Can Differences in Breast Cancer Utilities Explain Disparities in Breast Cancer Care?

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BACKGROUND: Black, older, and less affluent women are less likely to receive adjuvant breast cancer therapy than their counterparts. Whereas preference contributes to disparities in other health care scenarios, it is unclear if preference explains differential rates of breast cancer care.

OBJECTIVE: To ascertain utilities from women of diverse backgrounds for the different stages of, and treatments for, breast cancer and to determine whether a treatment decision modeled from utilities is associated with socio-demographic characteristics.

PARTICIPANTS: A stratified sample (by age and race) of 156 English-speaking women over 25 years old not currently undergoing breast cancer treatment.

DESIGN AND MEASUREMENTS: We assessed utilities using standard gamble for 5 breast cancer stages, and time-tradeoff for 3 therapeutic modalities. We incorporated each subject's utilities into a Markov model to determine whether her quality-adjusted life expectancy would be maximized with chemotherapy for a hypothetical, current diagnosis of stage II breast cancer. We used logistic regression to determine whether socio-demographic variables were associated with this optimal strategy.

RESULTS: Median utilities for the 8 health states were: stage I disease, 0.91 (interquartile range 0.50 to 1.00); stage II, 0.75 (0.26 to 0.99); stage III, 0.51 (0.25 to 0.94); stage IV (estrogen receptor positive), 0.36 (0 to 0.75); stage IV (estrogen receptor negative), 0.40 (0 to 0.79); chemotherapy 0.50 (0 to 0.92); hormonal therapy 0.58 (0 to 1); and radiation therapy 0.83 (0.10 to 1). Utilities for early stage disease and treatment modalities, but not metastatic disease, varied with socio-demographic characteristics. One hundred and twenty-two of 156 subjects had utilities that maximized quality-adjusted life expectancy given stage II breast cancer with chemotherapy. Age over 50, black race, and low household income were associated with at least 5-fold lower odds of maximizing quality-adjusted life expectancy with chemotherapy, whereas women who were married or had a significant other were 4-fold more likely to maximize quality-adjusted life expectancy with chemotherapy.

CONCLUSIONS: Differences in utility for breast cancer health states may partially explain the lower rate of adjuvant therapy for black, older, and less affluent women. Further work must clarify whether these differences result from health preference alone or reflect women's perceptions of sources of disparity, such as access to care, poor communication with providers, limitations in health knowledge or in obtaining social and workplace support during therapy.

KEY WORDS: breast cancer; disparities; quality of life; utilities; decision analysis.

DOI: 10.1111/j.1525-1497.2006.00609.x

J GEN INTERN MED 2006; 21:1253-1260.

No conflicts of interest to declare.

Versions of this work were presented at the 2004 Annual Meeting of the NIH Building Interdisciplinary Research Careers in Women's Health (BIRCWH) Program, Bethesda, MD, the 2005 Annual Meeting of the Society of General Internal Medicine, New Orleans, LA, and the 2005 BIRCWH Meeting, Providence, RI.

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There are substantial disparities in breast cancer detection,¹⁻⁸ treatment,⁸⁻¹⁷ and survival.^{8,11-14,18-24} The Institute of Medicine (IOM) has described 4 sources of disparities: access to care, ecology of health care, discrimination, and patient preference among health care options.²⁵ Whereas the IOM defined preference ideally as a choice based on complete understanding of health care options, they emphasized that in reality, preferences may be shaped by biases and discrimination of the health care system, individuals' mistrust of that system as well as limited knowledge of medical options.²⁵ Analysis of preferences may therefore reflect an individuals' perceptions of each potential source of disparities.

Whereas cytotoxic chemotherapy offers a survival advantage for almost all women with breast cancer,²⁶ not all women receive chemotherapy.^{15,16} One decision aid, designed to assist women in making this difficult choice by presenting the absolute survival benefit of chemotherapy based on a woman's prognostic factors and competing risk of mortality, decreased the proportion of women choosing chemotherapy.²⁷ Not only does this demonstrate a difference in preference, but also it suggests differing consideration of quality rather than quantity of life.

Utility is a preference-based measure reflecting the relative desirability of health states, most commonly in comparison with bounds of death (0) and perfect health (1).^{28,29} When survival is weighted by the utilities of experienced health states, measured in quality-adjusted life years (QALYs), preference for quantity or quality of life can be simultaneously assessed. Normatively, individuals should make health care decisions that optimize their QALYs.³⁰ Whereas breast cancer has been the topic of more cost-effectiveness analyses than any other malignancy,³¹ most single studies have collected utilities for a limited range of breast cancer health states or treatments, and from populations of limited diversity.

