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Disparities in Breast Cancer Treatment among American Indian, Hispanic and Non-Hispanic White Women Enrolled in Medicare

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Abstract: Because racial/ethnic disparities in breast cancer survival have persisted, we investigated differences in breast cancer treatment among American Indian, Hispanic, and non-Hispanic White (NHW) women. Surveillance, Epidemiology and End Results data linked to Medicare claims in New Mexico and Arizona (1987–1997) among enrollees aged 65 and older were used to identify treatment, treatment interval, and mortality risk associated with delays in care. We identified 2,031 women (67 American Indian, 333 Hispanic and 1,631 NHW women with time to treatment information. Treatment intervals from diagnosis to surgery (all stages, 18 versus 4 days, $p < .001$) and surgery to radiation (stages I/II, 69 versus 35 days, $p < .01$), were significantly greater for American Indian women than for NHW women. This disparity remained statistically significant after adjustment for age, stage, grade, year of diagnosis, poverty, and distance to care. There was no statistically significant difference in treatment among Hispanic women. Further, American Indian women without surgery within 6 months experienced a 5.6-fold higher breast cancer mortality ($p < .05$). The duration of time to surgery and radiation has not been previously reported for American Indian women. These results suggest older American Indian women experience significant delays in cancer treatment, resulting in greater breast cancer mortality.

Key words: American Indian, Hispanic American, White, breast cancer, episode of care, treatment outcome.

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Breast cancer is the most frequently diagnosed cancer among women in the United States.¹⁻³ Studies in the United States as a whole consistently report lower breast cancer survival among Hispanic and American Indian women than among non-Hispanic White women (approximately 50 to 60% lower).⁴⁻¹¹ Breast cancer is the leading cause of cancer death among Hispanic women and the second leading cause of cancer death among American Indian and non-Hispanic White women.^{2,12,13} Although survival rates have improved, improvements have lagged for American Indian and Hispanic women, resulting in increased racial/ethnic disparities.^{8-10,12} Such problems are not unique to American Indians and Hispanic women, as disparities in cancer treatment, mortality, and survival have also persisted between African American women and non-Hispanic White women.¹⁴⁻¹⁶

Although a higher proportion of racial/ethnic minority group members than non-Hispanic Whites are diagnosed with late stage breast cancer, disparities in survival persist even after adjustment for stage at diagnosis,¹⁷ suggesting that treatment, and other factors following diagnosis, are important in determining survival disparities. Time to treatment is one factor that has been investigated in several population-based studies, but not for American Indian women. Here we describe differences in treatment patterns, including the timing of surgery and radiation treatment following diagnosis, and the receipt of breast-conserving treatment among American Indian, Hispanic, and non-Hispanic White Medicare enrollees with breast cancer in the New Mexico Tumor Registry. Because age, stage, grade, year of diagnosis, poverty, and distance to surgery are indicators that have been associated with type of treatment received, we adjusted for these factors.^{14,15}

Methods

Case ascertainment, demographic, and tumor characteristics. Women aged 65 and older with a unilateral, single first primary breast cancer diagnosed between 1987 and 1996 were identified through the New Mexico Tumor Registry (NMTR), a participant in the National Cancer Institute's (NCI) Surveillance, Epidemiology and End Results (SEER) Program. Cases of *in situ* cancer were included because treatment is often similar to early stage invasive disease. Demographic and tumor characteristics gathered from SEER data included: age, race/ethnicity, ZIP code and county of residence at time of diagnosis, date of diagnosis (day/month/year), tumor stage, tumor grade, and lymph node involvement.

Classification of race/ethnicity. The methodology for assignment of race/ethnicity has been previously described.^{6,18} Briefly, people were classified as Hispanic through the medical record or a surname matching the 1980 U.S. Census Bureau list of Spanish surnames. People were classified as American Indian through the medical record, a reservation residence, or evidence of medical coverage through the Indian Health Service (IHS). Evidence of medical coverage included information from the medical record and through record linkage of cases to the Indian Health Service registration files that is conducted by the NMTR. This has resulted in improved racial/ethnic classification of American Indians in this registry compared with other state-based registries available in the SEER-Medicare linked dataset.¹⁹⁻²²

Staging definition. Lymph node involvement and tumor stage were classified according to the American Joint Committee on Cancer (AJCC) Cancer Staging Handbook 5th edition, using SEER Extent of Disease (EOD) 4-digit codes (for 1987 year of diagnosis), EOD 10-digit codes (for 1988–1996 years of diagnosis), and the SEER Comparative Staging Guide for Cancer.^{23–26} The EOD is a SEER classification system relying on clinical and pathologic information available in the medical record. A person's EOD is coded as unknown if it is not recorded prior to chemotherapy or radiation.

