hospitalization.[26]

While the treatment delays demonstrated in our study may be a downstream result of disruptions in care coordination, there are mechanisms for improvement inherent to contemporary healthcare reform efforts.[27] Implementation of Health Information Technology, the use of "virtual care teams" through remote consultation, and creation of dedicated screening centers have been proposed as means to reduce delays associated with care transitions.[27] Patient navigator programs have demonstrated promise to improve communication between providers and patients as they negotiate handoffs during the pre-treatment transition period[28]. Similarly, several models for improving care transitions post hospitalization have been implemented and tested[29]. While to date these have focused on chronic health conditions in the elderly such as congestive heart failure and chronic obstructive pulmonary disease, efforts to improve medication reconciliation, scheduling of follow up and primary care visits, taking ownership of personal health information, and recognizing "red flags" that could indicate a worsening health condition are certainly applicable to surgical patients as well.[30]

Inherent limitations to use of the NCDB database include its retrospective nature, lack of specific information regarding patient and surgeon preferences, and incomplete mortality data. Given the constraints of data availability, we were unable to evaluate individual surgeon performance, and relied on hospital self-report for quality assurance. Further, any comparison of treatment groups derived from nonrandomized cohorts is prone to bias from unmeasured confounders; as a result, we were unable to completely adjust for selection bias. While an association between treatment delay of 90 days and poor survival outcomes has been reported in patients with MIBC,[11, 12, 16, 17] we were unable to measure the impact of treatment delay on overall survival in our cohort as these data were available for only a small subset of patients (pre-2005). Regarding data reliability, information for patients who received some of their treatment at a hospital that does not report to the NCDB may be limited, and differentiating between non-primary treatment services between diagnosis and treatment hospitals is not possible. Finally, while the exposure of interest in our study is the

transition between diagnosis and treatment hospital, lack of diagnosis hospital specific information only allows evaluation of hospital characteristics and discrimination of volume status of the definitive treatment hospital, which may be a threat to inference.

Conclusions

In the NCDB, patients with MIBC who experienced a care transition between diagnosis and treatment were more likely to experience a treatment delay of 3 months. Strategies to improve provider care coordination at the time of care transitions may be a means to improve quality of care. Implementation of proposed strategies to reduce the adverse consequences of care transitions, including incorporation of health information technology, nursing navigation, and post hospitalization interventions, should be prioritized for patients undergoing cancer surgery.