The objectives of our analysis were 2-fold. We first wanted to determine utilities for all stages of breast cancer, and 3 modalities of treatment. Secondly, we wanted to determine whether a breast cancer treatment decision, modeled from participants' utilities, reflecting preference in the applied sense rather than the IOM's ideal definition, was associated with socio-demographic characteristics.

METHODS

We assessed utilities from a convenience sample of socio-demographically diverse women using standard gamble and time-tradeoff techniques for 8 breast cancer health states: 5 stages of disease and 3 treatments. Based on each woman's utilities, we determined if, given a present diagnosis of stage II breast cancer, she would optimize her quality-adjusted life expectancy with or without chemotherapy. We then used a logistic regression model to determine whether socio-demographic variables

Manuscript received April 4, 2006

Initial editorial decision May 18, 2006

Final acceptance July 10, 2006

were associated with the optimal strategy. The Rhode Island Hospital Institutional Review Board approved the protocol.

Participants

Between August 2003 and June 2004, we recruited a convenience sample of English-speaking women over 25 years of age from primary care clinics and the community. Women currently undergoing treatment for breast cancer were excluded on the grounds that they may respond to rationalize their decision, as opposed to projecting a future decision.³²

Given an absence of data on the variance of decisions modeled from utilities, we sought to assure representation of multiple groups and to avoid sparse categories that could be detrimental to our planned statistical analysis. We created a recruitment matrix based on race (Caucasian, African American, or other) and age (dichotomized at 50) and targeted 33 women from each of these 6 strata to allow exploration of further categories in our regression analyses. All participants provided written informed consent and were compensated for their time.

Health State Descriptions

With the assistance of a team of breast cancer specialists, we developed descriptions for 8 health states. These included 5 stages of disease based on the TNM classification system of the American Joint Committee on Cancer³³: stage I, stage II, stage III, stage IV receptor positive, and stage IV receptor negative (Appendix, available online). We divided stage IV by hormone receptor status due to the differences in treatment, and treatment-related side effects. Also included were 3 treatment modalities: chemotherapy, radiation therapy, and hormonal therapy.

Descriptions of disease stages included anticipated physical symptoms and the risk of recurrence, which may affect psychological well-being.^{34–37} Utility has previously been used as a metric to assess the value of variation in recurrence risk.³⁸ Descriptions of treatment modalities covered a full calendar year. This included active treatment, for which we described the frequency and nature of physician visits, testing, and side effects such as fatigue and hair loss. Each treatment year description also included a recovery phase, during which side effects resolved. An oncology nurse specialist with expertise in evaluating the concerns of patients and presenting information in lay terms reviewed all descriptions for patient level comprehension.

Utility Assessments

We began each face-to-face interview by asking each participant's age, race, highest level of education, marital status, household income, and knowledge of others with breast cancer. We also collected data to compute each individual's 5-year and lifetime risk of breast cancer according to the Gail model.³⁹

We then elicited each of the 8 utilities from each participant. We presented health state descriptions both verbally and in writing, and asked participants to imagine themselves in that health state. For stages of disease, we elicited utilities with the standard gamble,³⁰ comparing 10-year survival in the state of interest to a gamble between the best imaginable health for 10 years and some probability of instant painless death. We specified 10 years for all participants because util-

ities for the same hypothetical health state may vary with the duration considered,^{40,41} and 10 years was the interval preferred by most women in considering future health risks.⁴² We used the bisection method to reach a point of indifference and presented probabilities both verbally and with a color wheel.⁴³

We elicited treatment utilities with the time-tradeoff,⁴⁴ based on the 1 year description for treatment and recovery. For these temporary health states, time-tradeoff was more easily understood and less complex than the standard gamble, which would have required a 2-stage approach⁴⁵ with a potential for bias.⁴⁶ We explained both verbally and graphically that her lifetime after the year in question was unaffected by the time-tradeoff. We used the bisection technique to reach a point of indifference. The order of health states was randomized for each subject, although time-tradeoff and standard gamble assessments were grouped, to avoid confusion. Interviews lasted between 40 and 60 minutes.

Markov Model

To determine whether differences in utilities produced differences in preferred treatment, we created a simple Markov model depicting the decision to undergo chemotherapy following resection of a stage II malignancy (Fig. 1), which we evaluated from an individual perspective. Most data elements in our model remained constant to isolate the effect of variation in utilities (Table 1). To reflect the observation that individuals view near future changes in health as more important than the identical change in health in the distant future,⁴⁷ we discounted health outcomes. Whereas the magnitude of time preference varies between individuals,⁴⁷ we used a fixed discount rate of 3% to isolate the effects of variation in utilities. We assumed that women were at risk for recurrence for 10 years, that recurrence implied metastatic disease and that women who did not recur by 10 years were cured of disease. Chemotherapy reduced the risk of recurrence, and thereby mortality, and was constant in efficacy for all women.