Definition of treatment. Treatment for most women was determined through Medicare claims for one year following the date of diagnosis. Because the date of diagnosis may occur after cancer-directed surgery (e.g., excisional biopsy), treatment received 31 days prior to the date of diagnosis was also determined in Medicare claims. Evidence of cancer-directed surgery in Medicare claims prior to the date of diagnosis in SEER did not change the date of diagnosis used in our analysis. The SEER date was retained as recorded. We used Medicare inpatient summary (MEDPAR) files for the years 1986–1997, and Medicare Physician (NCH) claims for the years 1991–1997, as compiled by the Centers for Medicare and Medicaid Services (CMS). National Claims History claims for other years were not available. Treatment patterns were defined using the International Classification of Disease Procedure Codes, Revision 9 (ICD-9), Current Procedural Terminology (CPT), CMS's Health Care Procedure Codes (HCPCS), and Hospital Revenue codes. Each CPT manual from 1987–1996 was reviewed for consistency of codes over time. We tied the ICD, CPT, HCPCS, and revenue codes to the SEER Site-Specific Surgery Codes as shown in Table 1. Because physician claims for 1991 to 1997 are missing, we chose not to present results for chemotherapy, as the estimates could be misleading. For women without evidence of treatment in Medicare claims, SEER treatment information was used. We chose a preference for Medicare over SEER treatment information because during the time period of this study SEER treatment information recorded the first course of therapy within the first four months following initiation of cancer treatment.²⁷ Agreement between Medicare and SEER for breast cancer surgery and radiation has been estimated to be 85% or greater.^{27–29}

Classification of breast cancer surgery. We identified the following categories of breast cancer surgery: incisional biopsy, excisional biopsy, partial mastectomy with axillary node dissection, mastectomy, other/unknown surgery, radiation, and chemotherapy. Mastectomy included simple mastectomy, modified radical mastectomy, radical mastectomy, or extended radical mastectomy (see Table 1). Partial mastectomy included lumpectomy, wedge resection, quadrantectomy, segmental mastectomy, and tylectomy. Excisional biopsy was defined as partial or complete removal of the gross primary tumor without axillary node dissection. We defined cancer-directed surgery as excisional biopsy, partial mastectomy, or mastectomy. The number of women with axillary node-only surgery or subcutaneous mastectomy was small and therefore classified as other/unknown. Breast conserving surgery was defined as excisional biopsy or partial mastectomy. Breast conserving surgery followed by radiation is an accepted treatment modality for most women with Stage I/II breast cancer.^{30–33} Because SEER data during the time period of the study did not include the date of surgery, information on the time from diagnosis to cancer-directed surgery was based on Medicare

Table 1.
ICD-9 AND CPT CODES USED TO DEFINE TREATMENT FROM MEDICARE CLAIMS

Treatment	SEER site-specific surgery codes	ICD-9	CPT/HCPCS
Surgery			
Axillary lymph node dissection	n/a	40.23 40.3	38500, 38525, 38740, 38745
Breast surgery	40.51		
Incisional biopsy (includes needle aspiration)	2	85.91 85.1 85.11 85.12	19000, 19001, 19101, 88170, 19020
Cancer-directed surgery			
Excisional biopsy	10, 18	85.20-23 85.25	19120, 19125, 19126, 19160, 19162
Partial mastectomy with axillary lymph node dissection	20, 28	85.20-23 85.25	19120, 19125, 19126, 19160, 19162 and axillary lymph node codes, above
Mastectomy ^a	40-78	and axillary lymph node codes, above 85.33-36 85.43-44	19180, 19240, 19200, 19220
Other/unknown ^b	85.45-48 1, 9, 30-38, 80, 90	85.41-42, 85.91	19182
Chemotherapy	n/a	99.25 V58.1 V66.2 V67.2	96400, 96405, 96408, 96410, 96414, 96420, 96422, 96423, 96425, 96549, M0024 ^c ; Q0083-85, J9000-J9999
Radiation^d	n/a	92.2-92.29 V58.0 V66.1	77400-77499
	V67.1		

^aIncludes simple mastectomy, modified radical mastectomy, radical mastectomy, and extended radical mastectomy.

