

# Access to Care in Vermont: Factors Linked with Time to Chemotherapy for Women with Breast Cancer

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## INTRODUCTION

Several reports have demonstrated the timeliness of adjuvant chemotherapy for breast cancer to have an impact on survival. The optimal time interval from diagnosis to initiation of chemotherapy is not certain. The American Society of Clinical Oncology (ASCO) National Comprehensive Cancer Network (NCCN) quality measures recommend starting adjuvant chemotherapy within 120 days of diagnosis for women aged less than 70 years with stage II or III hormone receptor-negative breast cancer<sup>1</sup>.

In a rural state, there are multiple barriers to the timely initiation of chemotherapy which must be addressed in order to enhance outcomes and quality of care. Vermont has a goal to increase adherence to NCCN treatment standards<sup>2</sup> including timeliness of care.<sup>3</sup> In 2011, 87% of eligible women treated at Commission on Cancer accredited centers in Vermont considered or received adjuvant chemotherapy within four months of breast cancer (BC) diagnosis.<sup>4</sup> A task force was convened to evaluate which factors influence time to chemotherapy (TTC) in Vermont.

## PURPOSE

The goal of this study was to determine the time from diagnosis to chemotherapy in the state of Vermont and identify the possible barriers that may contribute to delay. Specifically, we investigated whether residence at diagnosis was a factor for timeliness of chemotherapy administration.

## METHODS

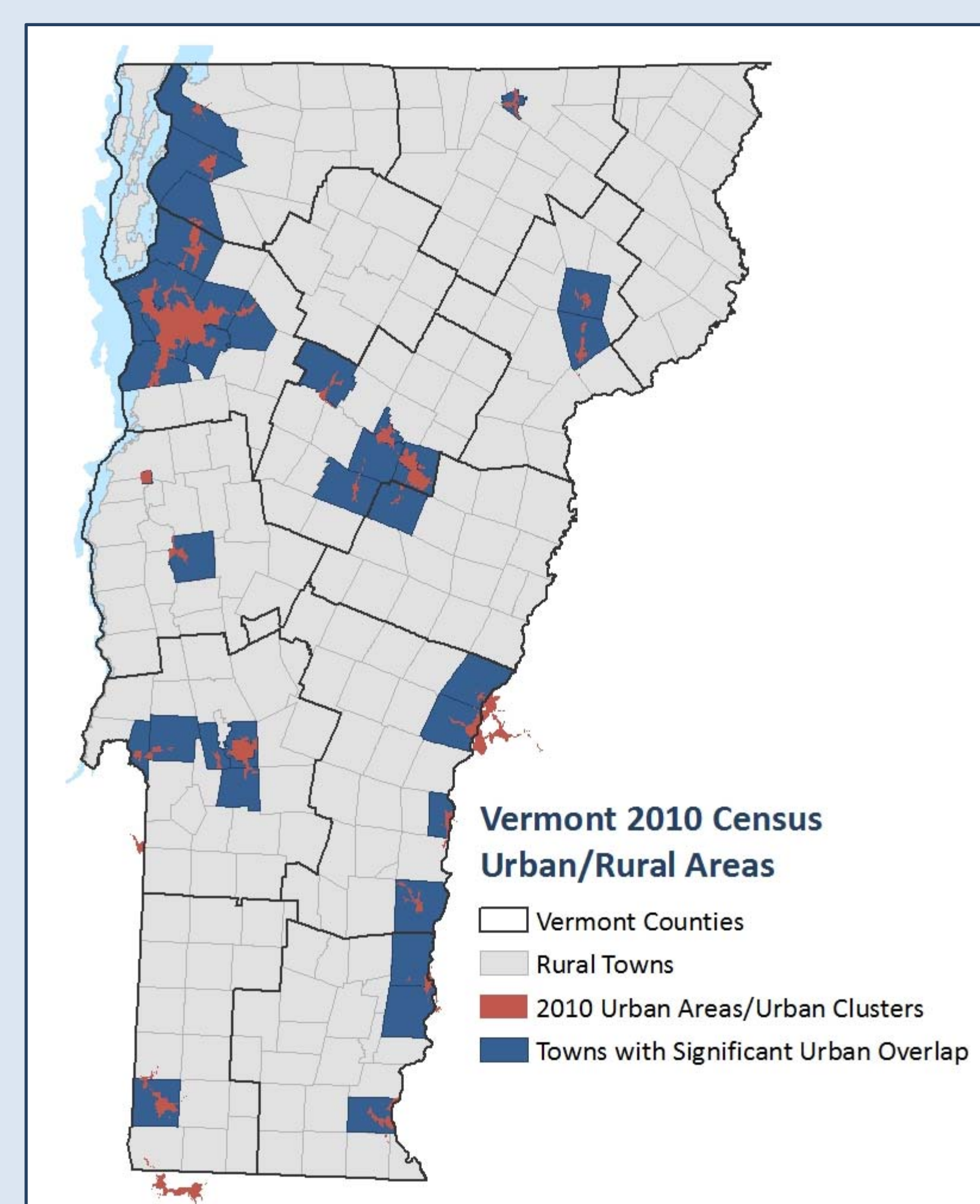
**Eligibility:** The Vermont Cancer Registry (VCR) was used to identify 2,345 Vermont women diagnosed with Stage I-III BC between 2006 and 2010. The following additional criteria were used for inclusion in the study: surgery performed and not unknown; date of systemic therapy not unknown and on or after surgery date (i.e., no neoadjuvant therapy); TTC less than or equal to 32 weeks; single agent, multi-agent, or not otherwise specified type of chemotherapy; and radiation either not given or it was given after systemic therapy. This resulted in 702 cases being eligible for inclusion in the study.

