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AWARD NUMBER DAMD17-96-1-6011

TITLE: Prior Mammography Utilization: Does It Explain  
Black-White Differences in Breast Cancer Outcomes?

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REPORT DATE: April 1998

19980617 093

TYPE OF REPORT: Final

PREPARED FOR: Commander  
U.S. Army Medical Research and Materiel Command  
Fort Detrick, Maryland 21702-5012

DISTRIBUTION STATEMENT: Approved for public release;  
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**DTIC QUALITY INSPECTED 1**

# REPORT DOCUMENTATION PAGE

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Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY <i>(Leave blank)</i>	2. REPORT DATE <b>April 1998</b>	3. REPORT TYPE AND DATES COVERED <b>Final (15 Apr 96 - 14 Apr 98)</b>	
4. TITLE AND SUBTITLE <b>Prior Mammography Utilization: Does It Explain Black-White Differences in Breast Cancer Outcomes?</b>		5. FUNDING NUMBERS <b>DAMD17-96-1-6011</b>	
6. AUTHOR(S) <b>Ellen P. McCarthy, Ph.D.</b>			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) <b>Boston University Medical Center Boston, Massachusetts 02118</b>		8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) <b>U.S. Army Medical Research and Materiel Command Fort Detrick, Maryland 21702-5012</b>		10. SPONSORING / MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES			
12a. DISTRIBUTION / AVAILABILITY STATEMENT <b>Approved for public release; distribution unlimited</b>		12b. DISTRIBUTION CODE	
<p>13. ABSTRACT <i>(Maximum 200 words)</i></p> <p>Older black women are diagnosed with advanced stage breast cancer more frequently than whites possibly because they receive fewer mammograms. We investigated the extent to which regular mammography use explains black-white differences in stage at diagnosis among older women with breast cancer.</p> <p>We studied black and white women, aged <math>\geq 67</math>, diagnosed with breast cancer from 1987-1993, residing in three SEER Program areas. Women were classified based on their mammography use during the 2 years before diagnosis: nonusers (no prior mammograms), regular users (at least 2 mammograms at least 10 months apart), or peri-diagnosis users (only mammogram(s) within 3 months before diagnosis). Stage was classified as early (in situ/local) or late (regional/distant).</p> <p>Black women were more likely to be nonusers of mammography (OR=2.19, 95% CI, 1.65-2.92) and to be diagnosed with late-stage disease (OR=1.78, 95% CI, 1.34-2.35) than white women. When stratified by prior mammography use, the black-white difference in stage occurred only among nonusers (adjusted OR=1.54, 95% CI, 1.04-2.28). Among regular users, blacks and whites were diagnosed at similar stages (adjusted OR=1.01, 95% CI, 0.54-1.88).</p> <p>These results suggest that differences in stage between older blacks and whites are related to prior mammography use. Increased regular mammography use may result in a shift toward earlier stage disease and narrow observed differences in stage between older black and white women.</p>			
14. SUBJECT TERMS <b>Breast Cancer</b> <b>Mammography, Black-White Differences, Older Women, Stage at Diagnosis</b>		15. NUMBER OF PAGES <b>35</b>	
		16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT <b>Unclassified</b>	18. SECURITY CLASSIFICATION OF THIS PAGE <b>Unclassified</b>	19. SECURITY CLASSIFICATION OF ABSTRACT <b>Unclassified</b>	20. LIMITATION OF ABSTRACT <b>Unlimited</b>

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4.10.98  
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**FINAL REPORT**

**Department of the Army  
US Medical Research and Materiel Command**

**Predoctoral Fellowship Grant  
Grant Number DMAD17-96-6011**

April 1998

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## **5.0 INTRODUCTION**

Breast cancer is the second leading cause of cancer-related mortality among women in the United States. Women 65 years of age and older bear the greatest burden of disease accounting for more than 43% of newly diagnosed cases of breast cancer (1). Older women are also more commonly diagnosed with advanced stage disease (1-4) and their breast cancer mortality rate is eight times greater than women under age 65 (5).

Older black women are at higher risk of being diagnosed with late-stage breast cancer than older white women (2, 6). Data from the Surveillance, Epidemiology, and End Results (SEER) Program from 1981 through 1986 demonstrate that black women 65 years of age and older were diagnosed more frequently with late-stage breast cancer (47% versus 40%, respectively) and less frequently with localized breast cancer (39% versus 49%, respectively) than their white counterparts (6). One possible explanation for the higher rate of late-stage disease observed among older black women is their lower use of mammography. Several recent studies of Medicare enrollees have found that mammography rates were appreciably lower for black women than for white women (7-10).

We undertook the present study to determine the relationship between prior mammography use and stage at diagnosis for older black and white women, and to investigate the extent to which prior mammography use explains the observed black-white difference in stage at diagnosis among older women.

### **5.1 Technical Objectives**

Specifically, we addressed the following technical objectives:

- 1) Describe prior mammography utilization and factors associated with prior use among black and white women, age 67 and older, who are diagnosed with breast cancer.