^bIncludes unknown, subcutaneous mastectomy and axillary node dissection-only.

^cPresent in 1989 version of HCPCS cod manual, Centers for Medicare and Medicaid Services.

^dThese codes were used in addition to the hospital radiation therapy indicator code (Hospital Revenue Code 35X) on the MEDPAR inpatient summary file.

claims, which limited the analysis to the subset of enrollees with a Medicare claim for breast cancer treatment.

Exclusion criteria and summary of case ascertainment. We excluded cases identified by autopsy, death certificate, and convalescent-home records. In addition, women with a Medicare claim for a total mastectomy more than one month prior to the SEER date of diagnosis were excluded because of the possibility that the records for these women were inaccurately linked. Because SEER-Medicare linked data does not capture all Medicare HMO claims, we excluded women enrolled in a Medicare HMO during the month of their breast cancer diagnosis.³⁴ In summary, there were 2,938 women (99 American Indian, 561 Hispanic, and 2,278 non-Hispanic White) with a unilateral, single first primary female breast cancer identified through the New Mexico Tumor Registry, after the exclusion of 659 cases with multiple primaries; 52 cases identified through either autopsy, death certificate or convalescent home source; and 5 cases with bilateral tumors. Of these, 2,814 women (85 American Indian, 525 Hispanic, 2,204 non-Hispanic White) were linked to Medicare Registration files. An additional 407 women (103 Hispanic women and 304 non-Hispanic White women) were excluded based on Health Management Organization membership, and another 9 women (3 Hispanic women and 6 non-Hispanic White women) were excluded because the date of mastectomy in Medicare preceded the date of diagnosis in SEER by more than one month. Thus, 85 American Indian Women, 419 Hispanic and 1,894 non-Hispanic White women were available for analysis of treatment patterns, including surgery and radiation. Time-to-treatment information was available in Medicare records for a subset of these women (67 American Indian, 333 Hispanic, and 1,631 non-Hispanic White).

Driving distance to surgery. Using a geographic information system (GIS) (ArcView 3.5), driving distance to surgery was determined from the nearest street location to the ZIP code centroid of residence at the time of diagnosis to the street address of the hospital or physician's office that filed a Medicare claim for the most extensive cancer-directed surgery. Distance to surgery was then categorized as the following: within one mile, 1–24 miles, 25–49 miles, and 50 or more miles. Poverty was defined as the proportion of people in poverty within the patient's ZIP code of residence according to the 1990 U.S. Census and quartiles were determined using all racial/ethnic groups combined.³⁵

Statistical methods. Chi-square and Fisher's Exact tests were used to determine statistical significance ($p \leq .05$) of racial/ethnic differences in demographic characteristics, tumor characteristics, surgery, and radiation treatment. Fisher's Exact test was used when an expected cell count was smaller than five.³⁶ Statistical significance of the difference in the median treatment interval in days was determined by the Wilcoxon Rank Sum test, using the two-sided normal approximation and the exact p -value calculation for cell counts smaller than five.

Multivariate logistic regression was used to determine the odds ratio (OR) for the absence of a first cancer-directed surgery within six months following diagnosis, adjusted for age, stage, grade, year of diagnosis, distance to surgery, and poverty. Poverty and distance to surgery were highly correlated and therefore placed in separate regression models. The Hosmer and Lemeshow (H-L) Goodness-of-Fit test statistic was calculated for each multivariate model, with a p -value $< .15$, indicating significant lack of

fit.³⁷ Cox proportional hazards regression was used to estimate the risk of dying from breast cancer among women without a cancer-directed surgery within six months following diagnosis, adjusting for the effects of age, stage, grade, year of diagnosis, and driving distance.

