

UC Davis

UC Davis Previously Published Works

Title

Breast Cancer Survivorship Care Variations Between Adjuvant Chemotherapy Regimens

Permalink

<https://escholarship.org/uc/item/3c05n59b>

Journal

Clinical Breast Cancer, 18(4)

ISSN

1526-8209

Authors

Leal, Alexis D
Van Houten, Holly
Sangaralingham, Lindsey
et al.

Publication Date

2018-08-01

DOI

10.1016/j.clbc.2017.09.011

Peer reviewed



Published in final edited form as:

Clin Breast Cancer. 2018 August ; 18(4): e513–e520. doi:10.1016/j.clbc.2017.09.011.

Breast Cancer Survivorship Care Variations Between Adjuvant Chemotherapy Regimens

Alexis D. Leal¹, Holly Van Houten^{2,3}, Lindsey Sangaralingham^{2,3}, Rachel A. Freedman⁴, Ahmedin Jemal⁵, Heather B. Neuman⁶, Tufia C. Haddad¹, Robert W. Mutter⁷, Theresa H.M. Keegan⁸, Sarah S. Mougalian⁹, Charles L. Loprinzi¹, Cary P. Gross⁹, Nilay Shah^{2,3}, and Kathryn J. Ruddy¹

¹Division of Medical Oncology, Mayo Clinic, Rochester, MN

²Robert D. and Patricia E. Kern Center for the Science of Health Care Delivery, Mayo Clinic, Rochester, MN

³OptumLabs, Cambridge, MA

⁴Dana-Farber Cancer Institute, Boston, MA

⁵American Cancer Society, Atlanta, GA

⁶Wisconsin Surgical Outcomes Research Program, Department of Surgery, University of Wisconsin School of Medicine, Madison, WI

⁷Division of Radiation Oncology, Mayo Clinic, Rochester, MN

⁸Division of Hematology and Oncology, University of California Davis School of Medicine, Sacramento, CA

⁹Cancer Outcomes, Public Policy and Effectiveness Research Center, Yale University, New Haven, CT

Abstract

Administrative claims data from a commercial insurance database were analyzed to evaluate differences in rates of outpatient office visits during the year after completion of 4 chemotherapy regimens for early stage breast cancer. Combined anthracycline/taxane was associated with more frequent office visits than docetaxel-cyclophosphamide or doxorubicin-cyclophosphamide, possibly because of greater long-term toxicities. Primary care visits were infrequent.

Background: Treatment-related toxicity can vary substantially between chemotherapy regimens. In this study we evaluated the frequency of outpatient office visits among a cohort of early stage breast cancer survivors after completion of 4 different adjuvant chemotherapy regimens to better understand how differences in toxicities between regimens might affect health care use.

Address for correspondence: Kathryn J. Ruddy, MD, MPH, Mayo Clinic, Oncology, 200 First St SW, Rochester, MN 55905 Fax: 507-284-1803; ruddy.kathryn@mayo.edu.

Disclosure

The authors have stated that they have no conflicts of interest.

Materials and Methods: We analyzed administrative claims data from a US commercial insurance database (OptumLabs) to identify women who received adjuvant doxorubicin/cyclophosphamide (AC), AC followed or preceded by docetaxel or paclitaxel (AC-T), AC concurrent with docetaxel or paclitaxel (TAC), or docetaxel/cyclophosphamide (TC) between 2008 and 2014. We compared mean numbers of visits per patient (adjusted for age, race/ethnicity, region, year, surgery type, radiation, chronic conditions, and previous hospitalizations) across the different regimens (TC = reference) for 12 months, starting 4 months after the end of chemotherapy.

Results: In 6247 eligible patients, the mean adjusted number of outpatient visits per patient was significantly higher in patients who received AC-T (8.1) or TAC (7.3) than TC (6.5) or AC (6.0; $P < .001$ for comparisons of AC-T and TAC with TC), primarily because of differences in Medical Oncology visits. Approximately 40% did not see a primary care provider at all during this time frame.

Conclusions: AC-T and TAC are associated with more subsequent outpatient visits than TC. Visits to primary care providers are infrequent during the year after completion of chemotherapy.

Keywords

Breast neoplasms; Follow-up; Health care use; Outpatient; Toxicity

Introduction

Breast cancer is the most prevalent cancer among women, with an estimated 252,710 new cases in 2017 and more than 3.3 million breast cancer survivors currently in the United States.¹ Early stage breast cancer is treated with surgical resection with or without radiation therapy, chemotherapy, and/or endocrine therapy in an effort to reduce the risk of cancer recurrence. Eighty percent of breast cancers do not overexpress HER2/*neu*, a critical determinant of optimal systemic therapy. There are multiple chemotherapy regimens available for adjuvant treatment of HER2/*neu*-negative breast cancer, and preferred regimens vary according to geographic region, institution, and individual provider. Treatment-related complications can differ among these regimens, which might potentially affect health care use and quality of life during treatment and afterward.

