A Tracking and Feedback Registry to Reduce Racial Disparities in Breast Cancer Care

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Background Black and Hispanic women with early-stage breast cancer are more likely than white women to experience fragmented care and less likely to see medical oncologists to get effective adjuvant treatment. We implemented a tracking and feedback registry to close the referral loop between surgeons and oncologists.

Methods We compared completed oncology consultations and use of adjuvant treatment among a group of 639 women with newly diagnosed stage I or II breast cancer who had undergone surgery at one of six New York City hospitals from 1999 to 2000 with the same outcomes for a different group of 300 women with breast cancer whose surgeries occurred in 2004–2006, after the implementation of the tracking registry. Underuse of adjuvant treatment was defined as no radiotherapy after breast-conserving surgery, no chemotherapy for estrogen receptor (ER)–negative tumors, or no hormonal therapy for ER-positive tumors 1 cm or larger. We used hierarchical modeling to adjust for clustering within hospital and surgeon practice. Odds ratios were converted to adjusted relative risks (aRRs). All statistical tests were two-sided.

Results Implementation of the tracking and feedback registry was accompanied by a statistically significant increase in oncology consultations (83% before vs 97% after the intervention; difference = 14%; 95% confidence interval [CI] = 11% to 18%; $P < .001$) and decrease in underuse of adjuvant treatment (23% before vs 14% after the intervention; difference = −9%, 95% CI = −12% to −6%; $P < .001$). Underuse declined from 34% to 14% among black women, from 23% to 13% among Hispanic women, and from 17% to 14% among white women (chi-square of change in underuse from before to after among the three racial groups; $P = .001$). In multivariable models adjusting for clustering by hospital and surgeon, the intervention was associated with increased rates of oncology consultation (aRR = 1.6, 95% CI = 1.3 to 1.8), and reduced underuse of adjuvant treatment (aRR = 0.75, 95% CI = 0.6 to 0.9). Compared with the preintervention findings, minority race was no longer a risk factor for low rates of oncology consultation (aRR = 1.0, 95% CI = 0.7 to 1.3) or for underuse of adjuvant therapy (aRR = 1.0, 95% CI = 0.8 to 1.3).

Conclusions A tracking and feedback registry that enhances completed oncology consultations between surgeons and oncologists also appears to reduce rates of adjuvant treatment underuse and to eliminate the racial disparity in treatment.

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Despite plentiful evidence of the efficacy of adjuvant treatments for improving survival of women with early-stage breast cancer, substantial proportions of subpopulations of affected women remain untreated, particularly women of racial and ethnic minorities (1–6). The causes of underuse of adjuvant therapy are multiple, ranging from lack of physician recommendation (3,7,8), to inability to get access to and pay for care (9), to lack of patient understanding of treatment benefit (8). These barriers are further compounded by the challenges of navigating a fragmented health care delivery system, in which women are treated by different physicians and in dispersed settings, often without an infrastructure to facilitate communication between the numerous specialists (1,10). Previous work has found that women with breast cancer who connect successfully with a medical oncologist are more likely to undergo adjuvant treatment (1). Strikingly, one-third of adjuvant underuse cases were system failures: that is, surgeons recommended treatment and the patient did not refuse, but care did not ensue (7). When interviewed about their underuse

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CONTEXT AND CAVEATS

Prior knowledge

Black and Hispanic women with newly diagnosed stage I or II breast cancer are less likely than white women to visit an oncologist and receive adjuvant therapy after surgery, a problem attributable to system failure. That is, even though their surgeons have recommended adjuvant treatment and the patients have not refused, many women end up not getting treated.

Study design

A program that tracked whether breast cancer patients successfully completed oncology referrals and received adjuvant treatment and that sent out reminders to surgeons of patients who had not visited an oncologist was implemented in September 2004 in conjunction with breast cancer surgeons at six New York City hospitals. Rates of oncology referral completion and adjuvant underuse among a retrospectively reviewed preintervention cohort of 639 women who had breast cancer surgery in 1999–2000 were compared with those for a postintervention cohort of 300 women who had breast cancer surgery in 2004–2006.