Results

Tumor and demographic characteristics. A significantly lower proportion of American Indian and Hispanic women than non-Hispanic White women were diagnosed with Stage I breast cancer (33% and 35% versus 44%, $p < .05$, Table 2). There were no statistically significant differences in age or other tumor characteristics. Median poverty levels were significantly greater among American Indian and Hispanic women than among non-Hispanic White women, and a higher percentage of American Indian (18%) and Hispanic (12%) women than non-Hispanic White women (7%) resided in a ZIP code located 50 or more miles away from the facility where they underwent cancer surgery, $p < .05$.

Table 2.

DEMOGRAPHIC AND TREATMENT PATTERNS BY RACE/ETHNICITY

	American Indian	Hispanic	Non-Hispanic White
Number of cases linked to Medicare	85	419	1,894
Median age	75	73	73
AJCC stage (%)			
<i>In situ</i>	5	9	10
I	33*	35***	44
II	43**	36*	30
III	8	8*	5
IV	6	8*	5
Stage not assigned	5	4	6
Histologic grade (%)			
Well/moderate differentiation	42	40	43
Poor/undifferentiated	24	23	19
Regional or distant lymph node involvement (%)			
Positive	29	29*	24
Negative	62	60***	68
Percent of zip code residing in poverty			
Median	42***	24***	13
Number	72	387	1,783

(Continued on p. 654)

Table 2. (continued)

	American Indian	Hispanic	Non-Hispanic White
Distance to surgery (%)			
Within 1 mile	11***	23**	29
1 to 24 miles	22***	37**	44
25 to 49	25***	6*	4
50 or more	18***	12*	7
Unknown	25*	22**	16
Percent (%) of treatment received using SEER and Medicare data			
All stages			
No cancer-directed surgery	4	10**	6
Radiation	21	29	28
Stages I and II			
Breast conserving surgery	22	27	30
Mastectomy	77	70	68
Radiation	19	29	28
Breast conserving surgery with radiation	14	19	22
Timing of treatment using Medicare data			
All Stages			
Days (median) from diagnosis to surgery	18***	7	4
Number of cases	67	333	1,631
Stages I and II			
Days (median) from diagnosis to surgery	20***	7	4
Number of cases	55	256	1,271
Days (median) from surgery to radiation	69**	35	35
Number of cases	6	35	246

* $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$, compared with Non-Hispanic White women, using the Chi-Square or Fisher's Exact test statistic for dichotomous variables and the Wilcoxon rank sums test for the median value.

AJCC = American Joint Committee on Cancer

Treatment patterns: surgery and radiation. Within one year following breast cancer diagnosis, the proportion of women without cancer-directed surgery was greater among Hispanics (10%, $p < .01$), but not among American Indians (4%, $p > .05$), than among non-Hispanic Whites (6%, $p < .05$, Table 2). Among women with stage I or II disease the proportion of women receiving breast-conserving surgery with radiation was lower among American Indian (14%) and Hispanic women (19%) than among non-Hispanic White (22%) women, although this difference was not statistically significant.

Treatment intervals. For all stages combined, the median time from diagnosis to first breast cancer surgery was significantly greater for American Indian women (18 days), than for non-Hispanic White women (4 days, $p < .001$). Within the first month

following breast cancer diagnosis, 67.2% of American Indian women had received cancer-directed surgery, compared with 89.5% of Hispanic and 91.5% of non-Hispanic White women; this disparity persisted over later time intervals ($p < .001$, Figure 1).

Among women with stage I/II disease, the median number of days from diagnosis to first breast cancer surgery was significantly greater for American Indian women than for non-Hispanic White women (20 versus 4 days, $p < .001$). Among women receiving breast-conserving surgery and radiation, median time from surgery to first radiation treatment was significantly greater for American Indian women (69 days), than for non-Hispanic White women (35 days, $p = .001$, Table 2).