Previous studies have assessed hospitalization rates during and immediately after chemotherapy as a surrogate for treatment-related toxicity.²⁻⁴ Barcenas et al⁴ reported significantly higher rates of hospitalization in early stage breast cancer patients who received anthracycline-based chemotherapy than in those who received docetaxel/cyclophosphamide (TC), suggesting that TC carries less risk of acute severe toxicity. Similarly, in already-published work, our group reported higher adjusted rates of hospitalizations during the chemotherapy administration period among early stage breast cancer patients who received anthracycline-based chemotherapy compared with those who received TC.⁵ There were no observed differences in emergency department visit frequency between these regimens. Outpatient visit frequency has been less well studied as a surrogate for toxicity, but Baena-Canada et al⁶ included these types of visits in a composite end point of health care use during chemotherapy for breast cancer. These authors found that, among a small cohort ($n =$

268) of breast cancer patients who received chemotherapy, nearly half required additional and unexpected health care visits (either in an outpatient clinic, emergency department, or hospital) and that many visits resulted from treatment-related toxicity.

Guidelines from the National Comprehensive Cancer Network recommend that patients be seen in follow-up for early stage breast cancer 1 to 4 times during the year after completion of chemotherapy and radiotherapy.⁷ Data from a large Surveillance, Epidemiology, and End Results (SEER)-Medicare analysis of patients with early stage breast cancer older than age 65 showed that there is substantial variability in the types of providers participating in follow-up care of these patients, and that most patients (93%) continued to have routine follow-ups with their primary care providers during this period.⁸ We aimed to investigate patterns of care in a mixed-age population and to compare recipients of different standard chemotherapies to expand upon this previous work.

Harnessing the data from a large US insurance claims database, we compared the outpatient health care use between recipients of 4 common adjuvant chemotherapy regimens during the year after chemotherapy completion among a cohort of early stage, HER2/*neu*-negative breast cancer patients. Our hypothesis was that differences in long-term toxicities between regimens might affect health care use even after treatment completion.

Materials and Methods

We used administrative claims data from OptumLabs Data Warehouse⁹ to conduct a retrospective analysis of outpatient office visits among a cohort of breast cancer survivors beginning 4 months after completion of adjuvant chemotherapy and continuing for 1 year. This database includes over 100 million privately insured and Medicare Advantage enrollees throughout the United States and contains professional, facility, and outpatient medication claims for individuals enrolled in the included health plans.¹⁰ This analysis was exempt from Mayo Clinic Institutional Review Board approval because this study used a preexisting, deidentified data set.⁹

Patient Population

Women older than the age of 18 years with curatively treated breast cancer diagnosed between January 1, 2008 and December 31, 2014 were identified using a technique adapted from previous validated claims-based algorithms (Figure 1).^{11,12} Women with a diagnosis of breast cancer who underwent axillary lymph node dissection, lumpectomy, or mastectomy (unilateral or bilateral) between January 1, 2008 and December 31, 2014 were identified using International Classification of Diseases, Ninth Revision (ICD-9) and Current Procedural Terminology codes (n = 277,386). Of those women, those who received 1 cycle of doxorubicin/cyclophosphamide (AC), TC, AC followed or preceded by docetaxel or paclitaxel (AC-T), or AC concurrent with docetaxel or paclitaxel (TAC), within 12 months after their breast cancer surgery date, were included in this analysis (n = 35,246). Patients who received doxorubicin, cyclophosphamide, docetaxel, or paclitaxel during the 12 months before breast surgery were excluded to avoid including those with locally advanced disease that required neoadjuvant treatment, in an effort to assess a relatively homogeneous population. Chemotherapy drug administration was identified using Healthcare Common

Procedure Coding System (HCPCS) codes to identify chemotherapy regimens. Patients who underwent a subsequent lumpectomy, mastectomy, or axillary lymph node dissection within 24 months of initiation of chemotherapy were excluded so that patients with local recurrences were excluded (n = 31,082). Those with other cancer diagnoses or a metastatic breast cancer diagnosis (ICD-9 codes: 140.0–172.9, 176.0–195.8, 200.00–208.92, 238.6, 196.1, 196.2, 196.4, 196.9, 197.0, 197.3, 197.4, 197.6, 197.7, 197.8, 198.0, 198.2, 198.3, 198.4, 198.5, 198.6, 198.7, 198.82, 198.89, 199.0, 209.11, 209.20, 209.30, 237.5, and 239.6) within 12 months before or 24 months after chemotherapy initiation were also excluded (n = 21,196). Patients who received only 1 cycle of chemotherapy and those who received trastuzumab and/or other chemotherapy regimens during the 24 months after initiation of chemotherapy were excluded (n = 7163). Continuous medical coverage was required for 12-months before and 16 months after completion of chemotherapy (n = 916 excluded). In an effort to minimize capturing office visits for completion of radiation therapy, we started our year of follow-up 4 months after the last date of chemotherapy.

Outcome of Interest

The primary outcome of this analysis was the number of outpatient office visits, including visits in Family Medicine/Internal Medicine (primary care), Medical Oncology, and others (including surgical providers, radiation oncology, psychiatry, physical medicine and rehabilitation, gynecology, etc) during the 1-year period starting 4 months after the final dose of chemotherapy. Office visits were identified by restricting data to claims for which the place of service was reported as “office” and the HCPCS code was reported as either between 99,201 and 99,205 (new patients), or between 99,211 and 99,215 (established patients), or between 99,241 and 99,245 (office consultations). If patients had multiple visits on the same day to a given specialty, all were counted as 1 visit. Reasons for office visits were identified using ICD-9 codes and categorized according to the Agency for Healthcare Research and Quality’s Clinical Classifications Software.

