

# Health Care Utilization From Chemotherapy-Related Adverse Events Among Low-Income Breast Cancer Patients: Effect of Enrollment in a Medical Home Program

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**BACKGROUND** Chemotherapy-related health care utilization by breast cancer patients can be expensive for payers and patients. This study evaluated the patient-centered medical home program Community Care of North Carolina (CCNC) in terms of its potential to reduce health care utilization associated with chemotherapy-related adverse events (AEs).

**METHODS** Early-stage breast cancer cases diagnosed during the 5-year period 2003–2007 were identified in the North Carolina Central Cancer Registry; these cases were then linked to North Carolina Medicaid claims data. We measured health care utilization associated with chemotherapy-related AEs by setting (inpatient, outpatient, or emergency department) during a 15-month postdiagnosis follow-up period. Descriptive and multivariate analyses were performed to examine associations between CCNC enrollment and health care utilization associated with chemotherapy-related AEs.

**RESULTS** A large proportion of breast cancer patients had at least 1 health care visit associated with a chemotherapy-related AE ( $n = 412$  [72.3%]). The mean numbers of AE-related visits occurring in inpatient, outpatient, and emergency department settings were 0.30 (standard deviation [SD] = 0.83), 6.92 (SD = 10.94), and 0.46 (SD = 1.26), respectively. CCNC enrollment was associated with significantly fewer inpatient admissions (marginal effect,  $-0.1421$ ; 95% confidence interval,  $-0.280$  to  $-0.004$ ).

**LIMITATIONS** In this observational study, we were unable to draw conclusions about the causality of these associations.

**CONCLUSIONS** Patients enrolled in CCNC had fewer inpatient health care visits associated with chemotherapy-related AEs. Future research should continue to explore the extent to which patient-centered medical homes can monitor and help manage the effects of cancer treatments.

**B**reast cancer, which is the most common type of cancer in women, made up more than one-third of all new cancers diagnosed among women in North Carolina in 2011 [1]. The 5-year incidence rate of female breast cancer per 100,000 population in North Carolina increased from 148.2 in 2001 to 157.4 in 2011; during the same period, the rate of mortality from breast cancer decreased from 26.5 to 22.8 per 100,000 persons [1]. The growing incidence of breast cancer in North Carolina, the increasing number of breast cancer survivors, and the aging of the US population mean that the demand for breast cancer care will likely increase, and we must consider how to ensure that the health care system is prepared to respond to this demand.

Although most of the health care utilization by cancer patients is associated with diagnostic and therapeutic management of the disease, management of chemotherapy-related adverse events (AEs) also requires substantial resources [2]. Several studies have shown that treatment-related AEs are associated with substantial costs resulting from higher rates of inpatient and emergency department (ED) admissions [3–5]. A few observational studies of breast cancer patients have shown that chemotherapy-related AEs have an enormous impact on health care expenditures and utilization [6, 7].

The effective management of chemotherapy-related AEs can be facilitated by community care management programs such as the patient-centered medical home (PCMH) model (also known as the primary care medical home model); integrating such a model into cancer care can enable more efficient utilization of available health care resources. PCMHs are designed to improve health care quality, to coordinate patient care across multiple providers, and to reduce the need for inappropriate or avoidable utilization of hospital EDs and inpatient beds [8]. In North Carolina, Community Care of North Carolina (CCNC) was established to provide care coordination, management, and prevention services for Medicaid beneficiaries [9]. Medicaid beneficiaries voluntarily enroll in the CCNC program and select a PCMH provider from the list of primary care providers serving their area; this provider is expected to coordinate the overall health care needs of that beneficiary, with support

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from a medical management team [10]. The CCNC program focuses on patients who are moving across care settings and provides transitional support services such as face-to-face counseling during inpatient admission, medication reconciliation after discharge, self-management training, and other types of patient education. The ultimate goal of this PCMH program is to promote better health outcomes in primary care settings, thereby reducing the utilization of inpatient and ED services.