Acknowledgments

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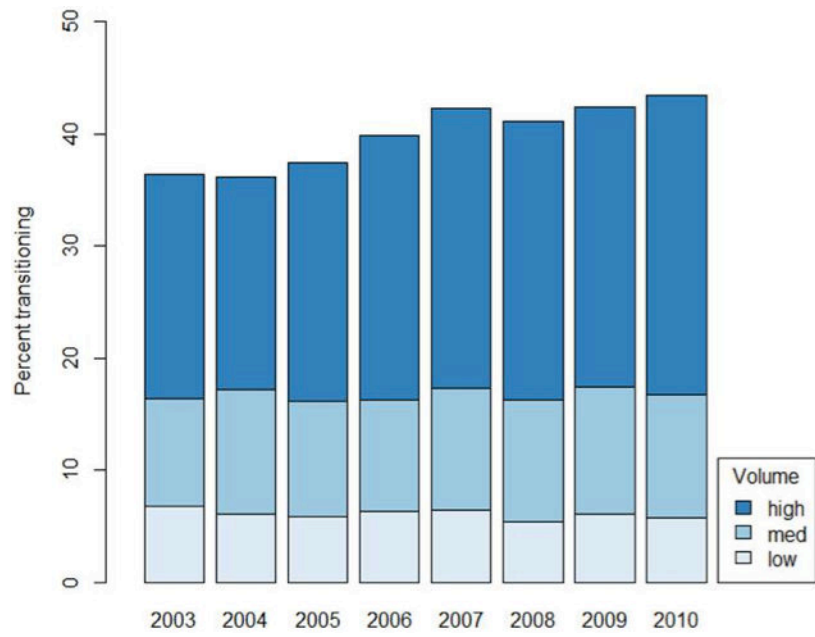
Figure 1.
Proportion of patients undergoing a care transition to low, medium, and high volume hospitals for RC
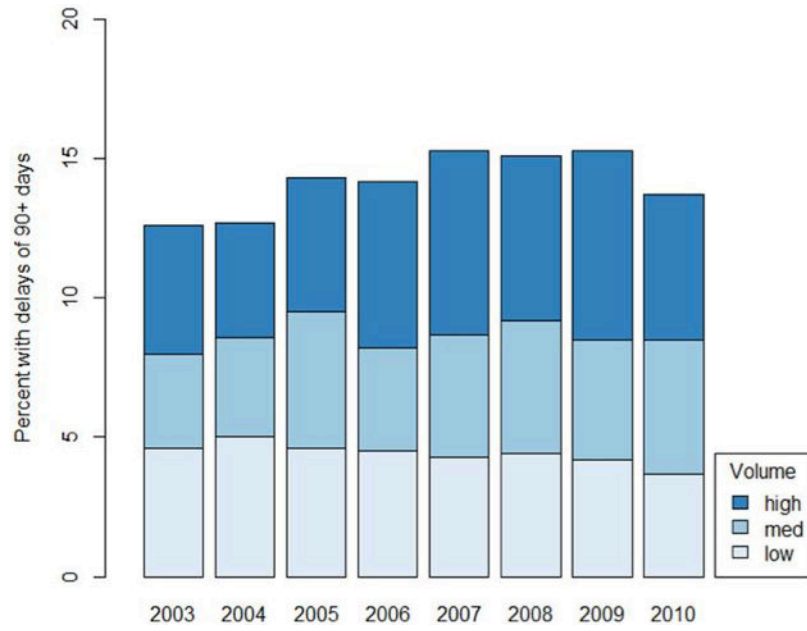
Figure 2.
Proportion of patients experiencing a significant delay (90 days) in receipt of RC stratified by hospital volume

Table 1

Characteristics of the Sample

	Overall	No Care Transition	Care Transition	P-value
	22,251	**13,370 (60.0)**	**8881 (40.0)**	
	N (%)	Proportion		
Age (years)				<0.001
<50	1343 (6.0)	752 (5.6)	591 (6.7)	
50 to 60	3943 (17.7)	2296 (17.2)	1647 (18.5)	
61 to 70	6808 (30.6)	4015 (30.0)	2793 (31.4)	
71	10,157 (45.6)	6307 (47.2)	3850 (43.4)	
Charlson Deyo Score				<0.001
0	15,925 (71.6)	9381 (70.2)	6544 (73.7)	
1	4879 (21.9)	3056 (22.9)	1823 (20.5)	
2	1447 (6.5)	933 (6.9)	514 (5.8)	
Gender				<0.001
Male	16,457 (74.0)	9693 (72.5)	6764 (76.2)	
Female	5794 (26.0)	3677 (27.5)	2117 (23.8)	
Race				<0.001
White	20,297 (91.2)	12,135 (90.8)	8162 (91.9)	
African American	1287 (5.8)	859 (6.4)	428 (4.8)	
Other	667 (3.0)	376 (2.8)	291 (3.3)	
Hispanic				<0.001
No	19,778 (88.9)	11,779 (88.1)	7999 (90.1)	
Yes	629 (2.8)	338 (2.5)	291 (3.3)	
Unknown	1844 (8.3)	1253 (9.4)	591 (6.7)	
Median income				<0.001
<$30K	2719 (12.3)	1579 (11.8)	1140 (12.8)	
$30–34.9K	4154 (18.7)	569 (4.3)	3585 (40.4)	
$35–45.9K	6287 (28.3)	911 (6.8)	5376 (60.5)	
$46K	7894 (35.5)	1086 (8.1)	6808 (76.7)	
Unknown	1197 (5.4)	161 (1.2)	1036 (11.7)	
*Education				<0.001
29%	3308 (14.9)	1896 (14.2)	1412 (15.9)	
20–28.9%	5075 (22.7)	2920 (21.8)	2155 (24.3)	
14–19.9%	5461 (24.5)	3248 (24.3)	2213 (24.9)	
<14%	7210 (32.4)	4613 (34.5)	2597 (29.2)	
Unknown	1197 (5.4)	693 (5.2)	504 (5.7)	
Payor Group				0.069
Private/HMO	7432 (33.4)	4405 (3.3)	3027 (34.1)	