- 2) Describe the relationship between prior mammography utilization and stage at diagnosis for black and white women.
- 3) Determine how much of the black-white difference in stage at diagnosis is explained by differences in prior mammography use.

## **6.0 BODY**

### **6.1 Methods**

#### **6.11 Data Source**

We conducted a retrospective cohort study using the Linked Medicare-Tumor Registry Database (11). The linked database was jointly created by the National Cancer Institute (NCI) and the Health Care Financing Administration (HCFA) to enable researchers to conduct cancer-related health services research. The linked database contains cancer information on patients aged 65 years and older from NCI's SEER Program linked with Medicare enrollment and utilization information from HCFA's Medicare Statistical System for the years 1985 to 1993.

Two Medicare utilization files are available in the linked database. Medical Provider Analysis and Review (MEDPAR) is a 100 percent utilization file with one record for every inpatient hospitalization or skilled nursing facility stay covered under Medicare Part A. The Physicians' Claims file is a 100 percent utilization file with one record for every physician and outpatient claim covered under Medicare Part B. Prior to 1991, the Physicians' Claims file was only available for ten states. Data from the SEER and Medicare Programs overlap in three tumor registries: Connecticut, metropolitan Atlanta, Georgia, and Seattle-Puget Sound, Washington. Specific information describing the linkage between SEER and Medicare has been published elsewhere (11). The match rates for Connecticut, Atlanta, and Seattle are 93.3%, 94.1%, and 91.5%, respectively.

#### **6.12 Study Sample**

Women were eligible for the study sample (n=11,060) if they were diagnosed with a first primary breast cancer between January 1, 1987 and December 31, 1993, aged 67 years and older, of black or white race, and resided in Connecticut, Atlanta, or Seattle-Puget Sound. Although we selected these areas because physicians' claims were available for all cases, they

represent a geographically diverse population of older women with breast cancer. Women who were enrolled in a health maintenance organization (HMO) and those with less than two full years of Medicare Part B coverage were not eligible for this study, since physician claims data, which are required for identifying mammography use, are not available. We limited our final study sample to women who were aged 67 years and older to ensure that all women had a minimum of two years of Medicare utilization (claims) information prior to their breast cancer diagnosis.

Women whose mammography use could not be categorized (47 black women and 721 white women) or whose disease was unstaged (33 black women and 309 white women) were excluded from the study.

### **6.13 Measures**

We ascertained the following sociodemographic variables from the SEER file: age at diagnosis, marital status at diagnosis, and SEER area. Age at diagnosis (range 67-107 years) was categorized as 67-74, 75-84, and 85 and older for descriptive purposes, but was modeled as a continuous variable (only four women were over 100 years of age). Marital status was defined as married or not at diagnosis. SEER area was classified according to the tumor registry of diagnosis: Connecticut, Atlanta, or Seattle. We used 1990 U.S. Census data as an ecological measure of socioeconomic status (SES). Women were assigned to the median household income of their zip code of residence and grouped as < \$15,000 or ≥ \$15,000.

We obtained information on race from the Medicare beneficiary enrollment file. A comparison of race between Medicare and SEER files demonstrated agreement for 99% of women. Enrollees are classified in Medicare files as Black, White, Asian, Native American, Hispanic, or unspecified. Because this analysis focused on black and white women, those of "other" racial groups were not eligible (n=339).

We computed a modified Charlson Comorbidity Index using Deyo's method of classifying ICD-9-CM diagnosis codes from inpatient claims (12). For each woman, we identified all inpatient hospitalizations beginning two years prior to diagnosis and ending one month after diagnosis. A priori, we extended the period of observation to one month past diagnosis because we expected that, during the study years 1987 to 1993, most women would have had at least one hospitalization around their breast cancer diagnosis. We classified women as: 1) non-hospitalized (i.e., comorbidity could not be assessed), 2) no comorbid conditions (i.e., a Charlson Index of 0), and 3) one or more comorbid conditions (a Charlson Index of 1 or greater).

We measured mammography utilization using Medicare physicians' claims. We identified women who had one or more bilateral mammograms (CPT procedure codes 76091 or 76092) within two years prior to their breast cancer diagnosis. We classified women as: 1) *nonusers* (n=2,019) if they did not have any mammograms during the entire two year period prior to their diagnosis, 2) *regular users* (n=2,483) if they had at least two mammograms within the two years prior to their breast cancer diagnosis that were ten or more months apart, and 3) *peri-diagnosis users* (n=5,448) if they had their only mammogram(s) within three months before their diagnosis. Women who did not fit into any category listed above were classified as *Uncertain* (n=768) and excluded from the study. "Peri-diagnosis users" were a heterogeneous group of women whose only mammography use was close to their date of diagnosis. This group includes women who had a screening mammogram and were diagnosed with breast cancer and those who had a diagnostic mammogram. Therefore, analyses relating prior mammography use to stage at diagnosis considered only nonusers and regular users as they are two distinct groups of women.