To our knowledge, there are no studies assessing the impact of CCNC on health care utilization associated with cancer treatment-related AEs. Specifically, we lack data on the role that CCNC plays in the care of breast cancer patients experiencing chemotherapy-related AEs. Hence, the specific aims of this study were to describe the extent of health care utilization associated with chemotherapy-related AEs in the Medicaid breast cancer population in North Carolina and to assess the relationship between CCNC enrollment and utilization of such health care.

## Methods

### Data Sources

The North Carolina Integrated Cancer Information and Surveillance System (ICISS) provided access to cancer registry data and Medicaid claims data, diagnostic and procedural code lookup libraries, and analytic support for this study. [Editor's note: For more information about ICISS, refer to the commentary by Meyer and colleagues on pages 265-269]. Specifically, North Carolina Central Cancer Registry (NCCCR) data were used to identify women diagnosed with early-stage breast cancer from January 1, 2003, through December 31, 2007. These data include clinical information relevant to the diagnosed cancer, such as primary site and tumor staging. The NCCCR data were then linked to Medicaid claims to identify women who were insured by Medicaid during this period. The Medicaid claims data provide details about health care utilization, including service dates, which allowed us to perform a longitudinal assessment of postdiagnosis treatments and health outcomes.

### Cohort Selection

Our study sample consisted of women aged 18-64 years who had a diagnosis of early-stage breast cancer (stage 0, I, or II) based on the presence in the NCCCR data of an International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) code of 174.X, 238.3, or 239.3. Eligible women had to have been enrolled in Medicaid for at least 1 month before their index diagnosis, and they must not have had evidence of cancer prior to that time. We excluded cases diagnosed at autopsy or on a death certificate, cases with missing or unknown tumor stage data, and cases with an additional cancer diagnosis reported in the registry within 1 year of the index diagnosis. Because Medicaid enrollment can be transient [11], we only included patients who had at least 12 months of Medicaid enrollment

during the 15-month postdiagnosis period, so that most of their service claims could be captured. These exclusions followed a protocol that we described previously in another paper [10]. We further excluded patients who were eligible to receive both Medicare and Medicaid benefits, because complete treatment claims for these patients were not available. See Figure 1 (online version only) for the numbers of patients involved at each stage of the selection process.

**FIGURE 1.**  
**Process of Selecting the Final Study Sample**

This figure is available in its entirety in the online edition of the NCMJ.

### Definition and Measurement of Variables

**Cancer treatments.** Breast cancer treatments (surgery, chemotherapy, radiation therapy, and hormone therapy) were identified using the codes listed in Appendix 1 (online version only). Binary variables—which were not mutually exclusive—were created to define receipt of each of these types of treatments at any time during the study period.

**Health care visits associated with chemotherapy-related AEs (dependent variable).** Because chemotherapy is the principal source of AEs in the breast cancer patient population, we specifically focused on these AEs. For the purpose of this study, we included moderate-to-severe chemotherapy-related AEs experienced by breast cancer patients as reported in other studies [7, 12]. Following the approach of Hassett and colleagues [7], we grouped these AEs into 8 categories: abnormal electrolyte levels or dehydration; constitutional symptoms and nonspecific symptoms associated with chemotherapy; nausea, emesis, and diarrhea; infection and fever; malnutrition; anemia and transfusion of red blood cells; neutropenia or thrombocytopenia; and deep vein thrombosis or pulmonary embolism. The codes for these AEs are listed in Appendix 1 (online version only).

It is important to note that these AEs are not 100% specific to the receipt of chemotherapy and may occur in breast cancer patients who did not receive chemotherapy. In order to be consistent with and allow comparisons to the published literature, we used the algorithm developed by Hassett and colleagues [7] to define this type of health care utilization, and we use the term "chemotherapy-related AEs" in our study; however, we also attempted to parse out the occurrence of these events in patients who did not receive chemotherapy. Patients diagnosed with stage 0 breast cancer were included in our analysis because we observed that a significant proportion (nearly 22%) of these patients received chemotherapy during the study period; thus, they were likely to have experienced clinically relevant AEs.

A patient was considered to have experienced a chemotherapy-related AE when an inpatient, outpatient, or ED claim indicated that any of the above-mentioned AEs had

been reported using a relevant procedure code, ICD 9-CM code, or diagnosis-related group (DRG) code. Because the first-listed diagnosis code on the claim does not necessarily represent the reason for the visit [13], mostly because of intercoder variations in practice, all available diagnosis code fields (up to 9) were used. Health care visits during which a patient received cancer treatments such as chemotherapy or radiation therapy were excluded. The primary outcome variables were the total number of visits to each of the 3 health care settings.

