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EPIDEMIOLOGY

Temporal trends and regional variation in the utilization of low-value breast cancer care: has the Choosing Wisely campaign made a difference?

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Abstract

Purpose Since 2012, about 80 specialty societies have released Choosing Wisely (CW) recommendations aimed at reducing the use of low-value, unproven, or ineffective medical services. The extent to which these recommendations have influenced the behavior of physicians and patients remains largely unknown.

Methods Using MarketScan Commercial Claims and Medicare Supplemental and Coordination of Benefits databases, we identified annual cohorts of women with incident, early-stage breast cancer and estimated the prevalence of four initial treatment and six surveillance metrics deemed as low-value breast cancer care by CW. Multivariable logistic regressions were subsequently used to estimate temporal trends and regional variation in the use of these metrics, with a special focus on the year of CW's publication.

Results There were 122,341 women identified as undergoing treatment for incident breast cancer between 2010 and 2014. Two of the four low-value initial treatment metrics and four of the six low-value surveillance metrics declined significantly over time. The temporal trend of declining use, however, preceded the release of CW's guidelines. Declines ranged from 11.0% for follow-up mammography to 40.6% for receipt of surgical biopsy without an attempted needle biopsy. There were marked regional differences in use of low-value breast cancer care for all metrics, much of which persisted after publication of CW.

Conclusions With two notable exceptions, use of low-value breast cancer care has declined steadily since 2010. The declines, however, were not accelerated by the publication of CW recommendations.

Keywords Choosing Wisely · Breast cancer · Low-value care · Disparities

Background

In 2009, medical societies were challenged to develop a top five list of relatively expensive procedures that do not provide meaningful benefit for some of the patients for whom they are commonly ordered [1]. Citing this challenge, and estimates that 30% of health care provided are not beneficial to patients [2], the Choosing Wisely® campaign to reduce "low-value care" was launched in April 2012 by the American Board of Internal Medicine [3]. The campaign has been embraced by most of the major medical specialty societies, including those representing surgical, medical, and radiation oncology. A number of strategies have been used to encourage dissemination of specialty recommendations, including partnering with Consumer Reports to involve patients [3], and endorsements by prominent physicians in the medical

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[4] and lay literature [5]. Physicians appear to agree that initiatives to reduce low-value care are appropriate; when surveyed in 2013, 79% of physicians agreed that they should adhere to guidelines that discourage marginally beneficial care [6].

Evidence suggests that new oncology-related care recommendations can be rapidly disseminated, particularly after landmark clinical trials [7]. However, whether specialty society recommendations such as Choosing Wisely can reproduce that rapid dissemination for messaging regarding *lack* of evidence is less clear [8]. Furthermore, the Choosing Wisely campaign faces particular challenges. Providers often express concerns about whether they should consider population-level costs in making decisions for individual patients, and fear loss of patient trust [6]. Others cite their inability to effectively communicate these recommendations to patients, as there is evidence that patients continue to believe that "more health care is better than less [9]." Even providers who agree, in principle, with efforts to reduce overuse may have concerns about specific recommendations [3].

In this paper, we sought to estimate the prevalence of low-value breast cancer care among women with incident, early-stage breast cancer who are covered by commercial insurance plans, and to examine temporal trends and regional variation therein, with a special focus on the uptake of Choosing Wisely recommendations. Specifically, we hypothesized that use of low-value metrics would be significantly reduced after the release of Choosing Wisely. We focus on ten metrics that, together, address the continuum of breast cancer care from initial diagnostic evaluations to treatment and surveillance. These metrics were specifically selected because they are commonly performed and are amenable to assessment using administrative billing and encounter data.

Methods

Data sources and study population

Our study sample consists of women nationwide identified from the Marketscan Commercial and Encounters and Marketscan Medicare Supplemental and Coordination of Benefits Databases as having had an incident breast cancer diagnosis between 2010 and 2014. The Marketscan databases consist of employer and health plan-source data containing medical and drug data for several million individuals annually, encompassing employees, early retirees, and their dependents who are covered by employer-based private health insurance. Healthcare for these individuals is provided by a variety of fee-for-service, fully capitated, and partially capitated health plans, including PPOs and exclusive provider organizations, point-of-service plans, indemnity plans, HMOs and consumer-directed health plans.