We measured stage at diagnosis using the SEER historical staging system (in situ, localized, regional, distant or unstaged) because it was available for all women. Stage of disease was dichotomized as early (in situ/localized) or late (regional/distant).

## 6.14 Statistical Analysis

All statistical analyses were performed using SAS statistical software version 6.11 (13). Black and white women were compared with respect to sociodemographic factors, comorbidity, stage at diagnosis, and prior mammography use. Chi-square statistics and Students' t-tests were performed to identify characteristics that differed significantly between black and white women.

Multivariable logistic regression was used to estimate the adjusted odds of late-stage disease for black women as compared to white women (14). To investigate the extent to which prior mammography use explains the observed black-white difference in stage at diagnosis, we compared simple models to more complex ones and examined changes in the estimated odds ratio for the race-stage association (15). First, we compared a model that only included race to a model that included race and prior mammography use to determine how much of the excess late-stage disease among black women is explained by differences in prior mammography use. Next, we compared a model that included race, sociodemographic, and comorbidity information to a model that included these factors and prior mammography use to determine the additional amount of excess late-stage disease among black women that is explained by prior mammography use after sociodemographic and comorbidity information were taken into account. The odds ratio for race and the corresponding 95 percent confidence intervals (CI) were estimated from the beta coefficient and standard error from the logistic models (14). We used the following formula to compute the percent change in the estimated odds ratio to compare our results with those from a previous study (16).

$$\% \text{ change in OR} = \frac{OR_{\text{mammography}} - OR_{\text{without mammography}}}{OR_{\text{without mammography}} - 1.00} \times 100$$

## 6.2 Results

All Tables are found in the Appendix, starting on page 26.

Characteristics of the study sample (n=9,950) are presented in Table 1. Overall, 4% (n=437) of the women were black. Twenty percent of women had no mammograms within two years prior to their breast cancer diagnosis (nonusers), 25% of women had at least two mammograms within two years preceding diagnosis that were ten or more months apart (regular users), and 55% had their only mammogram(s) within three months prior to their diagnosis (peri-diagnosis users). Nearly one-third (29%) of the women were diagnosed with late-stage disease.

Table 1 also shows the characteristics of the study sample by race. Race was confounded with SEER area of residence. For example, although only 17% of women in our study resided in Atlanta, nearly two-thirds (62%) of the black women were from Atlanta. Black women were less likely to be married (22% versus 39%) and more likely to live in a low income area (16% versus 1%). Comorbidity also varied with race: black women were somewhat more likely to have no hospitalizations (28% versus 25%), but among those hospitalized, were more likely to have at least one comorbid condition (28% versus 22%) as compared with white women. Age at diagnosis was similar for black and white women.

Black women were over-represented among nonusers of mammography (31% versus 20%) and under-represented among regular users of mammography (18% versus 25%) (Table 1). However, the percentages of black and white peri-diagnosis users were similar (51% versus 55%). Black women were more often diagnosed with late-stage disease as compared with white women (35% versus 29%).

Bivariate associations with late-stage disease among nonusers and regular users of mammography (n=4,502) are presented in Table 2. Black women were significantly more likely to be diagnosed with late-stage disease as compared with white women (OR=1.78, 95% CI 1.34-2.35). Women residing in Connecticut (OR=1.45, 95% CI 1.25-1.68) or Atlanta (OR=1.51,

95% CI 1.25-1.83) were more likely to be diagnosed with late-stage disease than those residing in Seattle. Late-stage at diagnosis was significantly associated with advancing age at diagnosis. Women who were married at diagnosis were less likely to be diagnosed with late-stage disease than those who were not married (OR=0.76, 95% CI 0.66-0.87). Women who had no comorbidities (OR=1.79, 95% CI 1.52-2.10) and women who had at least one comorbidity (OR=2.36, 95% CI 1.95-2.85) were more likely to be diagnosed with late-stage disease than women who were not hospitalized. A positive association with late-stage at diagnosis was observed among women residing in a low income area (OR=2.22, 95% CI 1.31-3.74).

Lack of prior mammography use was strongly associated with late-stage at diagnosis (Table 2). Nonusers of mammography were significantly more likely to be diagnosed with late-stage disease as compared with regular users (OR=3.04, 95% CI 2.66-3.48).

The crude odds ratios for late-stage disease comparing nonusers with regular users of mammography are presented separately for black and white women in Table 3. These analyses were performed to determine whether the relation between prior mammography use and stage at diagnosis is significant in black women and in white women. Prior mammography use was strongly associated with stage at diagnosis for both black and white women. Among black women, the odds of being diagnosed with late-stage disease was 5.03 comparing nonusers to regular users (95% CI 2.60-9.70). Among white women, the odds of being diagnosed with late-stage disease was 2.93 comparing nonusers to regular users (95% CI 2.56-3.36).