	Overall	No Care Transition	Care Transition	P-value
	22,251	**13,370 (60.0)**	**8881 (40.0)**	
	N (%)	**Proportion**		
Medicaid	920 (4.1)	572 (4.3)	348 (3.9)	
Medicare	12,479 (56.1)	7565 (56.6)	4914 (55.3)	
None/other	1420 (6.4)	828 (6.2)	592 (6.7)	
Urban/Rural				<0.001
Rural	1768 (7.9)	863 (6.5)	905 (10.2)	
Suburban	2754 (12.4)	1364 (10.2)	1390 (15.7)	
Small metropolitan	6628 (29.8)	4328 (32.4)	2300 (25.9)	
Large metropolitan	9766 (43.9)	6026 (45.1)	3740 (42.1)	
Unknown	1335 (6.0)	789 (5.9)	546 (6.1)	
Tumor Stage				<0.001
II	8483 (38.0)	5435 (40.7)	3048 (34.3)	
III	7112 (32.0)	4251 (31.8)	2861 (32.2)	
IV	6656 (30.0)	3684 (27.6)	2972 (33.5)	
Tumor Grade				<0.001
Low Grade (1/2)	1012 (4.5)	656 (4.9)	356 (4.0)	
High Grade (3/4)	20,051 (90.1)	12,052 (90.1)	7999 (90.1)	
Unknown	1188 (5.4)	662 (5.0)	526 (5.9)	
Facility Location				<0.001
Northeast	1389 (6.2)	1013 (7.6)	376 (4.2)	
Atlantic	3118 (14.0)	1717 (12.8)	1401 (15.8)	
Southeast	4449 (20.0)	2517 (18.8)	1932 (21.8)	
Great Lakes	4328 (19.5)	2803 (21.0)	1525 (17.2)	
South	1573 (7.1)	883 (6.6)	690 (7.8)	
Midwest	2202 (9.9)	1377 (10.3)	825 (9.3)	
West	1677 (7.5)	947 (7.1)	730 (8.2)	
Mountain	1042 (4.7)	663 (5.0)	379 (4.3)	
Pacific	2473 (11.1)	1450 (10.8)	1023 (11.5)	
Year of Diagnosis				<0.001
2003	2759 (12.4)	1755 (13.1)	1004 (11.3)	
2004	2690 (12.1)	1718 (12.8)	972 (10.9)	
2005	2784 (12.5)	1744 (13.0)	1040 (11.7)	
2006	2728 (12.3)	1641 (12.3)	1087 (12.2)	
2007	2765 (12.4)	1595 (11.9)	1170 (13.2)	
2008	2819 (12.7)	1661 (12.4)	1158 (13.0)	
2009	2771 (12.5)	1595 (11.9)	1176 (13.2)	
2010	2935 (13.2)	1661 (12.4)	1274 (14.3)	
Distance (Mile Quintiles)				<0.001

	Overall	No Care Transition	Care Transition	P-value
	22,251	**13,370 (60.0)**	**8881 (40.0)**	
	N (%)	**Proportion**		
0–4.2	4259 (19.1)	3632 (27.2)	627 (7.1)	
4.3–9.2	4266 (19.2)	3256 (24.3)	1010 (11.4)	
9.3–18.8	4216 (18.9)	2804 (21.0)	1412 (15.9)	
18.9–48.2	4248 (19.1)	2085 (15.6)	2163 (24.4)	
48.3–3217	4248 (19.1)	1004 (7.5)	3244 (36.5)	
Missing	1014 (4.6)	589 (4.4)	425 (4.8)	
Facility Type				<0.001
Community	2754 (12.4)	2279 (17.0)	475 (5.3)	
Comp community	9715 (43.7)	7356 (55.0)	2359 (26.6)	
Academic	9782 (44.0)	3735 (27.9)	6047 (68.1)	
Volume (Tertiles)				<0.001
T1	7444 (33.5)	6091 (45.6)	1353 (15.2)	
T2	7561 (34.0)	5194 (38.8)	2367 (26.7)	
T3	7246 (32.6)	2085 (15.6)	5161 (58.1)	
Mean (median) Time to Definitive Treatment (days)	66.8 (50.5)	56 (42)	77.6 (59)	
Community	56.5 (42)	–	–	
Comprehensive Community	57.9 (43)	–	–	
Academic	73.2 (56)	–	–	
T1	59 (43)	–	–	
T2	59.2 (45)	–	–	
T3	75.7 (58)	–	–	