The percent inclusion (proportion of Vermont women diagnosed with Stage I-III BC between 2006 and 2010 who met all additional study criteria) was calculated for age, county of residence, rural/urban residence, primary payer, managing facility, diagnosis year, primary site, laterality, histologic type, AJCC Stage Group, type of surgery, and type of chemotherapy. Differences were investigated to determine whether biases existed in study participant inclusion.

**Managing facility:** The method of assigning managing facility was: (1) if one reporting hospital, that hospital was used; (2) if more than one reporting hospital, and only one facility reported surgery, the hospital reporting surgery was used; if more than one reporting hospital, and more than one facility reported surgery, the largest institution (determined by the average annual caseload of all cancers reported) was used. For records with a New Hampshire facility not otherwise specified (n=24), the largest reporting New Hampshire facility was used.

**Rural/urban residence and drive-time:** The patient's geocoded town of residence was assigned through a spatial join of their geocoded location ((x,y) coordinates) and Vermont towns. Rural/urban residence was determined by a spatial join between the town of residence and towns with significant overlapping with Census 2010 urban areas/clusters. See Figure 1.

Figure 1. Vermont 2010 Census Urban/Rural Areas.



An origin-destination (OD) cost matrix analysis (ESRI ArcGIS 10.2.1 Network Analyst) was used to measure drive-time, where the origins were the patients' geocoded residences, and destinations were the managing facilities. For each patient, the model calculated drive-time as both distance and travel time to all destinations, using Vermont road networks, resulting in a drive-time for each patient to each possible facility. The drive-time for the managing facility, determined above, was assigned to each patient. Ninety-six percent of cases (n=674) were geocoded to an address with number and street; the remaining cases were geocoded to a town centroid.

**Survival analysis:** A survival analysis (SAS 9.3 Proc Lifetest) was used to measure TTC for the following: age group, rural/urban residence, primary payer, managing facility, method of assigning managing facility, number of reporting hospitals, diagnosis year, rural/urban residence, and drive-time category. The Wilcoxon test of the median and the log-rank test were used to determine statistical significance.

**Regression analysis:** A multivariate logistic regression analysis with interaction (SAS 9.3 Proc Logistic) was used to determine whether rural/urban residence or drive-times of one hour or more were a more significant predictor of TTC.

## RESULTS

**Descriptive statistics:** The overall percent inclusion was 30%. The percent inclusion varied by managing facility, from 0 to 41% (data not shown). See Table 1. for a distribution of characteristics among study participants.

Just over half of the study participants (53%, n=373) lived in urban towns; the others lived in rural communities (47%, n=328). Most study participants had drive-times in the minimum and maximum groups, with 204 participants (29%) having a drive-time less than 15 minutes and 181 participants (26%) having a drive time over one hour. The other drive-time groupings were distributed as follows: 17% (n=121) 15-29 min., 13% (n=92) 30-44 min., 15% (n=101) 45-59 min.

Table 1. Descriptive characteristics of study participants.