**CCNC enrollment (primary independent variable).** Because CCNC networks and primary care providers receive a per-member-per-month (PMPM) payment from Medicaid to coordinate the health and disease management needs of the enrolled population, patients were considered to be enrolled in the CCNC program (and thus to have a PCMH) when both the network and the provider management fees were paid on a monthly basis. We identified the PMPM payment using state-defined procedure codes (W9920 or W9921 for the provider and W9923 for the network) [14]. A binary variable representing patients who had any CCNC enrollment during the 15-month postdiagnosis period served as the primary independent variable.

**Control variables.** The sociodemographic control variables were sex, race (non-Hispanic white, non-Hispanic black, or other), rural/urban status of the county of residence, and whether or not Medicaid eligibility was due to blindness or disability.

Clinical control variables included cancer stage and comorbidity index, the latter of which was determined using a previously described [10, 15] modification of the National Cancer Institute Combined Index algorithm. Cancer stage was derived using the American Joint Committee on Cancer (AJCC) stage grouping, if possible; the Surveillance, Epidemiology, and End Results (SEER) summary staging was used if AJCC stage grouping was not available, or tumor, node, and metastasis (TNM) staging was used if neither AJCC stage grouping nor SEER summary staging was available [16].

#### Statistical Analysis

Bivariate analyses were performed to compare the characteristics and mean numbers of visits for chemotherapy-related AEs, by type of health care setting, for patients who had ever been enrolled in CCNC versus those who had never been enrolled in CCNC. Because of the lack of specificity of chemotherapy-related AEs, we also used bivariate statistics to compare the frequency with which patients experienced each type of AE and their chemotherapy status (ie, whether they received chemotherapy during the study period or not). Chi-square and Fisher's exact tests were used for comparing categorical variables, and *t* tests were used for comparing continuous variables.

We used a method proposed by Long and Freese [17] to select an appropriate analytic model with which to perform multivariate analyses for our continuous outcome measures

(see Figure 2; online version only). We chose negative binomial regression for our analytic model, because it fit the observed data best, and it took into account the possibility of AEs occurring in patients who were not receiving chemotherapy [18].

**FIGURE 2.**  
Comparison of Predicted Probabilities of Health Care Visit Counts From 3 Statistical Modeling Approaches With the Observed Data, Depicted as Deviation From the Observed Proportion, Based on a Method Proposed by Long and Freese [17]

This figure is available in its entirety in the online edition of the NCMJ.

Three separate regression analyses were performed to estimate health care utilization; outcomes were the number of inpatient visits associated with chemotherapy-related AEs, the number of outpatient visits associated with chemotherapy-related AEs, and the number of ED visits associated with chemotherapy-related AEs. We used an alpha level of 0.05 to determine statistical significance. Results are presented as average marginal effects (MEs), which represent the marginal change in the number of visits induced by changes in each independent variable [19]. For instance, for our primary independent variable (CCNC enrollment), the ME would indicate the increase or decrease in the number of inpatient admissions associated with chemotherapy-related AEs for patients who were enrolled in CCNC compared with those who were not enrolled in CCNC. Modeling was performed using Stata statistical software [20].

## Results

A total of 570 breast cancer patients met the inclusion criteria and were included in the analysis. The average age of patients in the sample was 48.4 years (standard deviation [SD] = 8.9); the sample included an almost equal proportion of white patients (43.0%) and black patients (44.4%); and the majority of patients (65.3%) lived in an urban area. Fifty-four percent of patients in the sample were enrolled in CCNC for at least 1 month during the study period; among patients with any enrollment, the mean duration of enrollment was 10.8 months. Table 1 summarizes the demographic and clinical characteristics of patients by CCNC enrollment status. Enrollment in CCNC was more common among younger women ( $P < .001$ ) and among those who were black ( $P = .005$ ).