Control Variables

Patient demographic characteristics including age at diagnosis, race/ethnicity, year of chemotherapy initiation, geographic region, insurance type (commercial, Medicare Advantage), type of definitive surgery (lumpectomy, mastectomy, or lymph node dissection alone), reconstructive surgery (yes/no), hospitalization (yes/no) within 12 months before initiation of chemotherapy (not including breast cancer surgery), radiation therapy (yes/no) within 12 months of chemotherapy initiation, and number of comorbid conditions. Comorbid conditions were identified using ICD-9 codes during the 12 months preceding chemotherapy initiation and the total sum of comorbid conditions was grouped according to 0, 1, 2, 3, 4, or 5 conditions. This method has been used previously by Magnan,¹³ which was adapted from a method previously reported by Hwang et al.¹⁴

Statistical Analysis

Negative binomial regression models were used to calculate the average number of office visits per patient during the 12-month follow-up period. These visit numbers were adjusted for age, race/ethnicity, region, year of chemotherapy initiation, surgery type, number of comorbid conditions,^{13,14} receipt of radiotherapy (within 12 months of chemotherapy

initiation), and previous hospitalization. A Sidak correction for multiple comparisons was used such that $P < .007$ was considered statistically significant. Because reconstructive surgery was generally limited to those with mastectomy and some reconstructions occurred after the visits of interest, we performed a sensitivity analysis that focused only on patients who did not undergo reconstruction. All statistical analyses were performed using SAS software version 9.4 (SAS Institute Inc, Cary, NC) and Stata/MP version 14.2 (StataCorp, College Station, TX).

Results

A total of 6247 women were included in this analysis, with a mean age of 54 (range, 25–87) years at the time of chemotherapy initiation. Of the included patients, 248 received AC, 2123 received AC-T, 430 received TAC, and 3446 received TC. Table 1 shows demographic and clinical details, and distributions of office visits according to regimen are shown in Table 2.

The adjusted mean number of office visits per patient in our study was lower among those who received TC (6.5) than AC-T (8.1; $P < .001$) or TAC (7.3; $P < .001$), with no statistically significant differences for the visit number after TC compared with AC (6.0; $P = .021$; Table 3). This finding seemed primarily driven by the difference in adjusted mean number of Medical Oncology visits. The mean number of Medical Oncology visits was 3.9 after AC-T ($P < .001$), 3.2 after TAC ($P < .001$), 2.5 after TC (reference), and 2.4 after AC ($P = .61$). When women who underwent breast reconstruction were excluded, the average number of office visits per patient after AC decreased more (a 0.4 decrease to 5.6) than after the other regimens, such that the difference between AC and TC (6.4) was statistically significant ($P = .003$; Table 3). Only 2% of patients had no office visits during the year of follow-up, but 41.7% did not see primary care at all during this timeframe. Primary care visit rates did not differ according to regimen, with an average adjusted number of 1.2 visits per patient. Breast cancer was the primary diagnosis billed for 66.9% of Medical Oncology visits, but only 5.5% of primary care visits. Hypertension, diabetes, and hyperlipidemia were other common primary diagnoses for primary care visits (accounting for 12.2%, 5.3%, and 5.2% of visits, respectively). See Table 4 for more details.

Discussion

Among a cohort of relatively young breast cancer survivors, the frequency of Medical Oncology office visits during the year after completion of chemotherapy varied according to chemotherapy regimen, with AC-T and TAC associated with more visits than TC and AC. These differences remained statistically significant, even after adjustment for a variety of other factors that might affect visit frequency. Our findings are consistent with data from Barcenas et al,⁴ showing higher rates of hospitalization during AC-T and TAC. We suspect that greater outpatient health care use during and after AC-T and TAC might, in part, reflect a greater burden of toxicity among recipients of combined anthracycline and taxane therapy. Taxanes are known to produce long-term neuropathy in a substantial minority of patients¹⁵ and anthracyclines can be cardiotoxic^{16,17}; combination therapy might increase risk of a variety of short- and long-term side effects that negatively affect patients during and after

treatment.¹⁸ In addition, patients who received a taxane as well as an anthracycline might have had more advanced disease, leading patients or providers to prefer more frequent follow-up, although national guidelines do not recommend more frequent follow-up of patients with higher stages of curatively treated breast cancer.⁷ Interestingly, when patients who underwent reconstruction were excluded from our analyses, outpatient visits were less frequent after AC than TC. This finding might be related to the fact that their toxicity profiles differ,¹⁹ or it might reflect unmeasured differences in the characteristics of the patients who were treated with AC versus TC.

Underuse of Medical Oncology care appears to be extremely rare, but approximately 2 in 5 patients did not see a primary care provider during the year after completion of adjuvant chemotherapy. The mean number of primary care visits we observed is substantially lower than those found in a recent analysis of visit frequency in an older SEER-Medicare population of breast cancer survivors,⁸ possibly reflecting less use of primary care among younger patients. There is an ongoing national effort to transition breast cancer survivorship care from medical oncologists to primary care providers earlier after completion of breast cancer treatment. However, transition of care will be difficult if patients do not maintain their relationships with their primary care providers by visiting with them at least once during the year after completion of treatment. A health care model that does not keep primary care providers involved during and shortly after specialty care will not encourage patients to feel comfortable with primary care follow-up in the long term. Additional supports might be needed (eg, tools that improve communication between oncology teams, primary care providers, and patients) to help young women feel comfortable transitioning their care back to their primary care providers.