To identify the sample, we used a validated algorithm based on billing/claims data that preferentially selects early-stage cases (I–III) [10]. By linking hospital claims longitudinally to outpatient claims, we characterized complete episodes of breast cancer care. Subjects were required to have been enrolled in plans covered by Marketscan-data submitting employers for 12-month prior to diagnosis date and, for surveillance metrics, to have continuous enrollment during follow-up periods.

Low-value breast cancer care metrics

Table 1 describes the low-value or unproven breast cancer practices evaluated in this study, including their measurement and source. Specifically, we focus on four initial treatment metrics and six surveillance metrics. Initial treatment metrics are initial surgical biopsy without attempted needle biopsy, axillary lymph node dissection without attempted sentinel lymph node needle biopsy (ALND only), contralateral prophylactic mastectomy (CPM), and intensity-modulated radiation therapy for whole breast radiation therapy after breast-conserving surgery (IMRT). Surveillance metrics include tumor biomarker (TBm) blood testing, PET scan or PET-CT scan, CT scan of the chest, abdomen or pelvis, bone scan, breast MRI, and two or more follow-up mammograms within the first surveillance year after local therapy consisting of breast-conserving surgery with radiation therapy (BCS-XRT). Surveillance metrics were measured 181 days post-surgery to the end of the follow-up period (maximum 60 months post-surgery), with the exception of follow-up mammograms, which were measured between 12 and 24 months post-definitive incident breast cancer surgery.

These metrics have been selected from the Choosing Wisely® campaign as well as existing national society guidelines (National Comprehensive Cancer Network [11], and position statements (American Society of Breast Surgeons, [12] Society of Surgical Oncology [13]) and include expensive studies and procedures that are commonly used despite a lack of evidence to support their routine use.

Statistical analyses

Logistic regressions were applied to the pooled cohort of women diagnosed with breast cancer in each calendar year to estimate temporal and regional trends in the use of each initial treatment and surveillance metric. This strategy enabled us to examine possible discontinuities over time in the use of low-value breast cancer care that could be attributed to the Choosing Wisely campaign, which targeted specific metrics at different calendar years. It also enabled us to examine whether the uptake of Choosing Wisely recommendations differed across regions.

Table 1 Low-value metrics sources and description

Low-value metric	CW® release	Source	Codes	Observation
Initial surgical biopsy without needle biopsy	9/2013	CW Commission on Cancer list, NCCN [11], ASBS [22, 23], NQF [24]	**CPT** 10021, 10022, 19000, 19001, 19081-19086, 19100, 1910219103, 88321, 88323, 88325 **ICD-9** 85.11, 85.91	60 days or less prior to date of surgery
ALND without attempted SLNB	9/2013	CW American College of Surgeons; NCCN [25], ASBS [1]; ASCO guidelines [26, 27]	*SLNB* **CPT** (surgery codes): 38900, 38500, 38525, 38530 **CPT** (injection codes): 38790, 38792, 78195 *ALND* **CPT** 19162, 19200, 19220,19240, 19302, 19305-19307, 38740, 38745 **ICD-9** 40.50, 40.51, 85.43, 85.45-85.48	From date of diagnosis to date of surgery
Intensity-modulated radiation therapy (IMRT) for whole breast radiation therapy after breast-conserving surgery	9/2013	CW ASTRO	**CPT** 77418, 77385, 77386	Date of surgery + 180 days
Contralateral prophylactic mastectomy	6/2016	CW, ASBS, NCCN [25,] Society of Surgical Oncology [28]	Need to ad 1. **CPT** 19303 **OR** 19304 *with* modifier 50 (bilateral) or 2. Any claim with ICD-9 procedure 85.35 OR 85.36 OR 85.42; or 3. Any two claims separated by 1 day with ICD-9 procedure 85.33 OR 85.34 OR 85.41 OR 85.43 OR 85.45 OR 85.47, EXCLUDING two 85.45 OR two 85.47 OR (85.45 AND 85.47); or 2. Any claim with **ICD-9** procedure 85.35 OR 85.36 OR 85.42; or 3. Any two claims **separated by 1 day** with **ICD-9** procedure 85.33 OR 85.34 OR 85.41 OR 85.43 OR 85.45 OR 85.47, *excluding* two 85.45 OR two 85.47 or (85.45 AND 85.47)	Date of ipsilateral mastectomy surgery plus 1 day
Tumor biomarker (TBm) blood testing	4/2012	CW ASCO, NCCN [25], ASCO [29, 30]	**CPT** 82378 (CEA); 86300 (CA 15-3)	From 181 days post-date of surgery to end of study period
PET scan or PET-CT scan	4/2012	CW ASCO, ASCO [29, 30], NCCN [25]	**CPT** 78811-78816 **HCPCS** G0235, G0252, S8085	From 181 days post-date of surgery to end of study period
CT scan (chest/abdomen/pelvis)	4/2012	CW ASCO, ASCO [29, 30], NCCN [25]	**CPT** 71250, 71260, 71270, 72192-72194, 74150, 74160, 74170, 74176-74178	From 181 days post-date of surgery to end of study period