Nearly three-fourths ( $n = 412$  [72.3%]) of the patients in the sample had at least 1 health care visit associated with a chemotherapy-related AE during the 15-month follow-up period; specifically, 19.1% had at least 1 inpatient admission, 69.6% had at least 1 outpatient visit, and 24.9% had at least 1 ED visit. The mean numbers of visits associated with chemotherapy-related AEs during the follow-up period were

**TABLE 1.**  
**Descriptive Summary of Demographic and Clinical Characteristics of Breast Cancer Patients Included in the Study Sample**

Characteristic	All patients in sample (N = 570)	Patients never enrolled in CCNC (n = 262) (46%)	Patients ever enrolled in CCNC (n = 308) (54%)	P-value <sup>a</sup>
<b>Demographic characteristics</b>				
Age at diagnosis, in years: Mean±SD	48.8±8.9	49.9±8.6	47.2±9.0	<.001
Race: No. (%)				.005
White	245 (43.0%)	130 (49.6%)	115 (37.3%)	
Black	253 (44.4%)	103 (39.3%)	150 (48.7%)	
Other	72 (12.6%)	29 (11.1%)	43 (14.0%)	
Medicaid eligibility due to blindness or disability: No. (%)	261 (45.8%)	109 (41.6%)	152 (49.3%)	.064
Urban resident: No. (%)	372 (65.3%)	172 (65.6%)	200 (64.9%)	.858
<b>Clinical characteristics</b>				
NCI Combined Index for comorbidity: Mean±SD	0.25±0.41	0.23±0.41	0.26±0.42	.268
Tumor stage: No. (%)				.907
Stage 0	136 (23.9%)	61 (23.3%)	75 (24.3%)	
Stage I	249 (43.7%)	117 (44.7%)	132 (42.9%)	
Stage II	185 (32.5%)	84 (32.1%)	101 (32.8%)	
Treatment received: No. (%)				
Chemotherapy	318 (55.8%)	143 (54.6%)	175 (56.8%)	.592
Radiation	304 (53.3%)	140 (53.4%)	164 (53.2%)	.964
Surgery <sup>b</sup>	459 (80.5%)	191 (72.9%)	268 (87.0%)	<.001
Hormone therapy	124 (21.7%)	56 (21.4%)	68 (22.1%)	.839
Made health care visits associated with a chemotherapy-related adverse event: No. (%)				
Any visit to any setting	412 (72.3%)	180 (68.7%)	232 (75.3%)	.078
Inpatient admission	109 (19.1%)	52 (19.8%)	57 (18.5%)	.685
Outpatient visit	397 (69.6%)	176 (67.2%)	221 (71.7%)	.236
Emergency department visit	142 (24.9%)	63 (24.0%)	79 (25.6%)	.659

Note. CCNC, Community Care of North Carolina; NCI, National Cancer Institute; SD, standard deviation.

<sup>a</sup>P-values are based on t test for continuous variables and chi-square test for categorical variables.

<sup>b</sup>Breast-conserving surgery or mastectomy.

0.30 for inpatient admissions (SD = 0.83; range, 0-8), 6.92 for outpatient visits (SD = 10.94; range, 0-75), and 0.46 for ED visits (SD = 1.26; range, 0-15). Patients enrolled in CCNC had fewer overall visits associated with chemotherapy-related AEs across all 3 health care settings, but the differences were not statistically significant in the bivariate analysis (see Figure 3). Table 2 shows the numbers and percentages of patients who experienced each type of chemotherapy-related AE during the study period, by chemotherapy status (received chemotherapy or did not receive chemotherapy).