Our study is limited by its retrospective nature and reliance on insurance claims-based methodology, which impairs our ability to fully appreciate the patient- and treatment- related factors that might affect the use of outpatient resources. Billing codes for specific toxicities might be underutilized such that it is difficult to tease out the true reasons for follow-up visits after cancer treatment. We did not have access to pathology or staging information, which might affect choice of treatment regimen as well as recurrence risk (which might drive visit frequency). We excluded patients who underwent subsequent surgical resections, those with metastatic diagnoses, and those who received alternative chemotherapy regimens, including HER2/*neu*-directed therapies, in an effort to focus on care use in early stage, HER2/*neu*-negative breast cancer. We were limited in our ability to determine whether patients seen for routine surveillance of breast cancer or complications of treatment, because providers might discuss or manage a variety of toxicities without billing for these specific issues. Further, patients might have been seen in clinic for follow-up from a previous hospitalization. In addition, we did not have data on endocrine therapy use, which might affect visit frequency.

Conclusion

The frequency of outpatient office visits after completion of adjuvant chemotherapy for early stage HER2/*neu*-negative breast cancer survivors varies significantly among treatment regimens, with the highest frequency among those who receive AC-T and TAC. Additional

nonclaims-based research is needed to elucidate the drivers of these patterns of health care use to optimize the costeffectiveness of cancer care. Understanding these differences in health care use might elucidate an opportunity for providers to proactively address health care concerns that arise for our patients during the survivorship period.

Clinical Practice Points

- Previous studies have shown that there are considerable differences in terms of acute treatment-related toxicity between chemotherapy regimens during the treatment of early stage breast cancer.
- However, there are limited data regarding outpatient visit utilization among breast cancer survivors after completion of chemotherapy, and how treatment regimen selection might affect later care needs.
- Among 6247 early breast cancer survivors, those who received combined anthracycline/taxane regimens (AC-T or TAC) had significantly more outpatient visits during the year after completion of treatment, primarily in Medical Oncology, compared with those who received AC or TC.
- Additionally, a large proportion of patients (40%) did not see a primary care provider during the year after completion of breast cancer treatment.
- These data are of interest because they suggest that adjuvant chemotherapy regimen selection might significantly affect later health care needs, perhaps at least in part as a result of differences in acute and long-term toxicities between regimens.
- These data emphasize the need for further research on the drivers of health care use to optimally address the concerns that arise during the survivorship period and to improve the costeffectiveness of cancer care.