We incorporated each participant's utilities into the model, using stage IV utility as a surrogate for metastatic disease. We calculated the disutility of chemotherapy, and subtracted this value from the quality-adjusted life expectancy of that strategy.²⁹ We also accounted for age-related mortality, excluding breast cancer mortality, which we explicitly modeled.⁴⁸

For each participant and each treatment option, we used the yearly cycling model to simulate each participant's quality-adjusted life expectancy. The number of cycles was determined by the age of the participant, the probability of breast cancer and age-related mortality, and her utilities, and was therefore not uniform across participants, nor between treatment options for a given participant. We defined the preferred treatment as that which produced the greater quality-adjusted life expectancy, and used this as a proxy for the treatment decision. We calculated the difference in quality-adjusted life expectancy for each participant, as well as the mean of this measure among all participants.

Statistical Considerations

Each participant provided 8 different utilities: 1 for each stage of disease and for each treatment modality. Utility comparisons between health states had to account for the within per-

FIGURE 1. Schematic representation of the Markov model. The square node on the left of the diagram depicts the simulated decision to accept or reject chemotherapy. Markov states are depicted in boxes. All subjects begin in the Stage II Markov state. In each yearly cycle, subjects are at risk both for age-related mortality (excluding the index breast cancer) and for progression of disease. If breast cancer progresses, subjects begin the next cycle in the Metastatic Disease state, and are at risk for breast cancer mortality, in addition to age-related mortality. Women without recurrence by 10 years were deemed cured. Annual cycles continued, simulating each participant's life expectancy under each treatment option.

son correlation. To do this, we used paired *t* tests. We also considered a nonparametric approach, but this provided no additional information beyond confirmation of our parametric approach. We assessed between group differences in utility scores for each health state with 1-way analysis of variance using Huber-White robust standard errors to adjust for the correlation.

We planned multivariate regressions for utilities for each health state, using socio-demographic characteristics as independent variables. Covariates to be considered in our regression models were constructed as follows. Age was dichotomized at 50, as in our recruitment strategy, and race was categorized as white, black, or other. We dichotomized socioeconomic status at household income under \$25,000. To distinguish those with an established social partner, we grouped women who reported being married or having a significant other. We used 2 variables to represent familiarity with breast cancer, one for a family member with breast cancer, and a second for a friend or acquaintance with breast cancer. Using the Gail model,³⁹ we defined high-risk as having either a 25% lifetime or a 2.5% 5-year risk of breast cancer.

To identify the total effect of a covariate on a utility, we first performed univariate analyses. Then, to identify the direct

effect of each covariate, we forced all independent variables into a multivariate model, and considered all possible interaction terms. Regression models on individual utilities demonstrated extreme heteroscedasticity, likely due to the number of participants providing utilities of 0 or 1. Data transformations and application of generalized linear models using robust standard errors did not improve model fit. Because our primary purpose was to explore the relationship between socio-demographic factors and a behavior modeled from multiple utilities, we excluded these analyses, and focused on the following logistic regression models.

We used logistic regression to determine if the preferred treatment from the Markov model was associated with socio-demographic factors. We modeled preference for chemotherapy, meaning that chemotherapy resulted in greater quality-adjusted life expectancy for that participant. In this context, we considered univariate analyses to assess the total effect of each covariate on the simulated treatment decision, and then forced all independent variables into a multivariate model to define the direct effect of each covariate. As is typically the case, we sought a balance between prediction and parsimony. We used both scientific and statistical criteria (sequential sum of squares, comparison of likelihoods and

Table 1. Markov Model Inputs

Definition	Value	Source
Annual probability of recurrence	.05	NCI. Surveillance Epidemiology and End Results (SEER) ⁵⁶
Annual probability of death given metastatic disease	.32	NCI. Surveillance Epidemiology and End Results (SEER) ⁵⁶
Efficacy of chemotherapy (RR)	0.8	Early Breast Cancer Trialists' Collaborative Group (EBCTCG) ²⁶
Utility of cured health state*	1	Assumed

RR, relative risk.

*Cure was assumed for individuals surviving 10 years from diagnosis without recurrence.

Akaike Information Criterion) to evaluate model fit and to identify a final, reduced form of the regression model. All analyses were done using JMP (SAS Institute Inc., Cary, NC) and Stata 8.0 (Stata Corporation, College Station, TX) using Huber-White robust standard errors.