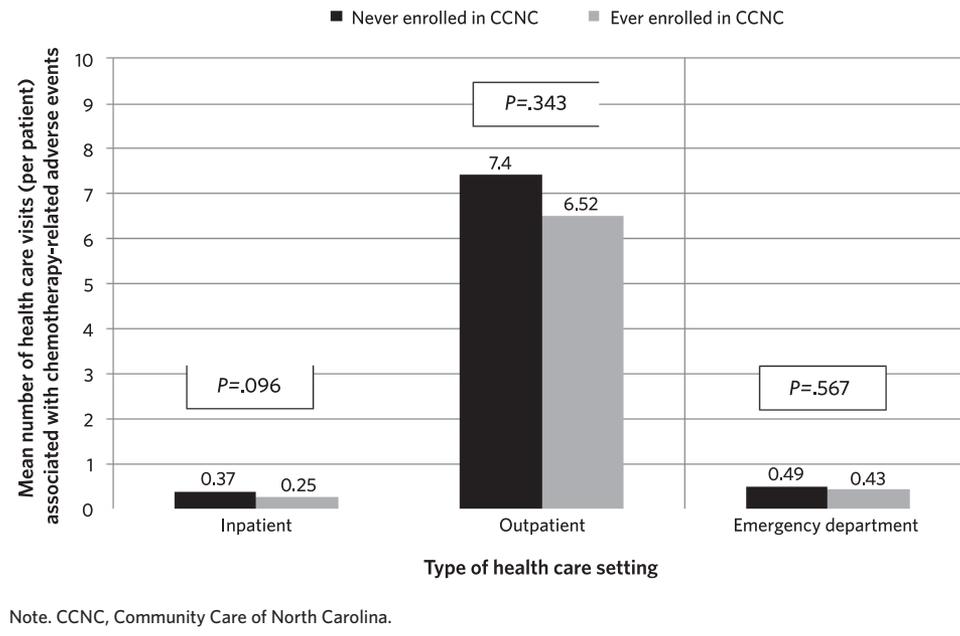
Table 3 shows the average ME of CCNC enrollment and other covariates on health care utilization (inpatient, outpatient, and ED visits) associated with chemotherapy-related AEs. CCNC enrollment was associated with significantly fewer inpatient admissions for chemotherapy-related AEs (ME, -0.14; 95% confidence interval, -0.280 to -0.004). Our analysis did not find any significant association between CCNC enrollment and the number of outpatient or ED visits

for chemotherapy-related AEs. Age at diagnosis and black race were significantly associated with fewer outpatient visits for chemotherapy-related AEs. Higher comorbidity score, receipt of chemotherapy, and receipt of surgery were significantly associated with a greater number of health care visits for chemotherapy-related AEs across all 3 health care settings.

## Discussion

To our knowledge, this is the first study to investigate the role of PCMHs in managing chemotherapy-related AEs among women who were recently diagnosed with breast cancer. In this study, we describe the extent of health care utilization associated with chemotherapy-related AEs among early-stage breast cancer patients insured by Medicaid. We found that these patients commonly experienced many of the AEs typically associated with chemotherapy—including abnormal electrolyte levels, dehydration, nausea, emesis, and diarrhea—all of which can be proactively monitored

**FIGURE 3.**  
**Bivariate Comparisons of the Average Number of Health Care Visits per Person Associated With Chemotherapy-Related Adverse Events During the First 15 Months After Diagnosis, by Type of Health Care Setting and CCNC Enrollment Status**



and managed during and after chemotherapy in coordinated care settings such as a PCMH. CCNC's patient-centered approach to providing transitional support and facilitating follow-up care in primary care settings gives it an advantage over other care delivery systems.

The proportions of patients seeking health care for chemotherapy-related AEs were higher in our study than in the study by Hassett and colleagues (19% versus 12% for hospi-

talizations; 25% versus 6% for ED visits) [7]. This could be because of differences between the 2 studies in population characteristics and/or duration of follow-up (15 months versus 12 months). Also, the Medicaid patient population has higher rates of hospitalization for conditions that can often be treated outside of the hospital or avoided altogether [21, 22], compared with Medicare populations that have been studied previously.

**TABLE 2.**  
**Number and Percentage of Breast Cancer Patients Who Experienced Adverse Events (AEs) During the First 15 Months After Diagnosis, by Chemotherapy Status (N = 570)**