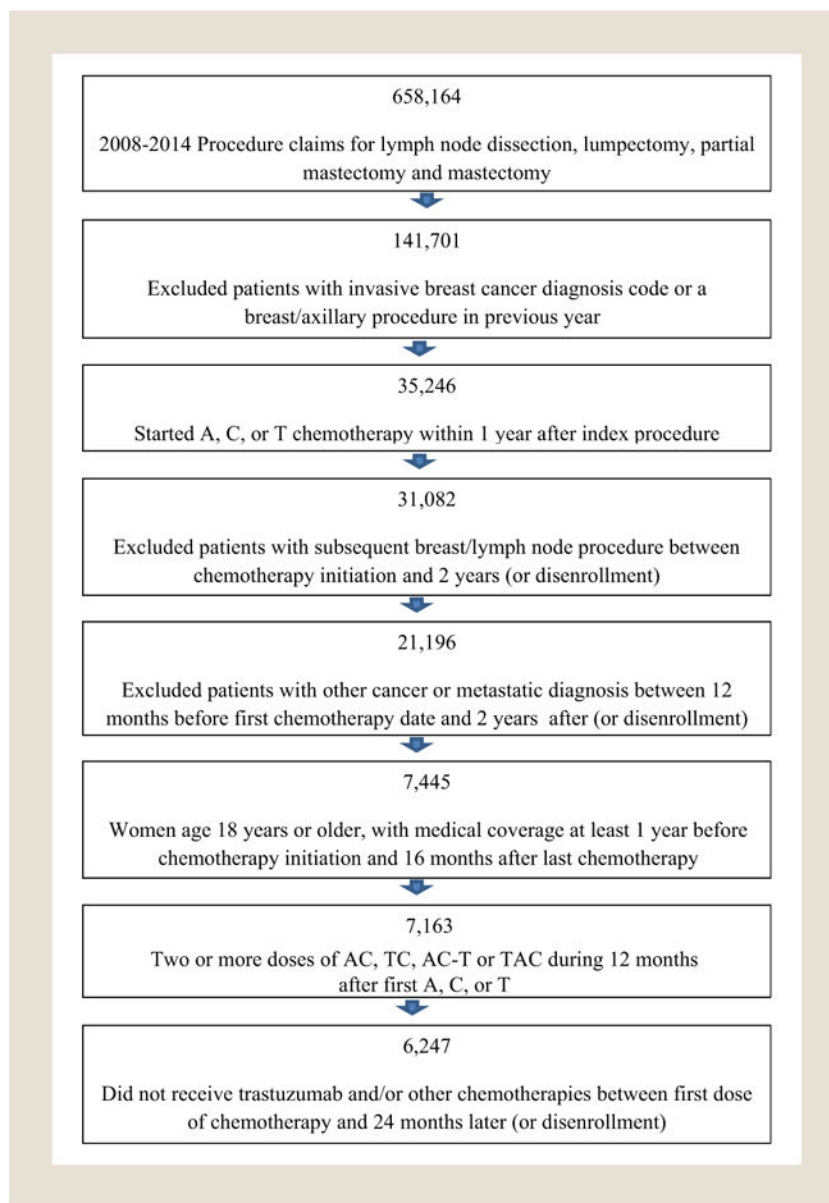
Acknowledgments

Kathryn J. Ruddy was supported by a National Institutes of Health (NIH) training grant under the Center for Translational Science Activities (CTSA) Grant Program from the National Center for Advancing Translational Sciences (UL1 TR000135, KL2TR000136-09). The contents of this article are solely the responsibility of the authors and do not necessarily represent the official view of NIH. Lindsey Sangaralingham was supported by a 2016 National Comprehensive Cancer Network Foundation Young Investigator Award (PI: Ruddy).

References

1. Cancer Facts & Figures 2017, *Vol. 2017* Atlanta: American Cancer Society; 2017.
2. Du XL, Osborne C, Goodwin JS. Population-based assessment of hospitalizations for toxicity from chemotherapy in older women with breast cancer. *J Clin Oncol* 2002; 20:4636-42. [PubMed: 12488407]
3. Hassett MJ, O'Malley AJ, Pakes JR, Newhouse JP, Earle CC. Frequency and cost of chemotherapy-related serious adverse effects in a population sample of women with breast cancer. *J Natl Cancer Inst* 2006; 98:1108-17. [PubMed: 16912263]
4. Barcnas CH, Niu J, Zhang N, et al. Risk of hospitalization according to chemotherapy regimen in early-stage breast cancer. *J Clin Oncol* 2014; 32: 2010-7. [PubMed: 24868022]

5. Ruddy KJ, Van Houten HK, Sangaralingham LR, et al. Impact of treatment regimen on acute care use during and after adjuvant chemotherapy for early-stage breast cancer. *Breast Cancer Res Treat* 2017; 164:515–25. [PubMed: 28493045]
6. Baena-Canada JM, Estalella-Mendoza S, Rosado-Varela P, et al. Use of health care services during chemotherapy for breast cancer. *Eur J Cancer* 2012; 48:3328–34. [PubMed: 22683169]
7. National Comprehensive Cancer Network. Breast Cancer (Version 2.2017) 2017 Available at: www.nccn.org/professionals/physician_gls/pdf/breast_blocks.pdf, Accessed: October 15, 2017.
8. Neuman HB, Schumacher JR, Schneider DF, et al. Variation in the types of providers participating in breast cancer follow-up care: a SEER-Medicare analysis. *Ann Surg Oncol* 2017; 24:683–91.
9. Wallace PJ, Shah ND, Dennen T, Bleicher PA, Crown WH. Optum Labs: building a novel node in the learning health care system. *Health Aff (Millwood)* 2014; 33:1187–94. [PubMed: 25006145]
10. Optum. Real-world health care experiences from over 150 million unique individuals since 1993, Available at: https://www.optum.com/content/dam/optum/resources/productSheets/5302_Data_Assets_Chart_Sheet_ISPOR.pdf. Accessed: October 14, 2016.
11. Nattinger AB, Laud PW, Bajorunaite R, Sparapani RA, Freeman JL. An algorithm for the use of Medicare claims data to identify women with incident breast cancer. *Health Serv Res* 2004; 39:1733–49. [PubMed: 15533184]
12. Gold HT, Do HT. Evaluation of three algorithms to identify incident breast cancer in Medicare claims data. *Health Serv Res* 2007; 42:2056–69. [PubMed: 17850533]
13. Magnan E Algorithm for Identifying Patients with Multiple Chronic Conditions (Multimorbidity), University of Wisconsin - Madison Department of Family Medicine, the University of California - Davis Department of Family and Community Medicine, and the UW Health Innovation Program 2015, Available at: <http://www.hipxchange.org/comorbidities>.
14. Hwang W, Ireys HT, Anderson GF. Comparison of risk adjusters for Medicaid-enrolled children with and without chronic health conditions. *Ambul Pediatr* 2001; 1:217–24. [PubMed: 11888404]
15. Seretny M, Currie GL, Sena ES, et al. Incidence, prevalence, and predictors of chemotherapy-induced peripheral neuropathy: a systematic review and metaanalysis. *Pain* 2014; 155:2461–70. [PubMed: 25261162]
16. Pai VB, Nahata MC. Cardiotoxicity of chemotherapeutic agents: incidence, treatment and prevention. *Drug Saf* 2000; 22:263–302. [PubMed: 10789823]
17. Chen MH, Colan SD, Diller L. Cardiovascular disease: cause of morbidity and mortality in adult survivors of childhood cancers. *Circ Res* 2011; 108: 619–28. [PubMed: 21372293]
18. Schwentner L, Harbeck N, Singer S, et al. Short-term quality of life with epirubicin-fluorouracil-cyclophosphamide (FEC) and sequential epirubicin/cyclophosphamide-docetaxel (EC-DOC) chemotherapy in patients with primary breast cancer - results from the prospective multi-center randomized ADEBAR trial. *Breast* 2016; 27:69–77. [PubMed: 27054751]
19. Jones SE, Savin MA, Holmes FA, et al. Phase III trial comparing doxorubicin plus cyclophosphamide with docetaxel plus cyclophosphamide as adjuvant therapy for operable breast cancer. *J Clin Oncol* 2006; 24:5381–7. [PubMed: 17135639]