The crude and adjusted odds ratios for late-stage disease comparing black with white women are presented separately for nonusers and regular users of mammography in Table 4. These analyses were performed to determine whether race is related to late-stage disease after considering prior mammography use. Among nonusers, black women were significantly more likely to be diagnosed with late-stage disease as compared with white women (OR=1.74, 95% CI

1.22-2.48). After adjusting for SEER area, age, marital status, income, and comorbidity, the odds of late-stage disease remained greater for black women (adjusted OR=1.54, 95% CI 1.04-2.28). However, among regular users of mammography, there was no important difference in stage at diagnosis between black and white women (adjusted OR=1.01, 95% CI 0.54-1.88).

Results obtained from logistic regression modeling to adjust the race-stage association for important factors associated with late-stage disease are summarized in Table 5. To determine the extent to which prior mammography use explains the black-white difference in stage at diagnosis, we compared the change in the estimated odds ratio from Models 1 and 2. Prior mammography use alone significantly reduced the estimated crude odds ratio for late-stage disease comparing black with white women from 1.78 to 1.49 and explained nearly 37% of the excess late-stage breast cancer observed among black women.

To determine the extent to which prior mammography use explains the black-white difference in stage at diagnosis after the other factors are taken into account, we compared the change in the estimated odds ratio from Models 3 and 4 (Table 5). Model 3 presents the association between race and stage after adjusting for sociodemographic and comorbidity information. Further adjustment for prior mammography use (Model 4) reduced the odds ratio from 1.54 to 1.39. Prior mammography use explained 27% of the excess late-stage breast cancer observed among black women once all of the other factors were taken into account.

## 7.0 CONCLUSIONS

We found that prior mammography use was strongly associated with stage at diagnosis in both black and white women aged 65 years and older. Most importantly, we found that among nonusers of mammography, black women were significantly more likely to be diagnosed with late-stage disease than white women; however, among regular users of mammography, we found no difference in stage at diagnosis between black and white women. These results suggest that prior mammography does help to explain the black-white difference in stage at diagnosis among older women.

We found that prior mammography use significantly contributed to the black-white difference in stage at diagnosis. Approximately 37% of the excess late-stage breast cancer among black women was explained by prior mammography use alone. We found that individual (data not shown) and combined adjustment for sociodemographic characteristics and comorbidity produced only modest changes in the race-stage association suggesting that these factors do not adequately explain the excess of late-stage disease among black women. However, prior mammography use explained an additional 27% of the black-white difference in stage at diagnosis after adjusting for sociodemographic characteristics and comorbidity.

Our findings differ from two previous studies that have examined the association of prior mammography use, race, and stage at diagnosis (16, 17). Jones and coworkers examined breast cancer patients enrolled in a Connecticut study and found that prior mammography use was associated with stage only in white women and that mammography use explained less than 10% of the black-white difference in stage at diagnosis after adjusting for age (16). Hunter and coworkers examined data from the Black/White Cancer Surveillance Study and found that prior mammography use was associated with stage at diagnosis only in black women. Although the authors did not quantify the explanatory power of mammography use, it did not appreciably alter the race-stage association (17).

Four major differences in the design of these studies may contribute to the discordant results. First, the present study focused on older women. We studied women aged 67 years and older and imposed no upper age limit. The other studies included women 20 to 79 years of age (16, 17). Second, we used a more rigorous definition of prior mammography use. To be considered a regular user, we required women to have had at least two mammograms that were at least 10 months apart within two years prior to their breast cancer diagnosis. The two previous studies required at least one screening mammogram within three years (16) and six years (17) preceding diagnosis. In our study, many of these women would be classified as nonusers of mammography. Third, we used the historical staging system as it was available for all women whereas the more precise TNM staging system was used in the previous studies. Fourth, we relied on Medicare claims as opposed to patient's self-report to measure mammography utilization.

There are potential limitations to using Medicare claims data to measure mammography use. First, our study is limited to women enrolled in fee-for-service settings as Medicare data do not capture services rendered to HMO enrollees. Although few women were enrolled in managed care during our study years, the proportion of Medicare HMO enrollees increased from 4% to 13% between 1990 and 1997 (11, 18). It is unclear how mammography use will change as more older women become enrolled in Medicare managed care plans.

Second, Medicare reimbursement policies have changed over time. Medicare began reimbursing providers for biennial screening mammography in 1991 and annual screening mammography in 1998. These changes in reimbursement raise two issues: 1) only diagnostic mammograms were covered during our study years, and 2) subsequent reimbursement for screening mammography has led to greater use among older women.

Although Medicare only paid for diagnostic mammograms during some of our study years, studies show that providers were performing screening mammograms and billing

Medicare under the diagnostic procedure code (7-10). Nevertheless, we cannot determine whether an individual mammogram was done for screening or diagnostic purposes. To address this issue, we took into account how women used mammography over time. We defined our measure of prior mammography use to identify two distinct groups: 1) women who had no evidence of mammography use during the two years prior to diagnosis, and 2) those who demonstrated a pattern of regular mammography use. Regular users were women who had at least two mammograms that were at least 10 months apart. We selected the 10 month interval as a clinically reasonable length of time to assume that women were receiving screening mammography and were not being followed for a suspicious lump. Although those with a pattern of regular use appear to be using mammography as a screening modality, we do not know which women had their cancer detected by symptoms and confirmed with diagnostic mammography.