[*]Education reported as the % of adults in the patient's zip code who did not receive a high school diploma

Table 2

Characteristics associated with undergoing a care transition in receipt of definitive therapy (RC or neoadjuvant chemotherapy)

Characteristic	aOR [CI]	P Value	Characteristic	aOR [CI]	P Value
Age (years)			Hospital Category		
50	1.0		Comp community	1.1 [0.92–1.3]	0.2939
51 to 60	1.02 [0.89–1.17]	0.4851	Academic	2.28 [1.8–2.8]	<0.001
61 to 70	0.97 [0.85–1.1]	0.8033	Payor Group		
71	0.94 [0.81–1.1]	0.696	Private/HMO	1.0	
Gender			Medicaid	0.83 [0.69–0.99]	0.0376
Male	1.07 [1.03–1.11]	<0.001	Medicare	1.07 [0.99–1.16]	0.1063
Race			None/Unknown	0.75 [0.64–0.88]	<0.001
White	1.0		Geographic Location		
AA	0.86 [0.75–0.99]	0.0419	Rural	0.98 [0.86–1.1]	0.8043
Other	1.09 [0.88–1.4]	0.4302	Suburban	0.99 [0.89–1.1]	0.7694
Charlson-Deyo Score			Small metropolitan	0.97 [0.89–1.1]	0.541
0	1.0		Large metropolitan	1.08 [0.98–1.2]	0.1401
1	0.94 [0.87–1.0]	0.0703	Unknown	Ref	
2	0.89 [0.79–1.0]	0.072	Facility Location		
Analytic Stage			Northeast	0.75 [0.59–0.96]	0.0208
II	0.88 [0.84–0.92]	<0.001	Atlantic	1.1 [0.93–1.3]	0.2406
III	1.03 [0.99–1.08]	0.1837	Southeast	1.2 [1.0–1.4]	0.0246
IV	1.0		Great Lakes	0.99 [0.85–1.2]	0.9219
Tumor Grade			South	0.89 [0.72–1.1]	0.2743
Low Grade (1/2)	0.95 [0.86–1.1]	0.3186	Midwest	0.82 [0.68–0.99]	0.0428
High Grade (3/4)	0.88 [0.82–0.94]	<0.001	West	0.71 [0.59–0.87]	0.0006
Unknown	1.0		Mountain	1.16 [0.93–1.4]	0.195
Median Income			Pacific	1.0	
<$30K	1.0		Year of Diagnosis		
$30–34.9K	1.16 [1.02–1.33]	0.0245	2003	0.92 [0.84–1.0]	0.0607
$35–45.9K	1.13 [0.98–1.3]	0.0916	2004	0.95 [0.88–1.04]	0.2575

Characteristic	aOR [CI]	P Value	Characteristic	aOR [CI]	P Value
$46K	1.04 [0.88–1.2]	0.6454	2005	0.93 [0.86–1.0]	0.128
Unknown	1.14 [0.87–1.5]	0.3475	2006	0.97 [0.90–1.1]	0.5375
Percent less than high school education			2007	1.1 [1.0–1.19]	0.0187
29%	1.0		2008	1.0 [0.93–1.1]	0.7451
20–28.9%	1.0 [0.90–1.1]	0.9016	2009	1.1 [0.98–1.2]	0.1629
14–19.9%	1.1 [0.92–1.2]	0.4304	2010	1.0	
<14%	1.0 [0.87–1.2]	0.9886	Volume (Tertiles)		
Distance (Mile Quintiles)			T1	1.0	
Q1	1.0		T2	1.47 [1.3–1.7]	<0.001
Q2	1.5 [1.3–1.7]	<0.001	T3	3.9 [3.0–5.0]	<0.001
Q3	2.1 [1.8–2.3]	<0.001			
Q4	3.7 [3.2–4.2]	<0.001			
Q5	6.9 [5.8–8.2]	<0.001			
Unknown	2.4 [1.7–3.5]	<0.001			