Abbreviations: A = doxorubicin; AC = doxorubicin-cyclophosphamide; AC-T = doxorubicin-cyclophosphamide before or after paclitaxel or docetaxel; C = cyclophosphamide; T = docetaxel or paclitaxel; TAC = doxorubicin-cyclophosphamide concurrent with paclitaxel or docetaxel; TC = docetaxel-cyclophosphamide.

Figure 1.
Cohort Flow Diagram

Table 1

Patient Characteristics (n, %) According to Adjuvant Chemotherapy Regimen

	AC (n = 248)	AC-T (n = 2123)	TAC (n = 430)	TC (n = 3446)	Total (n = 6247)
Patient Characteristics					
Age, Years					
Mean (SD)	54.0 (9.6)	52.6 (9.3)	50.7 (8.9)	55.2 (9.4)	53.9 (9.5)
Median	54	53	50	55	54
Q1, Q3	47.5 60.0	46.0 59.0	44.0 57.0	48.0 61.0	47.0 60.0
Range	31.0–83.0	26.0–81.0	25.0–82.0	27.0–87.0	25.0–87.0
Age Group, Years					
18–35	4 (1.6)	58 (2.7)	11 (2.6)	31 (0.9)	104 (1.7)
35–54	121 (48.8)	1164 (54.8)	274 (63.7)	1582 (45.9)	3141 (50.3)
55–64	95 (38.3)	705 (33.2)	121 (28.1)	1340 (38.9)	2261 (36.2)
65 and older	28 (11.3)	196 (9.2)	24 (5.6)	493 (14.3)	741 (11.9)
Year of Chemotherapy Initiation					
2008	66 (26.6)	262 (12.3)	81 (18.8)	451 (13.1)	860 (13.8)
2009	49 (19.8)	342 (16.1)	88 (20.5)	510 (14.8)	989 (15.8)
2010	33 (13.3)	308 (14.5)	73 (17.0)	531 (15.4)	945 (15.1)
2011	40 (16.1)	325 (15.3)	78 (18.1)	611 (17.7)	1054 (16.9)
2012	24 (9.7)	362 (17.1)	60 (14.0)	564 (16.4)	1010 (16.2)
2013	19 (7.7)	351 (16.5)	31 (7.2)	491 (14.2)	892 (14.3)
2014	17 (6.9)	173 (8.1)	19 (4.4)	288 (8.4)	497 (8.0)
Geographic Region					
Midwest	90 (36.3)	655 (30.9)	76 (17.7)	976 (28.3)	1797 (28.8)
Northeast	33 (13.3)	293 (13.8)	19 (4.4)	336 (9.8)	681 (10.9)
South	92 (37.1)	889 (41.9)	264 (61.4)	1559 (45.2)	2804 (44.9)
West	33 (13.3)	286 (13.5)	71 (16.5)	575 (16.7)	965 (15.4)
Race/Ethnicity					
Asian	8 (3.2)	48 (2.3)	13 (3.0)	59 (1.7)	128 (2.0)
Black	16 (6.5)	166 (7.8)	45 (10.5)	299 (8.7)	526 (8.4)
Hispanic	10 (4.0)	105 (4.9)	27 (6.3)	154 (4.5)	296 (4.7)
Unknown	77 (31.0)	688 (32.4)	124 (28.8)	1005 (29.2)	1894 (30.3)
White non-Hispanic	137 (55.2)	1116 (52.6)	221 (51.4)	1929 (56.0)	3403 (54.5)
Insurance Type					
Commercial	221 (89.1)	1956 (92.1)	409 (95.1)	3022 (87.7)	5608 (89.8)
Medicare Advantage	27 (10.9)	167 (7.9)	21 (4.9)	424 (12.3)	639 (10.2)
Surgery Type					
Lumpectomy	137 (55.2)	954 (44.9)	181 (42.1)	1959 (56.8)	3231 (51.7)
Mastectomy	110 (44.4)	1159 (54.6)	247 (57.4)	1479 (42.9)	2995 (47.9)