Type of AE	Patients experiencing AE No. (%)		P-value <sup>a</sup>
	Did not receive chemotherapy (n = 252)	Received chemotherapy (n = 318)	
Abnormal electrolyte levels or dehydration	25 (10%)	76 (24%)	<.001
Constitutional symptoms and nonspecific symptoms associated with therapy <sup>b</sup>	60 (24%)	117 (37%)	<.001
Nausea, emesis, and diarrhea	36 (14%)	179 (56%)	<.001
Infection and fever	57 (23%)	110 (35%)	<.002
Malnutrition	7 (3%)	25 (8%)	<.009
Anemia and red blood cell transfusion	41 (16%)	151 (47%)	<.001
Neutropenia or thrombocytopenia	6 (2%)	134 (42%)	<.001
Deep vein thrombosis/pulmonary embolism	1 (<1%)	6 (2%)	.109
<b>Total</b>	<b>133 (53%)</b>	<b>279 (88%)</b>	<b>&lt;.001</b>

<sup>a</sup>P-values were based on chi-square test, or on Fisher's exact test if cell counts were less than 30.

<sup>b</sup>Includes symptoms such as malaise, fatigue, dizziness, or syncope.

**TABLE 3.**  
Average Marginal Effects on Number of Health Care Visits Associated With Chemotherapy-Related Adverse Events in 570 Patients<sup>a</sup>

Variable	Inpatient admissions		Outpatient visits		Emergency department visits	
	Marginal effect <sup>b</sup> (95% CI)	P-value	Marginal effect <sup>b</sup> (95% CI)	P-value	Marginal effect <sup>b</sup> (95% CI)	P-value
CCNC enrollment	-0.1421 (-0.280 to -0.004)	.043	-1.1213 (-2.837 to 0.594)	.200	-0.0871 (-0.267 to 0.093)	.344
Age at diagnosis	-0.0040 (-0.013 to 0.005)	.360	-0.1170 (-0.228 to -0.006)	.038	-0.0105 (-0.023 to 0.002)	.093
NCI Combined Index for comorbidity	0.4012 (0.194 to 0.608)	<.001	3.5705 (1.412 to 5.729)	.001	0.3381 (0.105 to 0.572)	.005
Tumor stage						
Stage 0 (reference)						
Stage I	-0.0106 (-0.200 to 0.179)	.913	2.2101 (-0.096 to 4.517)	.060	0.0456 (-0.202 to 0.293)	.718
Stage II	0.1143 (-0.083 to 0.311)	.255	3.4278 (0.849 to 6.006)	.009	0.0823 (-0.181 to 0.346)	.540
Race						
White (reference)						
Black	-0.0054 (-0.141 to 0.131)	.939	-3.0589 (-4.992 to -1.126)	.002	0.0191 (-0.169 to 0.207)	.842
Other	-0.0458 (-0.260 to 0.168)	.675	-1.4944 (-4.162 to 1.173)	.272	-0.1241 (-0.427 to 0.179)	.422
Medicaid eligibility due to blindness or disability	0.1050 (-0.045 to 0.255)	.169	2.0296 (0.052 to 4.007)	.044	0.2231 (0.008 to 0.439)	.042
Urban resident	-0.0227 (-0.154 to 0.108)	.734	-0.5685 (-2.260 to 1.122)	.510	0.0827 (-0.104 to 0.270)	.386
Chemotherapy received	0.2212 (0.052 to 0.390)	.010	12.2019 (9.226 to 15.178)	<.001	0.4441 (0.209 to 0.679)	<.001
Surgery received	0.2360 (0.023 to 0.449)	.030	3.3285 (1.038 to 5.619)	.004	0.2462 (-0.009 to 0.501)	.059
Radiation received	0.1178 (-0.024 to 0.259)	.103	2.3941 (0.652 to 4.136)	.007	-0.1050 (-0.287 to 0.077)	.259
Hormone therapy received	0.0477 (-0.104 to 0.200)	.538	0.9972 (-0.994 to 2.988)	.326	0.1447 (-0.069 to 0.358)	.184

Note. CCNC, Community Care of North Carolina; CI, confidence interval (calculated based on the delta method); NCI, National Cancer Institute.

<sup>a</sup>Marginal effects were calculated using multivariate negative binomial regression analysis.

<sup>b</sup>Estimates represent the marginal change in the number of visits induced by a 1-unit change in the independent variable, or marginal change compared with the reference category.