Table 1 (continued)

Low-value metric	CW® release	Source	Codes	Observation
Bone scan	4/2012	CW ASCO, ASCO [29, 30], NCCN [25]	**CPT** 78306	From 181 days post-date of surgery to end of study period
Breast MRI		ASBS [31], ASCO [29, 30], NCCN [25]	**CPT** 77058, 77059 **HCPCS** C8903-C8908	From 181 days post-date of surgery to end of study period
Follow-up Mammograms	9/2014	CW ASTRO, NCCN [25], ASCO [29, 30, 32]		Two or more mammograms within 12–24 months post incident surgery

In addition to the main factors of interest (calendar year of diagnosis and Census divisions), all regressions included covariates capturing the woman's age at time of the breast cancer diagnosis, number of comorbid illnesses, assessed by the National Cancer Institute Combined Comorbidity Index [14] and calculated from claims during the 12-month period preceding the breast cancer diagnosis, plan type of commercial insurance coverage, and residence in an Metropolitan Statistical Area (MSA). Surveillance regressions further controlled for years since diagnosis to capture (over) use of surveillance tests during the immediate versus longer-term surveillance period. Based on coefficient estimates from these models, we calculated adjusted (predicted) probabilities that women would receive each test/procedure over the 5-year period following incident breast cancer diagnosis, over time and by Census division of residence.

Results

Table 2 describes the characteristics of women at time of incident breast cancer diagnosis. Our full sample included 122,341 subjects. The median age at diagnosis was 58 (SD 12) years with 13.4% were diagnosed at or before age 45 and slightly over one-quarter were diagnosed between 46 and 54 years old. The majority were covered by Preferred Provider Organizations. Consistent with the geographic distribution of employees of firms contributing data to Marketscan, the sample was more heavily concentrated in the East North Central and South Atlantic Census divisions. The vast majority (86.6%) lived in a metropolitan area.

Nearly three out of every five women with incident breast cancer underwent a breast-conserving surgery. Nearly one-quarter received no axillary surgery, about half received SLNB only, 18% SLNB and ALND, and 6% ALND only. Overall, 68% had no significant comorbid illness, 21% had one comorbidity, and about 11% had two or more comorbid conditions.

Trends in use of low-value breast cancer care

To put our results into perspective, we used multivariate models to compute the adjusted probability that women treated during different calendar years received the low-value breast cancer care tests or procedures targeted by Choosing Wisely and other professional societies. Table 3 shows the results of these computations.

There were marked temporal trends in the direction of lower use in two of the four initial treatment metrics. The adjusted probability of receipt of surgical biopsy without an attempted needle biopsy in 2010 was 13.3%. This probability decreased by 40.6–7.9% ($p < 0.01$) in 2014. This difference represents the independent effect of time on the probability

Table 2 Characteristics of the 122,341 women diagnosed with breast cancer in 2010–2014