	AC (n = 248)	AC-T (n = 2123)	TAC (n = 430)	TC (n = 3446)	Total (n = 6247)
Lymph node dissection ^a	1 (0.4)	10 (0.5)	2 (0.5)	8 (0.2)	21 (0.3)
Reconstruction Within 12 Months After Chemotherapy Initiation					
No	191 (77.0)	1652 (77.8)	307 (71.4)	2737 (79.4)	4887 (78.2)
Yes	57 (23.0)	471 (22.2)	123 (28.6)	709 (20.6)	1360 (21.8)
Radiation Within 12 Months After Start of Chemotherapy					
No	110 (44.4)	632 (29.8)	135 (31.4)	1486 (43.1)	2363 (37.8)
Yes	138 (55.6)	1491 (70.2)	295 (68.6)	1960 (56.9)	3884 (62.2)
Hospitalization Within 12 Months Before Start of Chemotherapy					
No	230 (92.7)	1992 (93.8)	403 (93.7)	3221 (93.5)	5846 (93.6)
Yes	18 (7.3)	131 (6.2)	27 (6.3)	225 (6.5)	401 (6.4)
Number of Chronic Conditions Per Patient^b					
Mean (SD)	4.1 (2.9)	4.0 (2.8)	3.9 (2.6)	4.2 (2.9)	4.1 (2.9)
Median	4	4	3	4	4
Q1, Q3	2.0 6.0	2.0 6.0	2.0 6.0	2.0 6.0	2.0 6.0
Range	0.0–14.0	0.0–20.0	0.0–13.0	0.0–20.0	0.0–20.0
Number of Chronic Conditions Per Patient^b					
0	16 (6.5)	135 (6.4)	34 (7.9)	244 (7.1)	429 (6.9)
1	32 (12.9)	280 (13.2)	40 (9.3)	390 (11.3)	742 (11.9)
2	38 (15.3)	282 (13.3)	64 (14.9)	487 (14.1)	871 (13.9)
3	30 (12.1)	318 (15.0)	78 (18.1)	490 (14.2)	916 (14.7)
4	38 (15.3)	322 (15.2)	53 (12.3)	451 (13.1)	864 (13.8)
5 or more	94 (37.9)	786 (37.0)	161 (37.4)	1384 (40.2)	2425 (38.8)

Data are presented as n (%) except where otherwise noted.

Abbreviations: AC = doxorubicin-cyclophosphamide; AC-T = doxorubicin-cyclophosphamide before or after paclitaxel or docetaxel; Q1, Q3 = first quartile, third quartile; TAC = doxorubicin-cyclophosphamide concurrent with paclitaxel or docetaxel; TC = docetaxel-cyclophosphamide.

^aLymph node dissection only (without breast surgery). Those with lymph node dissection in addition to breast surgery were characterized according to their type of definitive breast surgery.

^bNumbers of chronic conditions per patient are on the basis of the Agency for Healthcare Research and Quality's Clinical Classification Software.

Table 2Office Visits According to Adjuvant Chemotherapy Regimen Over a Year of Follow-up^a

	AC (n = 248)	AC-T (n = 2123)	TAC (n = 430)	TC (n = 3446)	Total (n = 6247)
Overall: Number of Office Visits Per Patient					
Mean (SD)	6.0 (4.5)	8.3 (5.0)	7.8 (4.8)	6.7 (4.5)	7.3 (4.8)
Median	5	7	7	6	6
Q1, Q3	3.0 8.0	5.0 11.0	5.0, 10.0	4.0, 9.0	4.0, 10.0
Range	0.0–28.0	0.0–36.0	0.0–29.0	0.0–58.0	0.0–58.0
Overall: Proportion With Visits					
0 visits	14 (5.6)	22 (1.0)	4 (0.9)	83 (2.4)	123 (2.0)
1 visit	17 (6.9)	60 (2.8)	12 (2.8)	141 (4.1)	230 (3.7)
2 visits	24 (9.7)	94 (4.4)	20 (4.7)	268 (7.8)	406 (6.5)
3 visits	21 (8.5)	116 (5.5)	32 (7.4)	313 (9.1)	482 (7.7)
4 visits	28 (11.3)	169 (8.0)	39 (9.1)	385 (11.2)	621 (9.9)
5 or more visits	144 (58.1)	1662 (78.3)	323 (75.1)	2256 (65.5)	4385 (70.2)
Medical Oncology: Number of Office Visits Per Patient					
Mean (SD)	2.4 (2.2)	4.0 (3.0)	3.5 (2.5)	2.5 (2.0)	3.1 (2.5)
Median	2	4	3	2	3
Q1, Q3	0.0, 4.0	2.0, 5.0	2.0, 5.0	1.0, 4.0	1.0, 4.0
Range	0.0–12.0	0.0–27.0	0.0–13.0	0.0–18.0	0.0–27.0
Medical Oncology: Proportion With Visits					
0 visits	68 (27.4)	228 (10.7)	44 (10.2)	662 (19.2)	1002 (16.0)
1 visit	30 (12.1)	240 (11.3)	62 (14.4)	548 (15.9)	880 (14.1)
2 visits	44 (17.7)	249 (11.7)	55 (12.8)	635 (18.4)	983 (15.7)
3 visits	36 (14.5)	307 (14.5)	69 (16.0)	633 (18.4)	1045 (16.7)
4 visits	28 (11.3)	310 (14.6)	80 (18.6)	479 (13.9)	897 (14.4)
5 or more visits	42 (16.9)	789 (37.2)	120 (27.9)	489 (14.2)	1440 (23.1)
Primary Care: Number of Office Visits Per Patient					
Mean (SD)	1.3 (2.1)	1.4 (1.9)	1.3 (1.9)	1.4 (2.0)	1.4 (2.0)
Median	1	1	1	1	1
Q1, Q3	0.0, 2.0	0.0, 2.0	0.0, 2.0	0.0, 2.0	0.0, 2.0
Range	0.0–23.0	0.0–18.0	0.0–14.0	0.0–31.0	0.0–31.0
Primary Care: Proportion With Visits					
0 visits	115 (46.4)	892 (42.0)	197 (45.8)	1402 (40.7)	2606 (41.7)
1 visit	60 (24.2)	545 (25.7)	95 (22.1)	858 (24.9)	1558 (24.9)
2 visits	31 (12.5)	291 (13.7)	62 (14.4)	521 (15.1)	905 (14.5)
3 visits	12 (4.8)	158 (7.4)	37 (8.6)	289 (8.4)	496 (7.9)