A higher proportion of American Indian women (7%) than non-Hispanic White women (2%, $p < .001$, data not shown) did not receive a first cancer-directed surgery within 6 months following diagnosis, and this difference persisted after adjustment for age, stage, grade, year of diagnosis, and distance to surgery (OR=6.3, 95% CI: 2.3–17.2, Table 3). Among women who did not receive their surgery within 6 months following diagnosis, American Indian women were significantly more likely than non-Hispanic White women to die from breast cancer (HR=5.6; 95% CI: 1.2–25.7), although this was based on a small number of American Indian cases ($n=6$). Odds ratio and HR values adjusted for poverty were similar, but slightly higher, (data not shown); the more conservatively adjusted estimates are presented in Table 3.

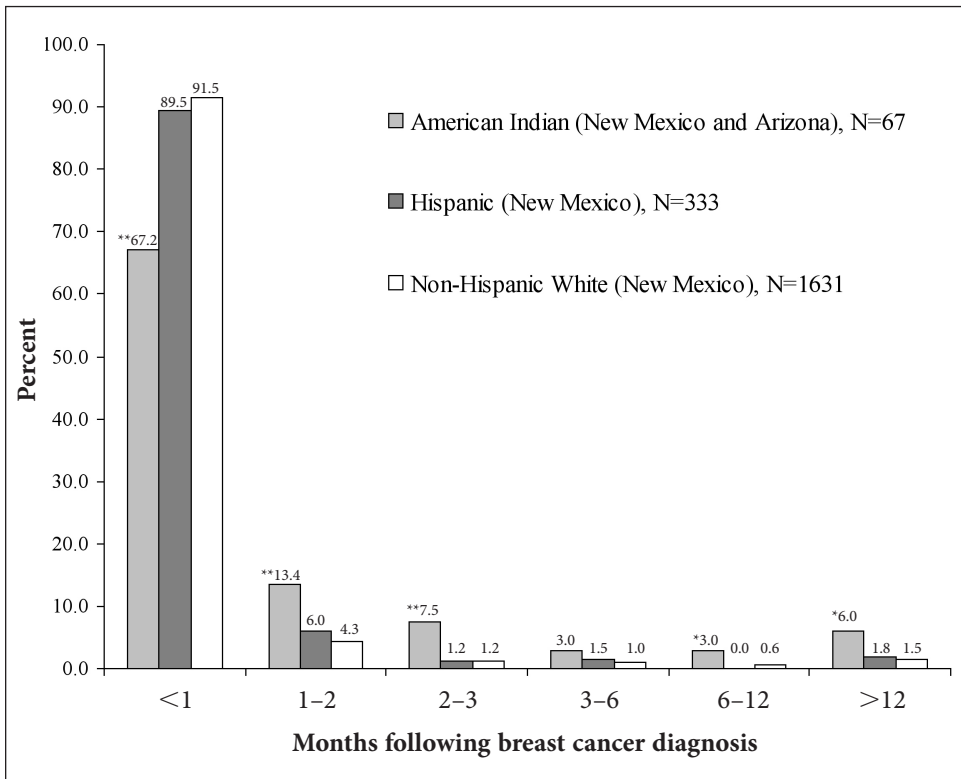


Figure 1. Time period of cancer-directed surgery by racial/ethnic group.
Note: * $p \leq .05$; ** $p \leq .001$, relative to non-Hispanic White (NHW) women.

Table 3.
ODDS OF NO CANCER-DIRECTED SURGERY WITHIN 6 MONTHS FOLLOWING DIAGNOSIS
AND BREAST CANCER MORTALITY RISK, BY RACE/ETHNICITY

Timing of first cancer-directed surgery	Odds Ratio ^a or Hazard Ratio ^a for Racial/Ethnic Group			H-L Goodness of Fit p-value
	American Indian (New Mexico and Arizona)	Hispanic (New Mexico)	Non-Hispanic White (New Mexico)	
Crude Odds Ratio	4.3 (1.7-10.5)	.8 (.3-2.0)	Reference	N/A
Adjusted Odds Ratio	6.3 (2.3-17.2)	.7 (.2-2.0)	Reference	.87
Breast Cancer Mortality Hazard Ratio	5.6 (1.2-25.7)	.7 (.2-2.3)	Reference	N/A
Number of women	6	6	33	

^aAdjusted for age, stage, grade, year of diagnosis and distance to surgery.
 Bold numbers emphasize statistically significant differences.