	N	%
Age		
≤ 45	16419	13.4
46–54	31794	26.0
55–64	39521	32.3
65–90	34607	28.3
Insurance coverage plan type		
Basic/major medical	15147	12.4
Comprehensive	10793	8.8
Exclusive provider organization	16160	13.2
Health maintenance organization	9387	7.7
Preferred provider organization	70854	57.9
Census division of residence		
New England	7229	5.91
Middle Atlantic	17564	14.36
East North Central	25273	20.66
West North Central	5027	4.11
South Atlantic	23896	19.53
East South Central	7136	5.83
West South Central	12501	10.22
Mountain	6136	5.02
Pacific	17579	14.37
Residence in an MSA		
No	16429	13.4
Yes	105912	86.6
Type of breast surgery		
Mastectomy	50741	41.5
Breast-conserving surgery	71600	58.5
Comorbidities		
None	83387	68.2
One	25634	21.0
Two or more	13320	10.8

of performing a surgical biopsy without attempting a needle biopsy, after controlling for the patient's age, comorbidities, geographic region of residence, and other potentially confounding variables described above. Temporal trends were also marked for performance of an ALND without attempted SLNB. Among women treated in 2010, 27.4% received an ALND only compared to 21.6% in 2014, a 21% reduction ($p = 0.04$). In both cases, there was a monotonic decrease in use of low-value breast cancer care that, however, began prior to and was not intensified by the release of Choosing Wisely recommendations. In contrast, there were no significant temporal trends in the adjusted probability of receiving a contralateral prophylactic mastectomy or IMRT for whole breast radiation therapy after breast-conserving surgery.

Downward trends in use of low-value or unproven tests or procedures were also evident for all surveillance metrics, although reductions were relatively small for two of the six metrics considered (CT scan and breast MRI). During 2011, one-quarter of women in their first year of surveillance underwent tumor biomarker testing. By 2014, that figure had declined to 19.2%, a 22.3% ($p = 0.03$) reduction over a 3-year period. Although the use of PET scans and bone scans for surveillance were less prevalent in 2011, with only 6.3% and 5.9% of women undergoing a PET scan or bone scan, respectively, during their first year of surveillance, their use declined even further to 4.4% and 4.5% (−30.2%, $p < 0.01$ for PET scans and −23.7%, $p = 0.02$ for bone scans) by 2014. The prevalence of surveillance mammography, measured as women undergoing two or more follow-up mammography during the 12- to 24-month period following their incident breast cancer surgery, declined by 11% from 41.4% among women diagnosed in 2010 to 36.8% among women diagnosed in 2013 (both groups followed to 24 months post-surgery).

Finally, for all surveillance metrics, the change in use of low-value breast cancer care was generally uniform across surveillance years (i.e., across 12-month periods corresponding to first, second, or three or more years since surgery).

Regional variation in use of low-value breast cancer care

Figures 1 and 2 illustrate the variation in use of low-value breast cancer care among patients residing in different Census Divisions of the country. The percentages reflect adjusted/predicted probabilities obtained based on multivariate models described above. For all metrics, adjusted probabilities capture regional variation at the most recent study year in the series, corresponding to the post-Choosing Wisely era for all metrics, except the follow-up mammography.

After adjusting for secular trends and subjects' age, insurance coverage, level of comorbidity, and residence in an MSA, there remained a significant regional variation in use of several low-value or unproven breast cancer metrics. The percentage of women receiving surgical biopsies without an attempted needle biopsy ranged from roughly 5.1% in New England to 10.6% of women undergoing incident breast cancer surgery in the East South Central region of the country. Similarly, use of IMRT for whole breast radiation therapy after breast-conserving surgery was at least three times as prevalent in the South and Mid-Atlantic regions (8.0% and 7.1%, respectively) compared to New England.

Among surveillance metrics, post-Choosing Wisely geographic variation was especially large—two to three times in adjusted probability of use—for tumor biomarkers, breast MRI, and excessive follow-up mammography. Use of tumor biomarkers ranged from 11.1% in New England to 25.5% in West South Central. Breast MRIs were

Table 3 Adjusted probability of receipt of low-value metric, by calendar year and CW publication year