In our study, North Carolina breast cancer patients who were enrolled in CCNC had fewer overall health care visits associated with chemotherapy-related AEs than did patients who were not enrolled in CCNC; this finding was clinically and statistically significant for inpatient admissions but not for outpatient visits or ED visits. Because inpatient admissions are costly to the North Carolina health care system and may represent more severe AEs, our findings suggest an important potential value of CCNC's efforts to improve coordination of care and to ensure timely access to primary care providers. This finding is consistent with the general expectation that medical care is more often provided in the outpatient setting in a PCMH model, thus increasing outpatient utilization and decreasing inpatient admissions and ED use.

Interestingly, we observed a negative association between age at diagnosis and the number of AEs (ie, there were fewer AEs with older age). One possible explanation for this finding could be that younger breast cancer patients tend to present with more advanced tumors that require

more aggressive treatment [23-25]; hence, these patients may be more likely to experience a chemotherapy-related AE that leads to 1 or more health care visits.

Like previous studies [6, 7], our study found a significantly positive association between the overall number of health care visits associated with AEs and several other factors: cancer stage, the presence of comorbidities, and receipt of chemotherapy. Our finding that a sizeable proportion of stage 0 patients received chemotherapy may indicate that these patients were initially diagnosed at stage 0 but later progressed to a more advanced stage, at which time they were deemed appropriate candidates for chemotherapy. Unfortunately, we cannot verify this hypothesis, because NCCCR data only record cancer stage at incident diagnosis. Other possibilities are that these stage 0 patients may have been found to have *HER2*-positive tumors, or they may have had high Oncotype Dx scores.

Our study has several limitations. First, Medicaid claims data include up to 9 diagnosis codes for each health care

encounter, and some of the visits that we identified as being associated with a chemotherapy-related AE may have been only peripherally related to the AE; this could have led to a possible overestimation of health care utilization associated with chemotherapy-related AEs. In the absence of patient- or provider-reported data about the visit, we have no way of knowing whether this is the case. Second, in the absence of patients' medical records, we did not have detailed contextual information about communication with and recommendations of providers, or about any sentinel events leading up to and possibly influencing the visit. Third, because of unavailability of data, we were unable to include patients with stage III breast cancer, who are also suitable candidates for chemotherapy and may therefore experience chemotherapy-related AEs. Finally, because this was an observational study, we cannot draw any conclusions about the causality of these associations.

Despite these limitations, our study provides important and timely information about the extent of health care utilization associated with chemotherapy-related AEs, and it suggests that care management programs such as CCNC may reduce the number of health care visits associated with chemotherapy-related AEs. In the context of an aging population and rising cancer-related health care costs, these findings have important implications for estimating health care demand and for containing health care costs in North Carolina [26].

Providing high-quality cancer care for economically disadvantaged populations is challenging for several reasons, including gaps in communication, poor access to primary care, and lack of post-treatment coordination of care [27]. In addition, disadvantaged patients may be less able to self-manage their condition and to meet their post-treatment health care needs [28]. The importance of innovative interventions that can bridge these gaps, facilitate optimum care of breast cancer patients, and maintain quality of care cannot be overemphasized under current economic conditions, given the increasing demand for care and shortages of providers. PCMHs are equipped to improve communication and to provide care management and coordination of care [29, 30]; thus, they can help providers to meet these challenges more effectively when caring for breast cancer survivors.

PCMHs have proven to be effective in improving outcomes for patients with chronic diseases such as asthma, diabetes, and cardiovascular conditions [14, 31-33]. As we have reported elsewhere [10], breast cancer survivors who were enrolled in CCNC were significantly more likely to receive guideline-concordant follow-up care. By virtue of their patient-centered primary care approach, CCNC and other PCMH programs hold huge potential for reducing costs (by proactively managing treatment-related AEs in a primary care setting) and for reducing preventable inpatient admissions and ED visits. The results of this study, although based on North Carolina Medicaid data, provide relevant information to providers and policymakers and

should encourage PCMH initiatives nationwide. In this study we showed that any CCNC enrollment during the 15-month postdiagnosis period may decrease health care utilization associated with chemotherapy-related AEs, but future studies could investigate how the duration and intensity of CCNC participation affect health care utilization among cancer patients. Future research also should continue to explore the extent to which PCMHs can help to coordinate survivorship care and to monitor and manage late effects of cancer treatments. NCMJ

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