Discussion

This study of Medicare claims information reports significant disparities in the timing of treatment for breast cancer of American Indian women enrolled in Medicare. This includes a greater time interval from breast cancer diagnosis to first cancer-directed surgery and a greater time interval from breast-conserving surgery to radiation among those women with stage I/II cancer. Among women who do not undergo surgery within six months following cancer diagnosis, our study suggests a significantly increased breast cancer mortality risk for American Indian women, although this finding is based on a small number of cases. No significant differences in time-to-treatment were found between Hispanic and non-Hispanic White women.

Time to treatment for American Indian women. Our research is consistent with a report from the National Breast and Cervical Cancer Early Detection Program reporting a time interval from diagnosis to cancer treatment (the *treatment interval*) that is at least 2 times greater among American Indian and Alaska Native women than among White women.³⁸ In addition, the median time to treatment interval reported in this study is consistent with previous reports for American Indian (18 days) and non-Hispanic White women (6 to 10 days).³⁸⁻⁴¹ Most literature on time to treatment has focused on (1) patient time to seeking medical attention for a problem (the *care-seeking interval*),^{39,40,42-47} (2) time from first patient visit to cancer diagnosis (the *diagnostic interval*),^{39,43,44,47-49} and (3) the total time interval from recognition of an abnormality to treatment (the *care-seeking interval* + *diagnostic interval* + *treatment interval*).^{40-42,46,50} One study has reported a median care-seeking interval among American Indian women of 30 days.⁵¹ At each time interval opportunities arise for delays that compound problems and contribute to poor health outcomes. Two studies at separate Indian Health Service clinics in New Mexico and Arizona have documented that between one fifth and one third of American Indian women do not receive appropriate treatment once it is initiated.^{52,53}

With regard to patient survival following treatment delay, some studies report reduced survival with increased delay, including one meta-analysis that reports reduced survival with delays of 3 to 6 months.^{42,47} However, other studies have found improved or no difference in survival associated with a greater time interval.^{40,41} This inconsistency may be due to the fact that delay can also occur among women seeking a second opinion and who have more health care options or better access to care. Our study suggests that, among American Indian women, delays in the treatment interval alone contribute to reduced breast cancer survival. This finding is consistent with at least one other published report demonstrating a 3.5-fold increased risk of recurrence and death among American Indian women who do not receive appropriate care.⁵³ Thus, in order to reduce health disparities and continue to improve breast cancer survival, efforts to reduce this delay are needed and should be coordinated with ongoing programs to promote the early detection of breast cancer among American Indian women.

To our knowledge, the duration of time from surgery to radiation therapy among women receiving breast-conserving therapy has not been previously reported for American Indian women. It is possible that administration of chemotherapy between surgery and radiation may have influenced our results. Treatment guidelines suggest

the interval between surgery and radiation should be no more than 12 weeks (84 days),^{54,55} and studies report the median interval with and without chemotherapy to be 12 and 8 weeks (84 and 56 days), respectively.⁵⁶ It is not clear whether this could explain the differences seen in this study. In a separate review, using the codes outlined in Table 1, we found the overall proportion of American Indian women who received chemotherapy was not significantly greater. However, outpatient Medicare files are not available for the entire time period of the study, and this may mask differences in chemotherapy treatment. Some studies report a higher recurrence rate associated with greater delay of radiation therapy, although the data available for this study do not contain recurrence information.^{57,58,59}

A majority of American Indian women in Arizona and New Mexico rely on the Indian Health Service (IHS) as their primary source of health care. Funding and staffing shortfalls occur in IHS and may contribute to delays in access, diagnosis, and treatment.^{60,61} Most cancer surgery and virtually all chemotherapy and radiation therapy is performed outside of the IHS system through contract health care, which is subject to severe rationing because of inadequate funding, and may not be available to many individuals because of their residence and/or federal tribal recognition status.^{60,62} In some cases a patient may have to leave her current residence and return to a reservation in order to become eligible for contract care services. Even after a patient becomes eligible for Medicare coverage, referral by IHS to a cancer specialist still occurs through the same bureaucratic channels and therefore subject to the same delays. Future epidemiologic studies are needed to clearly identify and document bureaucratic and systems shortfalls as well as patient characteristics that may lead to treatment delays.