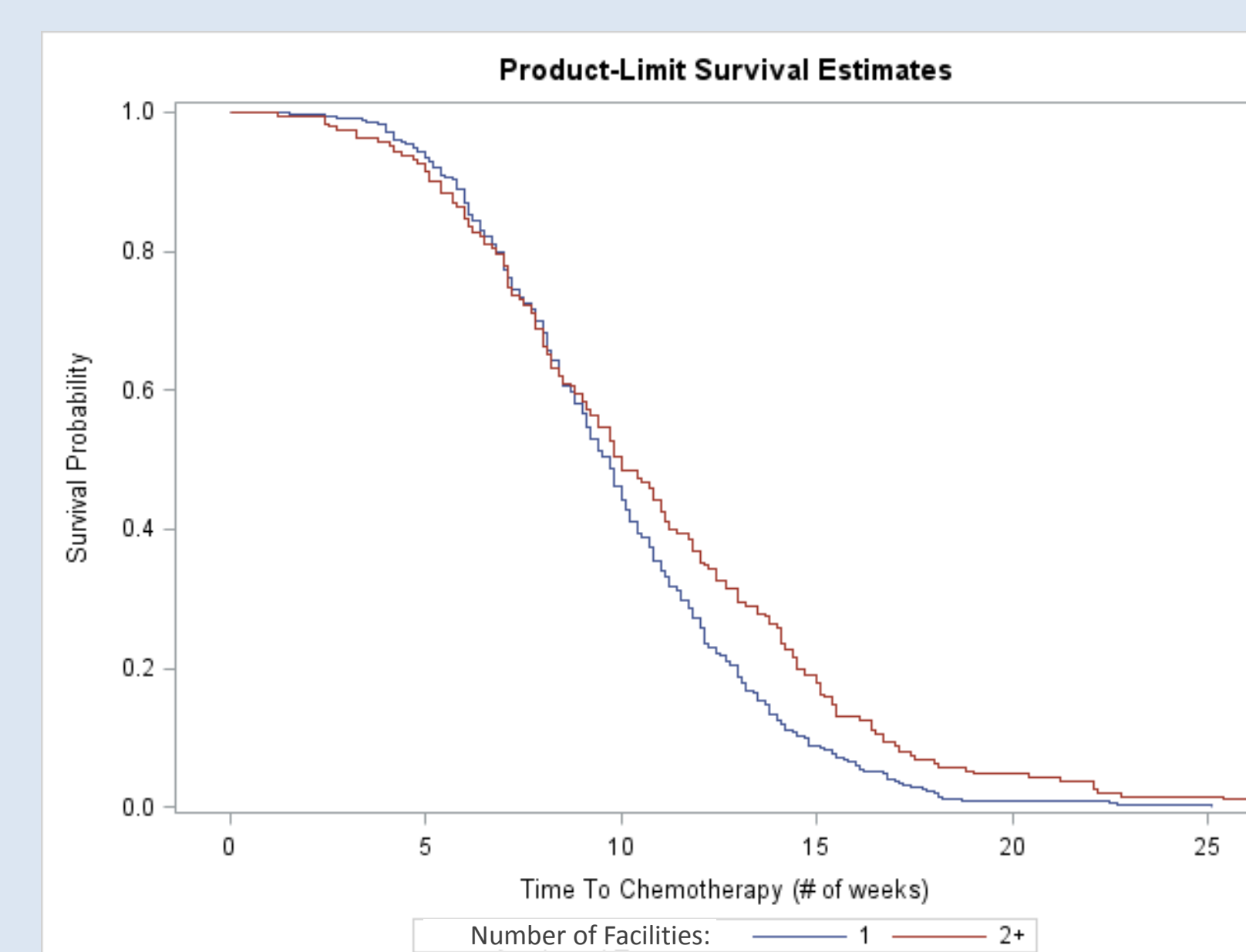
Characteristics	No.	%	Characteristics	No.	%
<b>Age at diagnosis (years)</b>					
<40	49	7	<b>Primary payer</b>		
40-49	218	31	Private Insurance	513	73
50-64	334	48	Medicaid	43	6
65-74	86	12	Medicare	118	17
75+	15	2	Not Insured	11	2
<b>Rural/urban residence</b>					
Rural	328	47	VA/TRICARE	3	<1
Urban	373	53	Unknown	14	2
Uncategorized	1	<1	<b>Method for assigning managing facility</b>		
<b>Diagnosis year</b>					
2006	127	18	Only facility	512	73
2007	163	23	Surgery facility	22	3
2008	136	19	Largest facility	168	24
2009	135	19	<b>Number of reporting facilities</b>		
2010	141	20	1	512	73
<b>AJCC stage group</b>					
I	249	35	2+	190	27
II	341	49	<b>Drive-time (minutes)</b>		
III	112	16	<15	204	29
			15-29	121	17
			30-44	92	13
			45-59	101	14
			60+	181	26

**Survival analysis:** Mean TTC was 10.1 weeks (median 9.7 weeks, range 1.2 to 26.5 weeks). In univariate analysis, differences in TTC were found for managing facility, number of reporting facilities, rural/urban residence, and drive time to managing facility. No differences in TTC were found for patient age, year of diagnosis, or primary payer.

**Managing facility and number of facilities:** TTC varied among managing facilities (Wilcoxon test p<0.0001, log-rank test p<0.0001). The median and 75th percentile ranged from 8.0-12.1 and 11.2-14.8 weeks, respectively.

Differences in TTC were associated with the number of reporting facilities (1 vs. 2+). Receiving treatment in only one facility was associated with a shorter TTC (median 9.7 weeks, 75th percentile 12.1 weeks) compared to receiving treatment at two or more facilities (median 10.0 weeks, 75th percentile TTC 14.1 weeks). Log-rank test p=0.0014, Wilcoxon test NS.