Low-value metric	Calendar year					% Difference (most recent year − earliest year)/earliest year
	2010[a]	2011[b]	2012	2013	2014	
Initial treatment						
Surgical biopsy without attempted needled biopsy	13.3	11.3	9.6	**8.9**	7.9	−40.6*
ALND without attempted SNLB	27.4	24.9	23.4	**22.8**	21.6	−21.2*
CPM	12.1	12.5	12.3	11.6	12.3	+ 1.7
IMRT	8.4	8.3	8.1	**8.1**	5.6	−33.3*
Surveillance metrics						
Tumor biomarker blood testing						
Surveillance year 1		24.7	**24.3**	21.6	19.2	−22.3*
Surveillance year 2		25.3	**24.8**	22.2	19.7	−22.1*
Surveillance year 3+			**25.7**	23.0	20.5	−20.2*
PET scan						
Surveillance year 1		6.3	**5.8**	5.2	4.4	−30.2*
Surveillance year 2		5.0	**4.6**	4.1	3.4	−32.0*
Surveillance year 3+			**4.2**	3.7	3.1	−26.2*
CT scan						
Surveillance year 1		18.0	**17.7**	16.7	16.7	−7.2*
Surveillance year 2		16.9	**16.7**	15.7	15.6	−7.7*
Surveillance year 3+			**16.0**	15.1	15.0	−6.3*
Bone scan						
Surveillance year 1		5.9	**5.4**	4.9	4.5	−23.7*
Surveillance year 2		5.4	**5.0**	4.5	4.1	−24.1*
Surveillance year 3+			**4.0**	3.6	3.3	−17.5*
Breast MRI						
Surveillance year 1		9.8	9.2	9.1	8.6	−12.2*
Surveillance year 2		8.9	8.4	8.3	7.8	−12.4*
Surveillance year 3+			7.6	7.5	7.1	−12.3*
2 + Follow-up mammographies within 12–24 month post-surgery[b]	41.4	40.9	39.1	36.8		−11.1*

Predicted probabilities are based on multivariate models that, in addition to calendar year (for initial treatment and surveillance metrics) and surveillance year (for surveillance metrics only), also adjust for patient's age, number of comorbidities, health insurance plan type, and Census division of residence. Bold entries denote year of publication of Choosing Wisely recommendation for each metric. For all metrics, except follow-up mammography, the calendar year corresponds to the observation year for each metric. Statistically significant differences at the $p < 0.05$ level, based on underlying coefficients of the calendar years in the multivariate regressions, are denoted by an asterisk (*)

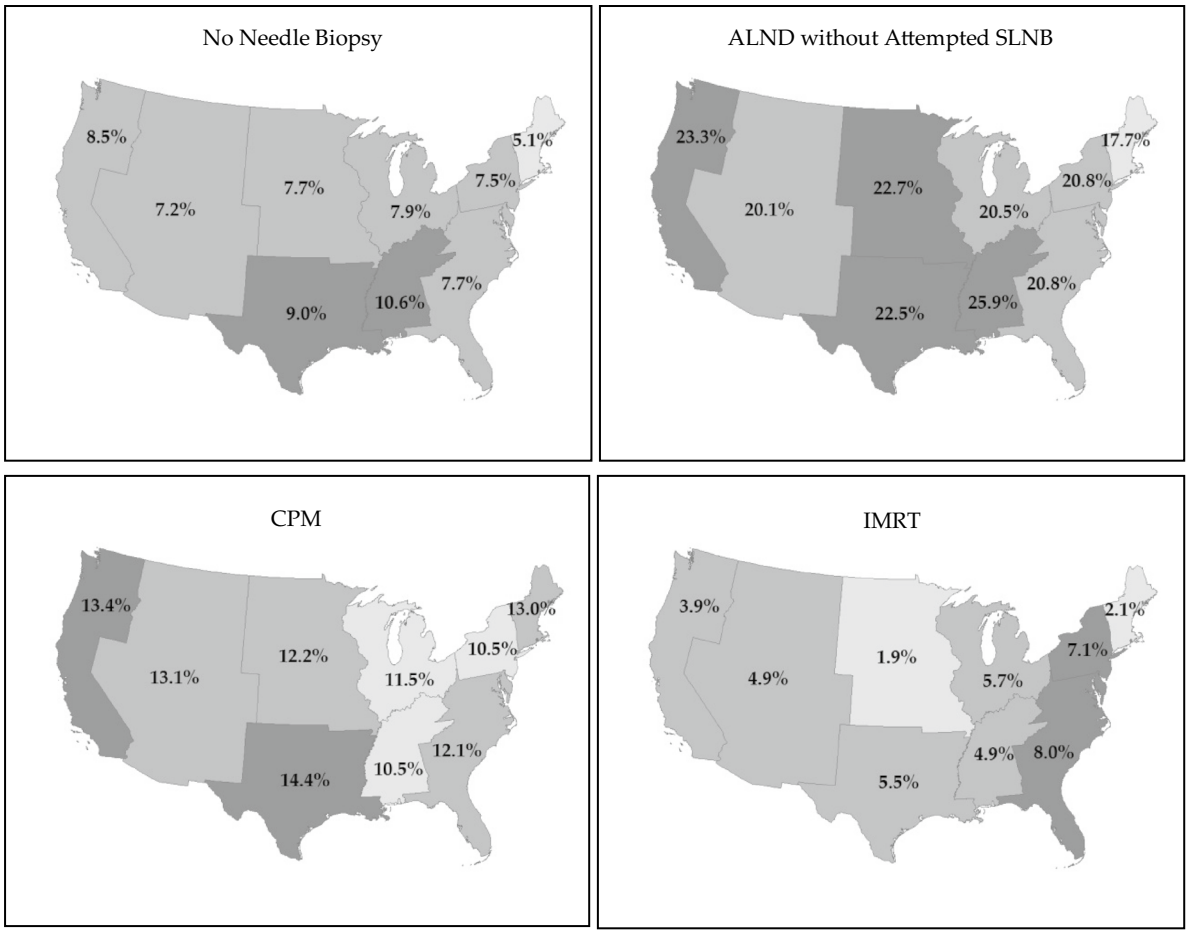
[a]Surveillance metric not available for the period due to lack of follow-up period