In addition, driving distance to treatment was significantly greater for American Indian women in this study, which is consistent with other research, and may contribute to treatment delays.⁶³ In focus group studies, American Indian women breast cancer survivors note that distance contributes to the additional time needed to plan for family and community responsibilities while they are away undergoing treatment.⁶⁴ American Indian women may choose traditional healing as a complement or as an alternative to conventional treatment, which may delay conventional therapy a few weeks or months.⁶⁵ The National Native American Cancer Survivors Support Network is working with traditional healers to provide abbreviated pre-treatment ceremonies, complemented by a full post-surgical ceremony.⁶⁴

Treatment patterns among Hispanic women. Our results are consistent with at least one report of a higher proportion of Hispanic than White women not receiving cancer-directed surgery.⁶⁶ Other studies report no significant difference in type of treatment received by Hispanic women versus White women, when treatment is defined as completeness of appropriateness of care.^{4,8,67} One study reports a significantly greater likelihood of Hispanic women receiving breast-conserving surgery, compared with Whites,⁶⁸ however the inclusion of “excisional biopsy” within the classification of breast-conserving surgery may be misleading. The care of women who receive excisional biopsy alone does not meet the highest standards.^{30,31} Notably, in our study, the higher proportion of Hispanic women not receiving cancer-directed surgery was apparent among the Medicare enrollees only when using SEER and Medicare data combined, and

not when using Medicare data alone. It is possible that our result may be an artifact of missing information in the SEER data, because of the four-month limit on the collection of treatment information that was in place by the SEER program during the time period of this study, and not due to a true disparity. We also did not find a longer time to treatment among Hispanic women than among White women as has been identified in previous work.³⁸ This may be due to the Medicare sub-population that was studied which may have better access to care than other age groups. In addition, a significant proportion (approximately 20%) of the Hispanic women in our study were part of a Medicare HMO, for whom there is no information or incomplete treatment information available in the SEER-Medicare data. Future studies should incorporate Medicare HMO enrollee information in order to elucidate this matter regarding Hispanic women aged 65 and older.

Strengths and limitations. The strengths of the study included case ascertainment through a large population-based cancer registry. Because the New Mexico Tumor Registry has routinely linked its data to Indian Health Service registration records, this registry has a comparatively low proportion of racial/ethnic misclassification compared with other areas of the United States and is therefore an excellent place to conduct a study of American Indian women.^{20,22} In general, other studies have shown that racial/ethnic misclassification results in the misclassification of American Indian women as White; and, therefore, we believe that our results might be more pronounced if all groups were correctly classified. Finally, there is an high linkage success rate of over 90% between SEER and Medicare datasets.⁶⁹

There are a number of limitations to this study. First, nearly one third of American Indian women identified by the SEER program either could not be linked with Medicare, or were linked to registration records but did not have a Medicare claim. Our analysis of time to treatment was limited to those individuals with a Medicare claim. It is possible that treatment patterns may differ for those women who could not be found in Medicare claims, or that, due to the small number of cases, the regression models did not fully adjust for age, stage, histologic grade, year of diagnosis, and distance to surgery. Second, the results of this study may not be generalizable to women in other geographic regions, Medicare HMO enrollees, or Hispanic sub-populations, including undocumented workers. Data for other racial ethnic groups in New Mexico was available but was not included due to the very small numbers. Third, we did not investigate the impact of several other factors on treatment decisions, including comorbidity, knowledge, and beliefs of patients and physicians, or language barriers, which may influence time to cancer treatment and treatment choice.^{70,71} We chose not to apply a comorbidity index in this analysis because of previously-recognized problems in underestimating comorbidity in Medicare files, which may be greater for American Indian women because of IHS primary care utilization that is not captured by Medicare.⁷² Finally, use of a ZIP code centroid as a proxy for the patient's residence may be less accurate in more rural locations, as some ZIP codes in this region extend more than 100 miles.

In summary. Our results suggest that American Indian women receiving cancer treatment services covered by Medicare experience significant delays in breast cancer

treatment and greater breast cancer mortality. Further research is needed to elucidate health care system shortfalls, referral patterns, and patient characteristics as they affect the timing of treatment for American Indian women.

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