Figure 2. TTC by number of reporting facilities.



**Rural/urban residence:** Urban residence was associated with shorter TTC, but by less than one week. (Urban residence median 9.7 weeks (75th percentile 12.1), rural residence median 9.8 weeks (75th percentile 13.0); log-rank test p=0.02, Wilcoxon test NS.)

**Drive-time:** Shorter drive-times from residence to managing facility were associated with significantly shorter TTC. (Wilcoxon test p<0.0001, log-rank test p<0.0001.) See Table 2. Drive-times of one hour or greater were found to be a more significant predictor of TTC than the rural/urban residence, using multivariate logistic regression analysis with interaction (p<0.0001).

Table 2. Time to chemotherapy by drive-time group

Drive-Time	Mean (weeks)	25 <sup>th</sup> Percentile (weeks) (95% CI)	50 <sup>th</sup> Percentile (weeks) (95% CI)	75 <sup>th</sup> Percentile (weeks) (95% CI)
<15 minutes	9.6	7.6 (7.0,8.0)	9.2 (8.7,9.8)	11.5 (11.0,12.1)
15-29 minutes	9.4	7.0 (5.8,7.1)	9.0 (8.1,9.7)	12.0 (10.4,13.0)
30-44 minutes	9.6	6.5 (6.0,7.4)	9.6 (8.1,10.7)	12.1 (11.0,13.4)
45-59 minutes	10.0	6.4 (5.4,7.8)	9.4 (8.4,10.5)	13.0 (11.8,14.5)
60+ minutes	11.7	8.2 (8.0,9.2)	11.0 (10.1,11.8)	14.2 (13.5,15.2)

## DISCUSSION/CONCLUSIONS

### Findings:

- The TTC found in the current study for Vermont (10.1 weeks) is similar the TTC recently reported<sup>5</sup> from the NCCN institutions (12.0 weeks), which are generally large urban institutions.
- A significant factor for longer TTC is a drive-time of 60 minutes or more. Improved outreach and coordination, such as with Vermonters Taking Action Against Cancer, and novel approaches, including mobile chemotherapy units, increased utilization of patient navigators, establishing more guest housing near medical oncology practices, and recruiting more volunteers to drive patients to medical appointments, will have to be developed in the community.
- However, considering the logistic challenges cancer patients face in small rural state with more limited resources, these findings are very reassuring.
- The differences in TTC for the different managing facilities and number of reporting facilities offer opportunities for process improvement.
- We are encouraged that we found no differences in TTC as a function of patient age, year of diagnosis or primary payer.
- Although the percent inclusion (30%) may appear low, it is similar to the recently reported NCCN study (32%).
- The differences in percent inclusion by stage, age and type of chemotherapy were consistent with indications for chemotherapy per the NCCN guidelines and the study design (having had chemotherapy administered).
- The use of population-based data to evaluate access to BC care is an inclusive approach because women were included regardless of residence or treating facility.

### Limitations:

- We were concerned that hospitals underreported chemotherapy due to prioritizing the reporting of incidence and stage over treatment data within the statutory requirements for timely reporting.<sup>6</sup> However, we followed back all potentially eligible cases that were not included in the analysis with one small community hospital and found that provider and patient decision-making, rather than this phenomenon, explained the low inclusion rate.
- There are some limitations with origin (patient residence) and destination (managing facility) in the drive-time analysis.
  - A small number of patients (n=24, 3%) received their care at an out-of-state facility for which we did not have enough detail to determine a specific facility. In those instances, the patients were attributed to the largest reporting facility for that state.
  - In the case where a hospital has a satellite medical oncology practice, it is impossible to tell the geographic location where chemotherapy was administered using the reporting hospital code.
  - When two or more hospitals were involved in a patient's care, and both facilities reported surgery, we assigned the largest facility to the role of managing facility. This affected 24% (n=168) cases.
  - A change in residence after diagnosis or use of short term housing near the managing facility during treatment would not be recorded by VCR.
  - A small number of patients' (n=28, 6%) residences were geocoded to a town centroid.For all of the above cases it is possible that the calculated drive-time was longer or shorter than actual. Only 0.4 percent of records (n=3) were excluded from the drive-time analysis because the managing facility was out of state and could not be located.
- Our study reflects a geographic area with nearly half of the study population living in rural towns. It is unclear how generalizable these results are to more urban areas. Additionally, this study represents only represents 30% of breast cancer patients. Our results should be generalizable to women undergoing chemotherapy for breast cancer in rural settings; results may not be generalizable to urban settings, other cancer types, or other treatments received for breast cancer (e.g., radiation).
- A multivariate logistic regression analysis is needed to determine the most significant independent predictors for TTC.

## REFERENCES

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- 18 VSA §§ 151-157, The Vermont Cancer Registry Law.