	AC (n = 248)	AC-T (n = 2123)	TAC (n = 430)	TC (n = 3446)	Total (n = 6247)
4 visits	18 (7.3)	87 (4.1)	12 (2.8)	168 (4.9)	285 (4.6)
5 or more visits	12 (4.8)	150 (7.1)	27 (6.3)	208 (6.0)	397 (6.4)

Data are presented as n (%) except where otherwise noted.

Abbreviations: AC = doxorubicin-cyclophosphamide; AC-T = doxorubicin-cyclophosphamide before or after paclitaxel or docetaxel; Q1, Q3 = first quartile, third quartile; TAC = doxorubicin-cyclophosphamide concurrent with paclitaxel or docetaxel; TC = docetaxel-cyclophosphamide.

^aYear of follow-up began four months after chemotherapy completion.

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Table 3

Adjusted Mean Numbers of Office Visits Per Patient According to Adjuvant Chemotherapy Regimen

All Patients	AC (n = 248)	AC-T (n = 2123)	TAC (n = 430)	TC (n = 3446)
All Office Visits				
Number Per Patient (95% CI)	6.0 (5.5–6.4)	8.1 (7.9–8.3)	7.3 (6.9–7.7)	6.5 (6.4–6.7)
P	.021	<.001	<.001	Reference
Medical Oncology Visits				
Number Per Patient (95% CI)	2.4 (2.2–2.7)	3.9 (3.7–4.0)	3.2 (3.0–3.4)	2.5 (2.4–2.6)
P	.611	<.001	<.001	Reference
Primary Care Visits				
Number Per Patient (95% CI)	1.1 (1.0–1.3)	1.3 (1.3–1.4)	1.2 (1.1–1.4)	1.3 (1.2–1.3)
P	.198	.236	.466	Reference
Patients Who Underwent Reconstruction Excluded				
	AC (n = 191)	AC-T (n = 1652)	TAC (n = 307)	TC (n = 2737)
All Office Visits				
Number Per Patient (95% CI)	5.6 (5.1–6.1)	8.0 (7.8–8.3)	7.1 (6.7–7.6)	6.4 (6.3–6.6)
P	.003	<.001	<.001	Reference
Medical Oncology Visits				
Number Per Patient (95% CI)	2.5 (2.2–2.8)	4.0 (3.8–4.1)	3.1 (2.9–3.4)	2.5 (2.5–2.6)
P	.592	<.001	<.001	Reference
Primary Care Visits				
Number Per Patient (95% CI)	1.1 (0.9–1.3)	1.3 (1.3–1.4)	1.2 (1.1–1.4)	1.3 (1.2–1.4)
P	.043	.398	.487	Reference

Numbers are adjusted by age, race, region, year of chemo initiation, surgery type, number of chronic conditions, previous hospitalizations, and radiation. Year of follow-up began 4 months after chemotherapy completion.

Abbreviations: AC = doxorubicin-cyclophosphamide; AC-T = doxorubicin-cyclophosphamide before or after paclitaxel or docetaxel; TAC = doxorubicin-cyclophosphamide concurrent with paclitaxel or docetaxel; TC = docetaxel-cyclophosphamide.

Table 4

Top 5 Primary Diagnoses Billed

	All Office Visits	Medical Oncology Visits	Primary Care Visits
1	Breast cancer (36.9%)	Breast cancer (66.9%)	Hypertension (12.2%)
2	Unclassified (6.4%) ^a	Unclassified (6.8%) ^a	Exam/evaluation (5.6%)
3	Hypertension (2.8%)	Maintenance chemotherapy/XRT (4.7%) ^b	Breast cancer (5.5%)
4	Maintenance chemotherapy/XRT (2.2%) ^b	Anemia (1.8%)	Diabetes (5.3%)
5	Breast disorder (2.1%)	Other aftercare (1.4%)	Hyperlipidemia (5.2%)

Abbreviation: XRT = radiation.

^aClinical Classifications Software (CCS) category “unclassified” includes diagnosis of estrogen receptor positive status, estrogen receptor negative status, postsurgical absence of breast/nipple, and personal/family history of malignant neoplasm of breast.

^b“Maintenance chemotherapy/XRT” includes office visits for “encounter for radiotherapy (V58.0),” “encounter for antineoplastic chemotherapy (V58.11),” “encounter for antineoplastic immunotherapy (V58.12),” “convalescence following chemotherapy (V66.2),” “follow-up examination, following radiotherapy (V67.1),” and “follow-up examination, following chemotherapy (V67.2).”