Contribution

Overall, the percentage of breast cancer patients who visited an oncologist rose from 83% to 97% and the number who did not receive adjuvant therapy declined, from 23% to 14%. Among black and Hispanic women, the postintervention decline in underuse of adjuvant therapy (30%–13%) was even more marked than among white and Asian women (19%–15%).

Implications

Implementation of such a tracking and feedback registry can help to overcome racial disparities in breast cancer outcomes.

Limitations

This was not a randomized study, so there may have been important confounding factors that influenced the observed results.

From the Editors

cases, several surgeons who were unaware that their patients had underused adjuvant treatment options said that they would have intervened had they known that their patients had not received the recommended adjuvant therapy (7). Such failures of connection are a critical target to improve the quality of breast cancer care.

Because physician-centered interventions, such as prompts and reminders to care providers and audit and feedback, are potent approaches to increase breast cancer screening rates (6), and because breast cancer patients who see an oncologist are more likely to undergo adjuvant treatment (1,11), we implemented a tracking and feedback registry to inform surgeons about whether their patients had consulted an oncologist. By closing the referral loop between surgeons and oncologists, we aimed to increase patient compliance with oncology referrals and thereby to increase rates of adjuvant treatment.

Subjects and Methods

Participants and Study Design

This study was unusual in that nearly all (97%) of the surgeons who operate on women with breast cancer at six unaffiliated hospitals in New York City agreed to participate, and their patients came from all socioeconomic strata. The project received Institutional Review Board approval at each of the six participating hospitals, which included two tertiary referral centers, three municipal hospitals, and one community hospital. The Steering Committee was composed of expert physicians treating breast cancer at each of the hospitals with representation from general and plastic surgery, medical and radiation oncology, radiology, pathology, women's health, primary care, and social work. Data concerning the treatment of an observational preintervention cohort of 677 women who had undergone breast cancer surgery at the six participating hospitals from January 1999 through December 2000 were collected and analyzed. Because these 677 women had been treated before Health Insurance Portability and Accountability Act became law, patient consent was not required for this retrospective review. For the postintervention cohort, which was composed of women who had breast cancer surgery between September 2004 and March 2006, both patient and physician consent to participate in the study were needed and obtained. A quasi-experimental observational design was used to compare rates of completed oncology consultation and underuse of adjuvant therapy before and after implementation of the tracking and feedback registry. The project was registered as Clinical Trial NCT00211731.

Study Population and Case Identification

In 2001, before we implemented the intervention, we identified all 677 women who had undergone surgery for invasive stage I or II breast cancer from January 1999 to December 2000 from pathology records at the six participating hospitals (1). Patients were eligible for the study if they had a new, primary stage I or II breast cancer, had undergone definitive surgical treatment (mastectomy, breast-conserving surgery, or axillary evaluation) at one of the participating hospitals, and required some form of postsurgical adjuvant therapy as per the guidelines created by the Steering Committee, which were consistent with national guidelines (12). Thirty-eight women were excluded because they did not require postsurgical adjuvant treatment, resulting in a final sample of 639. We applied the same eligibility criteria during recruitment of patients for the tracking and feedback registry, from September 2004 through March 2006. Race was assigned based on patients' charts for the preintervention group and based on self-report for the postintervention group. Because only 4% of the population was Asian and there was no difference between Asians and whites in receipt of treatment, these two groups were combined in the analyses.

Surgeon Population

A total of 51 surgeons operated on the 677 patients in the preintervention cohort. Of these, 32 were no longer doing breast surgery during the time of the intervention (2004–2006). Nine new surgeons joined the six hospitals over the course of the study, all of whom were recruited into the study. Thus, 28 surgeons operated on the postintervention cohort.