[b]For follow-up mammography, the calendar year corresponds to the year in which the woman was diagnosed with breast cancer: the observation period for this metric is fixed at 12–24 months post-surgery and varies across calendar years depending on the date of surgery

most often used in the Mid-Atlantic and Pacific regions (11.7% and 10.1%, respectively) compared to about 3.7% in the East South Central, while follow-up mammography ranged from 22.4% in New England to nearly twice that amount in Mountain region (43.9%).

Metrics exhibiting the least geographic variation in adjusted probabilities during 2014 were use of ALND without an attempted SLNB (range = 17.7% in New England to 25.9% in East South Central), contralateral prophylactic mammography (range 10.5%, Mid-Atlantic and East South Central to 14.4%, West South Central), and CT scan for surveillance (12.8% in the Pacific region to 19.3% in West South Central).

An analysis employing interaction terms between time (pre- and post-Choosing Wisely) and Census divisions demonstrated no significant regional differences in the uptake of Choosing Wisely recommendations across Census Divisions. For most metrics, lowest use throughout the series was observed in New England.



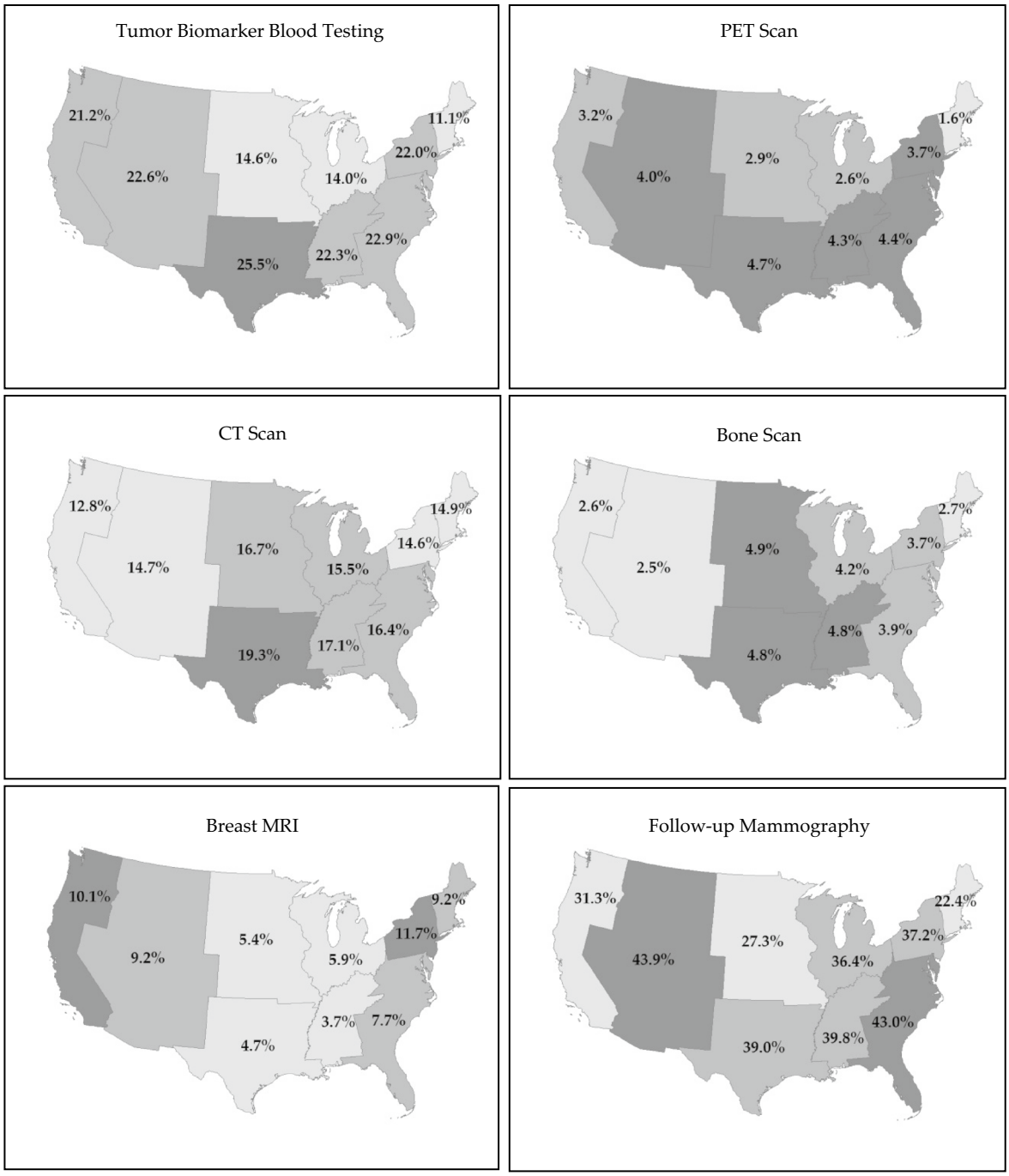
Notes: Percentage use for each metric is based on predicted probabilities obtained from models that adjust for Census division of residence, calendar year of breast cancer diagnosis, patients' age, health insurance plan type, residence in MSA, and number of comorbidities. Shading represents natural breaks with three categories of low, medium and high predicted probability of each metric. Lighter shading corresponds to lower predicted probabilities.

Fig. 1 Use of low-value breast cancer care by census divisions: initial treatment metrics, 2014

Discussion