We also cannot determine whether a clinical breast examination(s) (CBE) was performed. However, 1987 and 1992 National Health Interview Survey data demonstrate that black and white women were similar with respect to receiving a CBE within the previous year (19). Jones and coworkers found that CBE did not contribute to the black-white difference in stage at diagnosis (16). Finally, there is currently no evidence to suggest that CBE contributes additional benefit to screening with mammography. A meta-analysis of mammography trial data reported similar reductions in breast cancer mortality with and without CBE (20).

Several studies show that Medicare reimbursement for biennial screening mammography has generated an overall increase in mammography use among older women, but that this change in policy has not been sufficient to eliminate black-white differences in mammography use (7, 8, 21). Medicare data from 1993 demonstrates a pronounced lower rate of mammography use among older black women as compared with older white women (18% versus 26%, respectively) (7). A recent Connecticut study found that Medicare reimbursement

had a limited impact on mammography use among women during the first few years of implementation and that mammography rates continued to be low, particularly among older black women (21).

Greater mammography use has led to a shift toward earlier stage at diagnosis for all women (22, 23). However, this shift is not as great for black women as it is for white women which is consistent with their persistently lower mammography use (23, 24). In fact, the most recent SEER Public Use data from 1994 indicate that black women age 65 years and older continue to be diagnosed with late-stage breast cancer more often than their white counterparts (36% versus 27%, respectively) (unpublished data from the SEER CD-ROM).

Many factors, including those related to access to health care, the physician, and the patient, have been shown to contribute to the disparity in mammography use among black and white women and may be partly responsible for the persistent racial gap in stage at diagnosis. Blustein found that Medicare enrollees who also had supplemental insurance had greater mammography use than those who only had Medicare. However, even among those with supplemental insurance, black women had lower rates of mammography use (8). Previously, we found that greater mammography use was associated with an increasing number of visits to a primary care provider among black and white women, but that receiving primary care was not enough to correct the disparity in mammography use between black and white women (10). Furthermore, many studies show that a physician's recommendation is the most important determinant of mammography use (25-27). O'Malley and coworkers found that a physician's recommendation accounted for 60% to 75% of the black-white difference in mammography use (27). Lack of a physician recommendation was the most commonly cited reason for not having had a mammogram among older black women in National Health Interview Survey (6). Other studies show that patients' knowledge relates to their behaviors and that black women are less

knowledgeable regarding the importance of detecting breast cancer early using mammography (6, 28).

Other potential limitations include misclassification bias, residual confounding, and a small number of black women. We measured SES and comorbid illness using proxies as direct measures were not available. SES was measured by assigning each woman to the median income of her residence using census data. This methodology has been employed in several breast cancer studies (29-33) and may capture unknown characteristics related to a person's neighborhood of residence, such as access to care or environmental exposures (33-34). Although we could only estimate comorbidity for women who were hospitalized, information was available for three-quarters of our sample because many women were hospitalized around the time of their breast cancer diagnosis. Because black women were somewhat less likely to be hospitalized, they appeared to be healthier than white women in our study. This may, in fact, be an artifact as we observed among hospitalized women that blacks tended to have more comorbidity than whites. We chose to present analyses adjusted for comorbidity because analyses that excluded comorbidity variables achieved similar results.

Although our study sample was derived from three population-based tumor registries, there were relatively few black women as a result of the demographic characteristics of women on Medicare in these states. Among women covered by Medicare in 1990, blacks represented only 1% of women in Washington, 3% of women in Connecticut, and 20% of women in Georgia (10). Similarly, due to low rates of mammography use among older women in general and black women in particular (10), only a few black women were regular users of mammography in our sample. Nevertheless, their experience was identical to that of white regular users. Only 19% of regular users were diagnosed with late-stage disease -- which was substantially better than nonusers regardless of whether they were black or white.

The present study highlights the importance of regular mammograms for all older women. We found that among women who were regular users of mammography there was no black-white difference in stage at diagnosis suggesting that older black women may benefit from regular mammography use to a similar extent as older white women. Our findings suggest that differences in stage at diagnosis between older black and white women are associated with mammography use. Further, increased regular mammography use may result in a shift toward earlier stage disease and narrow the differences in stage at diagnosis between older black and white women.