The Intervention

The intervention was implemented in September 2004. As part of the intervention, surgeons identified a contact person in each of their offices to verify patient eligibility, to inform the study team

of oncology referrals including the oncologist's name and appointment date, to give the research team permission to contact patients, and subsequently, to receive our tracking information about whether patients had seen an oncologist and to convey this information to the surgeon. We contacted the 300 patients in the postintervention cohort to obtain their consent for participation in the study and to ascertain whether they had made upcoming oncology appointments. All pathology reports, contact data, and oncology appointment dates were entered into a computerized registry and tracking system. After the date for a patient's oncology appointment had passed, the tracking system alerted a research assistant to call the oncologist's office to verify that the patient had shown up for her appointment. Information about whether each patient had seen an oncologist was conveyed by phone to the surgeon's contact person and was followed with a mailed hard copy of that finding. For patients who had not visited an oncologist, surgeons were alerted to this fact and reminded of it by weekly telephone calls for the following 3 weeks with the goal of stimulating surgeons to encourage patient follow-through.

Outcomes and Assessment of Treatments

Use of adjuvant treatment was determined from patients' charts. Initially, data were collected from surgeons' offices; additional information was obtained from another 187 physicians' offices for the preintervention cohort, and from another 100 offices for the intervention cohort. Treatments were tracked by contacting other physicians named in the medical record and the oncologist that the patient named after consenting to participate. Treatment data could not be obtained for 72 out of 639 (11%) preintervention and 20 out of 300 (7%) postintervention patients (P = .03). Missing treatment data were coded as "no treatment" because without documentation we could not assume treatment. We combined "no treatment" and "no data" as underuse in the final analysis. However, to ascertain that detected changes in treatment rates were due to improved rates of treatment rather than improved data collection, in a separate analysis, we removed patients with missing data and analyzed only those for whom data documenting no treatment could be found. Because the findings of the analysis excluding cases classified as underuse due to missing data were essentially the same as those of the analysis that included the entire population, we report the rates for the entire population. Underuse of adjuvant treatment was based on the multidisciplinary Steering Committee's evidence-based definition of underuse, that is, no radiotherapy following breast-conserving surgery, no chemotherapy among women with hormone receptor–negative tumors that were at least 1 cm, or no hormonal therapy among women with hormone receptor–positive tumors that were at least 1 cm (1). Comorbidity was assessed with the Charlson Comorbidity Index (13). Subsequently, the surgeon and one of the study investigators (N. A. Bickell) together reviewed each underuse patient's chart to verify whether treatment had been received and, for those cases where it was not, to determine the primary reason for underuse.

Statistical Analysis

Bivariate comparisons between pre- and postintervention populations were done using chi-square tests for categorical variables, t tests for continuous variables, and nonparametric tests of medians for data that were not distributed normally. All statistical tests were two-sided. We ran hierarchical models using the GLIMMIX procedure (14) to take into account clustering within hospital and surgeon practices. Odds ratios were derived from the parameter estimate for each independent variable. Model variables entered included the following statistically significant variables in the bivariate analyses: intervention, age at least 70 years, comorbidity, stage, insurance status, and race. Because the study outcomes were common, odds ratios were converted to adjusted relative risks using the formula proposed by Zhang (15). Because of the difference in the surgeon population between the two cohorts and concern about different practice styles, we analyzed both the entire sample and also a sample consisting only of those patients of the 19 surgeons who were operating both pre- and postintervention (n = 574 patients: 366 pre- and 208 postintervention). The findings of the smaller sample were not statistically significantly different from those of the entire sample, and a comparison of models using the entire and limited populations is in the Appendix.