Among more than 122,000 recently diagnosed breast cancer patients, we observed reductions over time for two of four low-value practices in initial treatment and all six practices in cancer surveillance. The pattern of steady temporal decline, however, preceded and was not accelerated by the publication of Choosing Wisely guidelines. Use of many of these measures varied by region, with variation of two to three times for two initial treatment practices (invasive biopsies and IMRT) and three surveillance practices (biomarker use, MRI, and excessive mammography use). Although regional variation in use of low-value or unproven care was present, there were no significant regional differences in the uptake of Choosing Wisely recommendations across Census divisions.

Our study provides important new information both about recent reductions in low-value breast cancer care over time, and about how these trends might have been influenced by the Choosing Wisely campaign. Prior studies, with follow-up through the late 2000s, pointed to the high prevalence in the use of low-value surveillance care



Notes: Percentage use for each metric is based on predicted probabilities obtained from models that adjust for Census division of residence, calendar year of breast cancer diagnosis, surveillance year, patients' age, health insurance plan type, residence in MSA, and number of comorbidities. Shading represents natural breaks with three categories of low, medium and high predicted probability of each metric. Lighter shading corresponds to lower predicted probabilities.

Fig. 2 Use of low-value breast cancer care by census divisions: surveillance metrics, 2014

[15–17] and IMRT [17]. Most of these studies, however, relied on data up to 2011, prior to the first publication of the first Choosing Wisely recommendations. In some instances, results from these earlier studies showed small to moderate increases [17, 18] in use of certain low-value metrics, making our findings of recent decreases of multiple low-value care practices even more notable.