## 8.0 REFERENCES

1. **Yancik R, Ries LG, Yates JW.** Breast cancer and aging women: a population-based study of contrasts in stage, surgery and survival. *Cancer.* 1989;63:976-981.
2. **Satariano WA, Belle SH, Swanson GM.** The severity of breast cancer at diagnosis: A comparison of age and extent of disease in black and white women. *Am J Public Health.* 1986;76:779-782.
3. **Holmes FF, Hearne E.** Cancer stage-to-age relationship: implications for cancer screening in the elderly. *J Am Geriatr Soc.* 1981;29:55-57.
4. **Goodwin JS, Samet JM, Key CR, Humble C, Kutvirt D, Hunt C.** Stage at diagnosis of cancer varies with the age of the patient. *J Am Geriatr Soc.* 1986;34:20-26.
5. **Ries LAG, Kosary CL, Hankey BF, Miller BA, HARRAS A, Edwards BK (eds).** *SEER Cancer Statistics Review, 1973-1994: Tables and Graphs.* Bethesda, MD: National Cancer Institute; 1997. NIH Publication 97-2789.
6. **Caplan LS, Wells BL, Haynes S.** Breast cancer screening among older racial/ethnic minorities and whites: Barriers to detection. *J Gerontol.* 1992;47:101-110.
7. Use of mammography services by women aged  $\geq 65$  years enrolled in Medicare - United States, 1991-1993. *MMWR Morb Mortal Wkly Rep.* 1995;44(41):777-781.
8. **Blustein J.** Medicare coverage, supplemental insurance, and the use of mammography by older women. *N Engl J Med.* 1995;332:1138-1143.
9. **Burns RB, McCarthy EP, Freund KM, Marwill SL, Shwartz M, Ash AS, Moskowitz MA.** Variability in mammography use among older women. *J Am Geriatr Soc.* 1996;44:922-926.
10. **Burns RB, McCarthy EP, Freund KM, Marwill SL, Shwartz M, Ash AS, Moskowitz MA.** Black women receive less mammography even with similar use of primary care. *Ann Intern Med.* 1996;125:173-182.

11. **Potosky AL, Riley GF, Lubitz JD, Mentnech RM, Kessler LG.** Potential for cancer related health services research using a Linked Medicare-Tumor Registry Database. *Med Care.* 1993;31:732-748.
12. **Deyo RA, Cherkin DC, Ciol MA.** Adapting a clinical comorbidity index for use with ICD-9-CM administrative database. *J Clin Epidemiol.* 1992;45:613-619.
13. SAS Institute. *SAS/STAT User's Guide, Version 6, Fourth Edition, Volumes 1 and 2.* Cary, NC: SAS Institute; 1992.
14. **Hosmer DW, Lemeshow S.** *Applied Logistic Regression.* New York: John Wiley & Sons, Inc; 1989.
15. **Greenland S.** Modeling and variable selection in epidemiologic analysis. *Am J Public Health.* 1989;340-349.
16. **Jones BA, Kasl SV, Curnen GMG, Owens PH, Dubrow R.** Can mammography screening explain the race difference in stage at diagnosis of breast cancer? *Cancer.* 1995;75:2103-2113.
17. **Hunter CP, Redmond CK, Chen VW, Austin DF, Greenberg RS, Correa P, et al.** Breast cancer: Factors associated with stage at diagnosis in black and white women. *J Natl Cancer Inst.* 1993;85:1129-1137.
18. Bureau of Data Management and Strategy, Health Care Financing Administration. 1997 *Data Compendium.* Baltimore, MD: U.S. Department of Health and Human Services, Health Care Financing Administration; 1997. Publication no. 03395.
19. Trends in cancer screening - United States, 1987 and 1992. *MMWR Morb Mortal Wkly Rep.* 1995;45(3):57-61.
20. **Kerlikowske K, Grady D, Rubin SM, Sandrock C, Ernster VL.** Efficacy of screening mammography: a meta-analysis. *JAMA.* 1995;273:149-154.

21. **Preston JA, Scinto JD, Ni W, Wang Y, Galusha D, Shultz, AF, Petrillo MK.** Mammography underutilization among older women in Connecticut. *J Am Geriatr Soc.* 1997;45:1310-1314.
22. **Sondik EJ.** Breast cancer trends. Incidence, mortality, and survival. *Cancer.* 1994;74:995-999 (supplement).
23. **Swanson GM, Satariano ER, Satariano WA, Threatt BA.** Racial differences in the early detection of breast cancer in metropolitan Detroit, 1978 to 1987. *Cancer.* 1990;66:1267-1301.
24. **Swanson GM, Ragheb NE, Lin CS, Hankey BF, Miller B, Horn-Ross P, et al.** Breast cancer among black and white women in the 1980's: changing patterns in the United States by race, age, and extent of disease. *Cancer.* 1993;72:788-798.
25. **Zapka JG, Stoddard AM, Costanza ME, Greene HL.** Breast cancer screening by mammography utilization and other factors. *Am J Public Health.* 1989;79:1499-1502.
26. **Hayward RA, Bernard AM, Freeman HE, Corey CR.** Regular source of ambulatory care and access to health services. *Am J Public Health.* 1991;81:434-438.
27. **O'Malley MS, Earp J, Harris RP.** Race and mammography use in two North Carolina Counties. *Am J Public Health.* 1997;87:782-786.
28. **Burack RC, Liang J.** The acceptance and completion of mammography by older black women. *Am J Public Health.* 1989;79:721-726.
29. **Dayal HH, Power RN, Chiu C.** Race and socio-economic status in survival from breast cancer. *J Chron Dis.* 1982;35:675-683.
30. **Wells BL, Horm JW.** Stage at diagnosis in breast cancer: Race and socioeconomic factors. *Am J Public Health.* 1992;82:1383-1385.