Comparison of Tracking and Feedback Rates With National Rates of Adjuvant Underuse

To compare rates of underuse of adjuvant treatment among breast cancer patients in our New York City cohort with rates of underuse nationwide, we assessed data from the Surveillance, Epidemiology, and End Results (SEER) database concerning use of radiotherapy among women undergoing breast-conserving surgery because data for this adjuvant treatment have higher reliability than the rates of chemotherapy and hormonal therapies reported in SEER (4,16). We used SEER radiotherapy (RT) data from calendar years 1999 to 2003 to calculate an underuse value and to provide a control group because the data from these years were the closest years available to the timing of our two study groups. Using "No RT" as the numerator and "(No RT + RT Given + RT Refused + RT Recommended, Unknown if Given)" as the denominator, we obtained conservative estimates of the underuse of this adjuvant treatment nationwide for 1999–2000 and for 2003. There were some limitations to what could be done using this approach because the SEER data did not include comorbidity and prognosis information and did not report Hispanic background. Whereas our subjects included 21% and 19% black women in the pre- and postintervention groups, respectively, 7.5% of the SEER sample was black in roughly contemporaneous years. Comparisons of underuse rates for comparable time periods were also made using reports from the literature (5).

Results

Details of the preintervention population are described elsewhere (1); 639 women who needed postsurgical adjuvant therapy were included. A total of 553 women potentially eligible for the postintervention cohort (ie, who were treated after the intervention was implemented in September 2004) were identified from pathology reports. Of these women, 407 were able to be contacted by telephone to give consent, of whom 99 refused (24%). In addition, we excluded two women who did not speak English or Spanish, three who had recurrent breast cancer, and three who had late-stage breast cancer. Thus, 300 women were in the final sample with new,

Table 1. Characteristics of the two independent breast cancer patient cohorts in this study: those retrospectively observed before the initiation of a feedback and tracking registry (1999–2000) and those tracked after its implementation (2004–2006)

Characteristic	Preintervention patients (n = 639)	Postintervention patients (n = 300)	*P* value*
Age, no. (%)			.03
<70 y	465 (73)	238 (79)	
≥70 y	174 (27)	62 (21)	
Insurance type, no. (%)			.04
Commercial	297 (46)	164 (55)	
Medicaid	121 (19)	57 (19)	
Medicare	179 (28)	69 (23)	
No insurance	42 (7)	10 (3)	
Race†, no. (%)			<.001
White	307 (48)	172 (57)	
Black	136 (21)	56 (19)	
Hispanic	103 (16)	56 (19)	
Asian	28 (4)	11 (4)	
Unknown	65 (10)	5 (2)	
Comorbidity ≥1, no. (%)	130 (20)	82 (27)	.02
Breast cancer stage, no. (%)			.04
IA	92 (14)	55 (18)	
IB	255 (40)	116 (39)	
IIA	213 (33)	79 (26)	
IIB	79 (12)	50 (17)	
Surgery type, no. (%)			.05
Mastectomy	243 (38)	94 (31)	
Breast-conserving surgery	396 (62)	206 (69)	
Used tertiary referral center, no. (%)	483 (76)	224 (75)	.76
Cases per surgeon, median (range)	6 (1–78)	6 (1–47)	.94

* Categorical variables were tested with the chi-square test, continuous variables with the *t* test, and medians with the Wilcoxon test.

† There were no statistically significant differences between the ratio of black and Hispanic vs white and Asian women in the pre- vs postintervention patient populations (*P* = .67).

primary stage I or II breast cancer. There were no statistically significant differences in stage, hospital, surgeon, insurance, or age between women who could and could not be contacted by telephone (data not shown). Women aged 70 years or older were more likely to refuse to participate than younger women (37% vs 20%; $P < .001$). There were no statistically significant differences in stage, hospital, surgeon, or insurance between women who refused to participate and those who did not (data not shown).

Fewer surgeons performed breast cancer surgery in the postintervention period than in the preintervention period (28 vs 51). The 32 surgeons who stopped performing breast surgery tended to have a very low volume to begin with (median = 1 case). Among the remaining surgeons, the median number of breast cancer surgeries performed was unchanged between the groups.