Contrary to expectations, our results indicate that the decline in use of low-value breast cancer care preceded the formal release of Choosing Wisely statements, the earliest of which occurred in 2012. One possible explanation for these findings is that the CW recommendations, to a large extent, reflected consensus that had been reached in years prior to their publication from work done by existing professional societies that released similar guidelines prior to 2010. It is plausible, therefore, that our results are suggestive of a slow diffusion/acceptance of those existing society guidelines rather than a shortcoming of the Choosing Wisely campaign.

This paper contributes to the growing literature on the use of unnecessary, unproven, or ineffective medical care by focusing on ten low-value metrics covering the continuum of breast cancer care. It also provides evidence of use of such low-value care among a wider range of patients than most of the prior studies, which focused primarily on older Medicare beneficiaries included in the SEER–Medicare dataset [17] or in integrated delivery systems where physician practice patterns likely differ from those in fee-for-service setting [19].

Although targeted by Choosing Wisely only in 2016, and therefore outside of our study window, the selective use of CPM has been advocated by professional societies for nearly a decade beginning with statements from the Society of Surgical Oncologists in 2007 and those of the National Comprehensive Cancer Network in 2009. Our finding of no change in the use of CPMs, which is consistent with an earlier report [20], raises concerns about the limits of professional societies' statements in changing provider behavior. One plausible argument, raised in several recent studies focusing on patient and physician factors associated with the choice of pursue a CPM despite the absence of clinical justification for the procedure, is that the decision is driven primarily by patient preferences. Despite evidence that contralateral prophylactic mastectomies do not reduce mortality, several studies suggest that concerns about recurrence drive patients' choices. A more recent study using data from the Los Angeles and Georgia SEER registries, however, observed that surgeons' recommendations against CPM may have large effects in swaying patients' decision [21].

Finally, our finding of persistent and pervasive regional variation in low-value breast cancer metrics in the post-CW period raises concern about effective approaches to reducing geographic disparities in breast cancer care. Women in New England, for example, were the least likely to receive most, although not all, of the low-value metrics considered in the study.

Several limitations merit comment. Given that we rely on administrative and billing data, we do not have information about clinical exclusions and exceptions that may apply to each metric or which might constitute valid indications for the practices we examined. Clearly, there are appropriate indications for each of the interventions studied. In a recent study, for example, Hahn and colleagues [19] suggest that many follow-up imaging tests are appropriately ordered for signs or symptoms. Although a certain degree of measurement error is unavoidable in a study of this nature, our results remain valid and unbiased as it is unlikely that the underlying symptoms and signs that would result in exclusions or exceptions would be changing systematically over time during our 6-year study period. In addition, given the large sample size, it is unlikely that the percentage of women experiencing such exclusionary symptoms would differ geographically to such a degree as to be responsible for the substantial observed geographic differences in low-value measures. Finally, although several of the percentage point reductions identified may appear small, they correspond to thousands of women with the potential for large financial impact nationwide.

Conclusion

By focusing on multiple metrics and examining their prevalence over time among a large, contemporary sample of commercially insured women of all ages receiving breast cancer care at geographically diverse settings, we provided important insights into the extent to which the Choosing Wisely campaign influenced the use of low-value breast cancer care in the U.S. Given our findings that none of the observed temporal reductions can be attributed to the campaign, and in view of the persistent regional variation in use of several low-value breast cancer care, it seems that new models or interventions are needed to more effectively decrease the use of unnecessary care and reduce geographic disparities therein.

Author contributions JN: conception, design, and interpretation of the data and drafting of the article. AN: provision of study materials, critical revision for important intellectual content. TY: interpretation of the data, critical revision for important intellectual content. EM: analysis and interpretation of data, critical revision for important intellectual content. MN: analysis and interpretation of data, critical revision for important intellectual content. LP: provision of study materials, conception, design and interpretation of data, critical revision for important intellectual content.

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Data availability The datasets generated and analyzed during the current study are not publicly available given restrictions to data sharing provided to MCW under an institutional license to Truven, but further details are available from the corresponding author on reasonable request.

Compliance with ethical standards

Conflict of interest None of the authors has a competing or conflicting interest regarding the manuscript.

Ethics approval Per 45 CFR 46.101 and the MCW Institutional Review Board, this study did not meet criteria for human subjects research as it is a public and deidentified data set.

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