31. **Farley TA, Flannery JT.** Late-stage diagnosis of breast cancer in women of lower socioeconomic status: Public health implications. *Am J Public Health.* 1989;79:1508-1512.
32. **Ayanian JZ, Kohler BA, Abe T, Epstein AM.** The relation between health insurance coverage and clinical outcomes among women with breast cancer. *New Engl J Med.* 1993;329:326-331.
33. **Mandelblatt J, Andrews H, Kerner J, Zauber A, Burnett W.** Determinants of late stage at diagnosis of breast and cervical cancer: The impact of age, race, social class, and hospital type. *Am J Public Health.* 1991;81:646-649.
34. **McWhorter WP, Schatzkin AG, Horm JW, Brown CC.** Contribution of socioeconomic status to black/white differences in cancer incidence. *Cancer.* 1989;63:982-987.

**9.0 APPENDIX**

9.1 Table 1. Characteristics of the Study Sample by Race

	White (n=9,513)	Black (n=437)	Total (n=9,950)
	n (%)	n (%)	n (%)
<b>SEER Area<sup>†</sup></b>			
Connecticut	4711 (49)	126 (29)	4837 (49)
Seattle	3398 (36)	38 (9)	3436 (34)
Atlanta	1404 (15)	273 (62)	1677 (17)
<b>Age at Diagnosis</b>			
67-74	4453 (47)	217 (50)	4670 (47)
75-84	3982 (42)	182 (41)	4164 (42)
≥ 85	1078 (11)	38 (9)	1116 (11)
<b>Married at Diagnosis<sup>†</sup></b>			
No	5786 (61)	342 (78)	6128 (62)
Yes	3727 (39)	95 (22)	3822 (38)
<b>Median Income of Zip Code<sup>†‡</sup></b>			
≥ \$15,000	9444 (99)	368 (84)	9812 (99)
< \$15,000	48 (1)	68 (16)	116 (1)
<b>Comorbidity<sup>†</sup></b>			
No Hospitalizations	2388 (25)	123 (28)	2511 (25)
0	5053 (53)	190 (44)	5243 (53)
≥ 1	2072 (22)	124 (28)	2196 (22)

Table 1. Characteristics of the Study Sample by Race (Cont.)

	White (n=9,513)	Black (n=437)	Total (n=9,950)
	n (%)	n (%)	n (%)
<b>Mammography<sup>†</sup></b>			
Nonuser	1885 (20)	134 (31)	2019 (20)
Regular User	2405 (25)	78 (18)	2483 (25)
Peri-Diagnosis User	5223 (55)	225 (51)	5448 (55)
<b>Stage at Diagnosis<sup>*</sup></b>			
Early	6752 (71)	286 (65)	7038 (71)
Late	2761 (29)	151 (35)	2912 (29)

<sup>\*</sup>p = 0.013.

<sup>†</sup>p < 0.001.

<sup>‡</sup> There were 22 women with missing income data.

9.2 **Table 2. Bivariate Associations with Late-Stage Disease among Mammography Nonusers and Regular Users (n = 4,502)**

	% Late-Stage		
	n	Disease	OR (95% CI)
<b>Race<sup>†</sup></b>			
White	4290	29	1.00 <sup>‡</sup>
Black	212	42	1.78 (1.34-2.35)
<b>SEER Area<sup>†</sup></b>			
Seattle	1535	24	1.00 <sup>‡</sup>
Connecticut	2181	32	1.45 (1.25-1.68)
Atlanta	786	32	1.51 (1.25-1.83)
<b>Age at Diagnosis<sup>†</sup></b>			
67-74	2198	27	1.00 <sup>‡</sup>
75-84	1827	30	1.20 (1.04-1.37)
≥ 85	477	35	1.49 (1.20-1.83)
<b>Married at Diagnosis<sup>†</sup></b>			
No	2670	32	1.00 <sup>‡</sup>
Yes	1832	26	0.76 (0.66-0.87)
<b>Median Income of Zip Code<sup>†</sup></b>			
≥ \$15,000	4436	29	1.00 <sup>‡</sup>
< \$15,000	57	47	2.22 (1.31-3.74)
<b>Comorbidity Score<sup>†</sup></b>			
No Hospitalizations	1279	20	1.00 <sup>‡</sup>
0	2309	31	1.79 (1.52-2.10)
≥ 1	914	37	2.36 (1.95-2.85)

	% Late-Stage		
	n	Disease	OR (95% CI)
<b>Mammography<sup>†</sup></b>			
Regular Users	2483	19	1.00 <sup>‡</sup>
Nonusers	2019	42	3.04 (2.66-3.48)

<sup>\*</sup>p = 0.002.