Characteristics of the women in our preintervention study cohort are compared with those of study participants after the implementation of a feedback and tracking registry aimed to increase use of adjuvant treatment for breast cancer in Table 1. Patients in the two groups were similar in the proportions who received care at a high-volume tertiary referral center, a potential confounder because high-volume hospitals have been reported to deliver higher quality care and to have better breast cancer outcomes (17–19). Compared with patients in the preintervention group, those in the postintervention group were more likely to be white and younger than 70 years old, and to have comorbid conditions. Because we excluded from the postintervention cohort patients who did not require postsurgical adjuvant therapy, including radiotherapy, there were fewer patients in this group who had mastectomies and therefore did not require adjuvant radiotherapy (Table 1).

Table 2 shows the differences in the numbers of oncology consultations completed and of adjuvant treatments received between the pre- and the postintervention groups. Overall, rates of oncology consultations, chemotherapy, and hormonal therapy were higher in the postintervention group; there was no change in radiotherapy rates. Among black and Hispanic women (Table 3), there were statistically significant increases in oncology consultations completed (86% before vs 96% after the intervention; difference = 10%; 95% confidence interval [CI] = 4% to 16%; $P = .002$), and decreases in underuse of radiotherapy (23% before vs 10% after the intervention; difference = −13%; 95% CI = −23% to −3%; $P = .02$), chemotherapy (26% before vs 6% after the intervention; difference = −20%; 95% CI = −33% to −7%; $P = .01$) and hormonal therapy (27% before vs 11% after the intervention; difference = −16%; 95% CI = −26% to −6%; $P = .01$). Overall, underuse rates, as defined by missing one or more treatments, decreased in black women from 34% before to 14% after the intervention (difference = −20%; 95% CI = −33% to −8%), in Hispanic women from 23% before to 13% after the intervention (difference = −10%; 95% CI = −22% to 2%), and in white women from 17% before to 14% after the intervention (difference = −3%; 95% CI = −10% to 2%) ($P = .001$ of chi-square comparing all three race groups). Of note, women who did not see an oncologist were more likely than those who did to underuse adjuvant treatment (68% vs 18%, in the preintervention group and 80% vs 13% postintervention group; $P < .001$, for both). There was no change in adjuvant underuse rates pre- vs postintervention among women who did not see an oncologist ($P = .56$, data not shown).

The intervention had varying effects in the different hospitals, with the greatest reductions occurring in municipal hospitals. Adjuvant underuse decreased from 39% (41 of 106 patients) to 13% (6 of 45 patients) ($P = .002$) in municipal hospitals but was unchanged in the non–municipal hospitals (18% [88 of 483 patients] vs 14% [31 of 224 patients]; $P = .15$). Because the intervention had different effects in the different hospitals, we used multivariable hierarchical models to adjust for potential clustering within a hospital and within a surgeon's practice (Table 4). Adjusting for age, stage, insurance, race, and comorbidity in the pre- and postintervention bivariate analyses, the intervention appeared to increase the percentage of oncology consultations and to reduce underuse of adjuvant therapies. Older age and lack of insurance were associated with a lower likelihood of seeing an oncologist, but participation in the feedback registry and diagnosis with a more advanced stage of breast cancer were associated with increased likelihood of oncology consultation. Older age was

associated with higher rates of underuse of adjuvant therapies. With the intervention in place, minority race was no longer associated with greater likelihood of failure to complete an oncology consultation or failure to get effective adjuvant treatment.