Controlling for age, gender, race, Charlson-Deyo score, analytic stage, tumor grade, hospital category, payor group, geographic location, median income, proportion with less than high school education, year, region

Table 3

Characteristics associated with delay ≥90 days in receipt of definitive therapy (RC or neoadjuvant chemotherapy)

Characteristic	aOR [CI]	P Value	Characteristic	aOR [CI]	P Value
Care Transition	2.0 [1.8–2.2]	<0.001	Hospital Category		
Age (years)			Community	1.0	
50	1.0		Comp community	1.01 [0.86–1.18]	0.9437
51 to 60	1.07 [0.89–1.29]	0.4851	Academic	1.20 [1.00–1.45]	0.0536
61 to 70	1.13 [0.95–1.35]	0.1734	Payor Group		
71	1.19 [1.00–1.43]	0.0563	Private/HMO	1.0	
Gender			Medicaid	1.37 [1.13–1.66]	0.0014
Male	1.11 [1.07–1.16]	<.0001	Medicare	1.20 [1.08–1.34]	0.0012
Race			None/Unknown	1.28 [1.07–1.54]	0.0077
White	1.0		Geographic Location		
AA	1.48 [1.26–1.73]	<.0001	Rural	1.0	
Other	0.82 [0.63–1.06]	0.1367	Suburban	1.00 [0.89–1.12]	0.9773
Charlson-Deyo Score			Small metropolitan	1.01 [0.92–1.10]	0.8749
0	1.0		Large metropolitan	0.99 [0.89–1.10]	0.8256
1	1.09 [1.00–1.19]	0.0599	Unknown	Ref	
2	1.25 [1.08–1.45]	0.0034	Facility Location		
Analytic Stage			Northeast	1.52 [1.25–1.85]	<.0001
II	1.02 [0.96–1.07]	0.5819	Atlantic	1.36 [1.20–1.54]	<.0001
III	1.02 [0.96–1.07]	0.5298	Southeast	1.00 [0.88–1.12]	0.948
IV	1.0		Great Lakes	0.86 [0.76–0.97]	0.018
Tumor Grade			South	0.72 [0.59–0.87]	0.0008
Low Grade (1/2)	1.05 [0.93–1.20]	0.4101	Midwest	0.80 [0.64–0.99]	0.0432
High Grade (3/4)	0.95 [0.87–1.04]	0.2595	West	0.71 [0.59–0.87]	0.0006
Unknown	1.0		Mountain	1.01 [0.80–1.28]	0.9195
Median Income			Pacific	1.0	
<$30K	1.0		Year of Diagnosis		
$30–34.9K	0.93 [0.80–1.09]	0.3853	2003	0.88 [0.78–0.99]	0.0307

Characteristic	aOR [CI]	P Value	Characteristic	aOR [CI]	P Value
$35–45.9K	1.07 [0.92–1.24]	0.3651	2004	0.91 [0.81–1.02]	0.09
$46K	1.11 [0.94–1.32]	0.2225	2005	1.04 [0.95–1.15]	0.4153
Unknown	0.81 [0.57–1.14]	0.2204	2006	1.02 [0.92–1.12]	0.7672
Percent less than high school education			2007	1.09 [0.96–1.23]	0.1974
29%	1.0		2008	1.07 [0.97–1.18]	0.162
20–28.9%	0.94 [0.83–1.07]	0.3262	2009	1.08 [0.97–1.21]	0.1434
14–19.9%	0.84 [0.73–0.96]	0.0119	2010	1.0	
<14%	0.69 [0.59–0.82]	<.0001	Volume (Tertiles)		
Unknown	1.0 [1.0–1.0]	0.546	T1	1.0	
			T2	0.86 [0.75–0.99]	0.0369
			T3	0.87 [0.74–1.02]	0.0939

Controlling for age, gender, race, Charlson-Deyo score, analytic stage, tumor grade, hospital category, payor group, geographic location, median income, proportion with less than high school education, year, region