<sup>†</sup>p < 0.001.

<sup>‡</sup>Fixed reference category.

9.3 Table 3. Crude Odds Ratios for Late-Stage Disease Comparing Nonusers with Regular Users by Race (n = 4,502)

Late-Stage Disease	Black Women		White Women		OR (95% CI)
	Nonuser	Regular User	Nonuser	Regular User	
	n (%)	n (%)	n (%)	n (%)	
Yes	73 (55)	15 (19)	768 (41)	457 (19)	2.93 (2.56-3.36)
No	61 (45)	63 (81)	1117 (59)	1948 (81)	

9.4 Table 4. Crude and Adjusted Odds Ratios for Late-Stage Disease Comparing Black with White Women by Prior Mammography Use (n = 4,502)

Late-Stage Disease	Nonuser		Regular User					
	Black	White	Crude OR	Adjusted* OR	Black	White	Crude OR	Adjusted* OR
	n (%)	n (%)	(95% CI)	(95% CI)	n (%)	n (%)	(95% CI)	(95% CI)
Yes	73 (55)	768 (41)	1.74	1.54	15 (19)	457 (19)	1.02	1.01
No	61 (45)	1117 (59)	(1.22-2.48)	(1.04-2.28)	63 (81)	1948 (81)	(0.57-1.80)	(0.54-1.88)

\*Adjusted for SEER area, age, marital status, income of ZIP code of residence, and comorbidity.

**9.5 Table 5. Odds of Late-Stage Disease among Blacks Compared to Whites from Logistic Regression Analysis (n = 4,502)**

Variables in Model	Odds Ratio (95% CI)
1. Black Race	1.78 (1.34-2.35)
2. Black Race, Mammography Use	1.49 (1.11-1.99)
3. Black Race, Sociodemographic*, Comorbidity	1.54 (1.13-2.11)
4. Black Race, Sociodemographic*, Comorbidity, Mammography Use	1.39 (1.01-1.92)

\*Sociodemographic variables include SEER area, age, marital status, and income of ZIP code of residence.

## **10.0 BIBLIOGRAPHY**

### **Doctoral Dissertation of Ellen Patricia McCarthy, M.P.H.**

Prior mammography utilization: Does it explain black-white differences in breast cancer outcomes?

Submitted and Accepted by the Tulane University Graduate School, Department of Epidemiology, December 5, 1996. Published by UMI Dissertation Services, Ann Arbor, MI, UMI number 9731951, 1997.

### **Manuscript**

McCarthy EP, Burns RB, Coughlin SS, Freund KM, Rice J, Marwill SL, Ash A, Shwartz M, Moskowitz M. Mammography use helps to explain differences in breast cancer stage at diagnosis between older black and white women. *Ann Intern Med* 1998 (in press). The expected publication date for this manuscript is May 1, 1998.

### **Abstract**

Prior mammography use: Does it explain black-white differences in stage at diagnosis? *J Gen Intern Med* 1996;11(suppl 1):80A.

### **Oral Presentations Given by Ellen P. McCarthy**

- Presented at the Society of General Internal Medicine annual meeting, Washington, DC, May 1996.
- Presented at the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) Program's annual meeting of SEER principal investigators, Bethesda, MD, October 1996.
- Presented at the Department of Defense, United States Army Medical Research and Materiel Command (USAMRMC) Breast Cancer Program "Era of Hope" meeting, Washington, DC, October 1997.

## **11.0 PAID PERSONNEL**

The following personnel received pay from this grant:

**Ellen P. McCarthy, Ph.D., M.P.H., USAMRMC Predoctoral Fellowship Recipient.** Dr. McCarthy graduated from the Tulane University Graduate School with a Doctor of Philosophy degree in Epidemiology in December 1996. Dr. McCarthy completed this study while employed by the Section of General Internal Medicine, Department of Medicine, Boston University Medical Center, Boston, MA 02118. Dr. McCarthy is currently an Instructor in Medicine in the Division of General Medicine and Primary Care, Department of Medicine, Beth Israel Deaconess Medical Center, Harvard Medical School, 330 Brookline Avenue, Libby 326, Boston, MA 02215.

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## **12.0 ACKNOWLEDGMENT**

This study used the Linked Medicare-Tumor Registry Database. The interpretation and reporting of these data are the sole responsibility of the authors. The authors acknowledge the efforts of several groups responsible for the creation and dissemination of the Linked Database, including the Applied Research Branch, Division of Cancer Prevention and Control, National Cancer Institute; the Office of Research and Demonstrations, and the Bureau of Data Management and Strategy, Health Care Financing Administration; the Information Management Services (IMS), Inc.; and the Surveillance, Epidemiology, and End Results (SEER) Program Tumor Registries.