Nationally, there has been tremendous improvement in breast cancer treatment: rates of underuse of chemotherapy and hormonal therapy were close to 80% in 1987 but dropped to approximately 22% in year 2000 (5). The latter rate was similar to that for our preintervention group. This drop in underuse raised the concern that our findings might simply be a reflection of the overall improving quality of cancer care and not due to the intervention (20,21). To address this possibility, we compared our data with those from the SEER database for the time periods 1999–2000 and 2003, which were the closest available at the writing of this article; however, only 7.5% of the SEER sample was black and Hispanic rates are not reported in SEER. We examined radiotherapy rates specifically because radiotherapy is the most reliably reported adjuvant treatment (4,16). Nationally, in 1999–2000, there were 34 539 cases of breast-conserving surgery for women with stage I or II breast cancer and radiotherapy was underused in 23%; in 2003, there were 22 859 breast-conserving surgeries and underuse of radiotherapy rose to 27% (P for difference in underuse in 1999–2000 vs 2003 <.001). Although our study did not show a statistically significant reduction in overall underuse of radiotherapy, underuse of radiotherapy did not significantly increase over time as did the national rates of underuse.

Table 2. Oncology consultation and underuse of adjuvant treatment among two cohorts of breast cancer patients before and after the implementation of the feedback and tracking registry*

Treatment	Preintervention patients (n = 639)	Postintervention patients (n = 300)	*P* value†
Oncologist seen, no. (%)	532 (83)	290 (97)	<.001
No RT after BCS, no. (%)‡	64 (16)	24 (12)	.14
No chemotherapy, no. (%)‡	28 (22)	8 (11)	.05
No hormonal therapy, no. (%)‡	85 (20)	14 (8)	<.001
Missing ≥1 adjuvant treatment, no. (%)	145 (23)	43 (14)	<.001

* RT = radiotherapy; BCS = breast-conserving surgery.

† *P* values were generated from chi-square tests.

‡ Percentages shown reflect the number of women who did not receive a given adjuvant therapy compared with the number for whom each therapy was indicated (denominator not shown).

Discussion

We implemented a tracking and feedback registry to increase the likelihood that breast cancer surgery patients would connect with an oncologist as a way to ameliorate systemic problems that caused underuse of adjuvant treatment. After the initiation of the patient tracking system in 2004, the number of completed oncology consultations increased, the frequency of adjuvant underuse decreased, and the racial disparity in adjuvant underuse was eliminated. Before intervention, there was no racial difference in rates of completed oncology consultation. However, system failures, cases in which physicians recommend therapy and patients do not refuse care but care still does not ensue, did occur more commonly among black and Hispanic women particularly those treated at municipal hospitals, settings that tend to have less than optimal communication between surgeons and oncologists (7). The tracking and feedback registry, designed to target the system failure cause of underuse, was most effective at municipal hospitals that had greater frequencies of underuse due to system failure. Especially in such settings, this simple intervention appeared to eliminate previously detected racial disparities in adjuvant treatment underuse. The registry, however, did not reduce adjuvant underuse in whites and Asian women, groups whose underuse was more often related to older age and comorbidities.

Interventions to reduce disparities in health care should raise the overall quality of care by addressing causes that occur more commonly among disparate populations and sites of care (22–24). The tracking and feedback registry had important components of a quality intervention. It targeted a cause of treatment underuse that was more common among minority women. Implementation was systems based, was applied to all women with a new primary breast cancer, and included both people and technology, key components of socio-technical systems needed to change clinical practice (25). All surgeons performing breast cancer surgery in

Table 3. Oncology consultation and underuse of adjuvant treatment among black and Hispanic women and among white and Asian women with breast cancer before and after the implementation of the feedback and tracking registry*

	Black and Hispanic women			White and Asian women		
Treatment	Preintervention patients (n = 239)	Postintervention patients (n = 112)	*P*†	Preintervention patients (n = 400)	Postintervention patients (n = 188)	*P*†
Oncologist seen, no. (%)	206 (86)	108 (96)	.001	326 (82)	182 (97)	<.001
No RT after BCS, no. (%)‡	33 (23)	7 (10)	.02	31 (12)	17 (13)	.89
No chemotherapy, no. (%)‡	17 (26)	2 (6)	.013	11 (18)	6 (16)	.77
No hormonal therapy, no. (%)‡	42 (27)	7 (11)	.01	43 (16)	7 (6)	.01
Missing ≥1 adjuvant treatment, no. (%)	71 (30)	15 (13)	<.001	74 (19)	28 (15)	.28

* RT = radiotherapy; BCS = breast-conserving surgery.

† *P* values were generated from chi-square tests.

‡ Percentages shown reflect the number of women who did not receive a given adjuvant therapy compared with the number for whom each therapy was indicated (denominator not shown).

Table 4. Hierarchical models of oncology consultation and underuse of adjuvant therapy*

Characteristics Compared	Association with oncology consultation OR (95% CI)	Association with adjuvant underuse OR (95% CI)
Intervention vs preintervention	4.2 (2.0 to 8.9)	0.6 (0.4 to 0.9)
Stage IIB vs I	10.3 (3.0 to 35.3)	0.5 (0.3 to 0.9)
Stage IIA vs I	2.2 (1.3 to 3.7)	0.8 (0.6 to 1.2)
Age ≥70 vs <70 y	0.2 (0.1 to 0.4)	2.5 (1.8 to 3.6)
No/poor insurance vs commercial insurance or Medicare	0.5 (0.2 to 1.3)	1.5 (0.7 to 3.0)
≥1 comorbid condition vs no comorbidity	0.9 (0.5 to 1.5)	1.9 (1.3 to 2.8)
Black or Hispanic vs white or Asian	1.0 (0.5 to 1.8)	1.1 (0.7 to 1.7)

* Entire population (n = 939) includes both pre- and postintervention patients. The model takes into account clustering by hospital and surgeon and evaluates the effect of the intervention, cancer stage, patient age, insurance, comorbidity, and race on receipt of oncology consultation and underuse adjuvant therapy.

addition to the surgery, oncology, and pathology leadership needed to be engaged to make the project work. We obtained a 97% rate of participation by voluntary consent among surgeons and believe that this high rate was due to two key elements: first, the surgeons' desire to ensure that their patients would get the best care; second, previous discussions with each surgeon about his or her patients who had underused adjuvant treatment (7), which raised awareness of potential system failures within each practice. Practices were "activated" in that each surgeon was asked to designate a contact person in his or her office who was responsible to relate to the surgeon tracking information that we provided concerning follow-through with oncology referrals. Frequency of contact depended on the surgeon's volume of breast cancer cases; for high-volume practices, it was weekly, for low-volume practices, we called when prompted by the tracking software. Contact times were fit to accommodate each practice's preference.

An important challenge to improving cancer treatment lies in the dispersed locations of its multidisciplinary providers. Breast cancer adjuvant care is often delivered in ambulatory settings and is often provided by multiple providers (26–29) in unaffiliated institutions and physicians' offices. The challenges created by fragmentation, although important, were not the most important pitfalls faced by our cohort of patients at greatest risk of underuse due to system failure, namely black and Hispanic women. Most of these patients sought care at hospitals with higher underuse rates and when referred, usually to oncologists within the same institution, failed to see the oncologist and to receive adjuvant treatment. It is these women who appeared to benefit the most from the tracking and feedback intervention. This finding suggests that the intervention would be most successful in a closed delivery system or single hospital where gaps in follow-up occur.

Our findings suggest a number of simple ways in which patient follow-through and receipt of adjuvant treatments can be improved. First, we recommend an expanded role for tumor registrars, particularly those in municipal hospitals or at sites that serve predominantly minority patients (29). The tracking and feedback registry can enable tumor registrars to actively improve the quality of cancer care in real time by tracking oncology connections and giving feedback to surgeons, rather than merely retrospectively tracking treatment data for quality assurance. Hospitals administrators should consider underwriting tumor registry positions to take this more active role in improving cancer care. Second, health insurers should consider requiring a medical oncology consultation for patients diagnosed with invasive breast cancer because women seeing an oncologist are more likely to get treated.

Were there other changes at the hospitals during this time period that might account for the marked improvement in care? Five of the six hospitals now have electronic medical records systems, two of which were implemented after the year 2000, but in one of these two hospitals the adjuvant therapy underuse rate rose. The hospital with the greatest improvement in adjuvant treatment rates had an electronic medical records system before the initial preintervention period, so decreased underuse could not be associated with the new records system. Although electronic medical records systems provide critical clinical information, their effect on clinical care is mixed (30,31). Clinical prompts appear to improve practice (30). None of the hospitals in our study had electronic medical records systems with clinical prompts to provide adjuvant treatment. Four of the six hospitals had a patient navigator program that helps women navigate through the complex care setting to schedule and get to needed appointments. But in these four hospitals, navigation was in place both before and during the tracking and feedback intervention.

Our study has important limitations. First, ideally, to assess the efficacy of an intervention, a randomized trial should be performed. However, because surgeons' practices are limited in number, there were too few to randomize by surgical practice. It was impractical to randomly assign patients within a practice due to the threat of contamination, that is, the possibility of changing practice for some patients but not for others. For these reasons, we employed a pre–post test design that, due to the absence of a concurrent control group, encompasses inherent challenges to discern whether effects are due to changes over time, the intervention, or other confounding factors. To minimize the effects of hospital and surgeon practice, we conducted analyses that controlled for clustering within these groupings. To provide a national concurrent control group, we compared underuse rates with SEER data. This comparison with national data suggests that the reduction in underuse found with the tracking and feedback intervention is real. Our tracking registry was designed to increase patient follow-through with referrals and not to address other causes of underuse, such as lack of physician recommendation among older and sicker women, or patient refusal due to fear or other beliefs. Without qualitative postintervention interviews, we are unable to assess which element of the tracking and feedback intervention was the most potent. Finally, all participating physicians practiced at New York City teaching hospitals and thus may not represent the practices of community-based physicians and may not be able to be generalized to other locales.

To summarize, a tracking and feedback registry may be a simple and efficient mechanism to substantially improve treatment outcomes among women with new, primary, early-stage breast cancers. We found that the implementation of such an intervention

was associated with an increase in patients' follow-through with referrals to an oncologist and with reduced underuse of adjuvant treatments. Because, in the absence of such an intervention, minority women were more likely than white and Asian women to experience a failure to see an oncologist and to go untreated, implementation of the registry eliminated racial disparities in adjuvant treatment underuse.

Appendix Table 1. Multivariate models examining the effect of the tracking and feedback intervention and patient characteristics on rates of underuse of adjuvant treatment among women whose breast cancer surgeons participated in both the pre- and the postintervention periods (limited population) and among women operated on by any surgeon participating in the study (entire population)*

	Limited population (n = 574)	Entire population (n = 939)
Characteristic	**OR (95% CI)**	**OR (95% CI)**
Intervention	0.6 (0.3 to 0.9)	0.6 (0.4 to 0.9)
Age ≥70 y	3.0 (1.8 to 4.9)	2.5 (1.8 to 3.6)
Comorbidity	2.3 (1.4 to 3.8)	1.9 (1.3 to 2.8)
Stage IIA	0.8 (0.5 to 1.3)	0.8 (0.6 to 1.2)
Stage IIB	0.5 (0.2 to 1.0)	0.5 (0.3 to 0.9)
No insurance	2.3 (0.9 to 5.7)	1.5 (0.7 to 3.0)
Black or Hispanic	0.7 (0.4 to 1.3)	1.1 (0.7 to 1.7)

* Hierarchical linear models take into account clustering by surgeon and hospital. The limited population includes patients operated on by the 19 surgeons who participated in both the pre- and postintervention periods. The entire population includes all patients operated on by the 51 preintervention and the 28 postintervention surgeons.

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