RESULTS

Participants

We recruited 156 English-speaking women from primary care clinics and the community. Over half of our participants were nonwhite and participants were also diverse in level of education, household income, and marital status (Table 2). Sixty percent of subjects had a family member or acquaintance with a history of breast cancer. Women had received mammograms in an age related pattern consistent with current guidelines: 12 of 41 (29%) women under age 40, 36 of 43 (84%) women between 40 and 49, and 70 of 72 (97%) women age 50 or over.

Utilities

Utilities for successively higher stages of disease were each significantly lower than the preceding stage (all $P < .05$) with the exception of the variations on stage IV disease ($P = .7$). Median utilities and interquartile ranges were: stage I, 0.91 (0.50 to 1.00), stage II, 0.75 (0.26 to 0.99), stage III, 0.51 (0.25 to 0.94), stage IV ER+, 0.36 (0 to 0.75); and stage IV ER-, 0.40 (0 to 0.79). Utilities for each treatment modality were distinct from one another as well (all $P < .05$). Median utilities were: chemotherapy, 0.50 (0 to 0.92), hormonal therapy, 0.58 (0 to

1), and radiation therapy, 0.83 (0.10 to 1). Unsolicited participant comments indicated that concerns for weight gain and risk of secondary malignancy with hormonal therapy were particularly important.

Utilities for less advanced disease varied by socio-demographic characteristics. Black, less affluent, and less educated women had significantly lower utilities than their counterparts (Table 3). Participants from all backgrounds considered metastatic disease to be equally disabling. Women with social partners (spouse or significant other) cited higher utilities for all treatment modalities, whereas racial minorities and less affluent women noted lower utilities for hormonal therapy.

Markov Model

Assuming a current diagnosis of surgically resected stage II breast cancer for each participant, chemotherapy increased average quality-adjusted life expectancy by 0.42 QALYs. Benefits were not universal, however. Only 122 of 156 (78.2%) participants optimized quality-adjusted life expectancy with chemotherapy. Individual differences in quality-adjusted life expectancy ranged from a loss of 1.01 QALYs with chemotherapy to a gain of 1.36 QALYs.

Regression Analysis

In univariate analyses, 3 characteristics identified women with significantly lower odds of maximizing quality-adjusted life expectancy with chemotherapy: age over 50, black race, and low household income (Table 4). The odds that chemotherapy was optimal were significantly increased for women with social partners.

Our results changed little in the multivariate analysis, with the exception of a loss of significance for marital status. No interaction terms significantly contributed to model fit, so our model reduced to the 4 variables identified in univariate analysis without loss of predictive power.

DISCUSSION

With this study, we provide utilities covering the full spectrum of breast cancer health states, elicited from a socio-demographically diverse population. Utilities for lower stages of disease varied with socio-demographic characteristics, but those for metastatic disease did not. Women with social partners considered all therapeutic modalities less disabling than did women without partners. In a simulated decision based on these utilities more than 20% of our sample optimized their quality-adjusted life expectancy without chemotherapy. These women were more likely to be black, single, over 50 years old, and less affluent than women who maximized QALYs with chemotherapy. The reason that chemotherapy did not maximize QALYs was not uniform across socio-demographic characteristics. Black and less affluent women, because of their lower utility for stage II disease, experienced a smaller decrement in utility with disease progression. In contrast it was higher utility for the treatment itself that translated to a greater proportion of women with social partners favoring chemotherapy.

Our work differs from a similarly structured analysis that addressed the decision to seek surgery for lung cancer.⁴⁹ Whereas both analyses found racial differences in utilities, there was no racial variation in the modeled decision to un-

Table 2. Participant Characteristics

	Number (N=156)	Percent
Age ≥ 50	72	46.2
Race		
White	75	48.1
Black	64	41.0
Asian	3	1.9
American Indian	14	9.0
Hispanic	13	8.3
Education		
Not a high school graduate	32	20.5
High school graduate	54	34.6
Some college	42	26.9
College graduate	10	6.4
Post graduate or professional	18	11.5
Household income*		
<\$10,000	47	31.5
\$10 to 25,000	29	19.5
\$25 to 50,000	42	28.2
\$50 to 100,000	20	13.5
>\$100,000	10	6.7
Marital status		
Married	45	28.8
Significant other	17	10.9
Single	34	21.8
Separated	6	3.9
Divorced	29	18.6
Widowed	25	16.0
Postmenopausal	95	60.9
Prior mammogram	118	75.6
Prior breast biopsy	29	17.9
Family member with breast cancer	77	49.4
Friend with breast cancer	77	49.4
High-risk for breast cancer	15	9.6

*Eight subjects either did not know or did not report household income.

Table 3. Variation in Utilities by Socio-Demographic Characteristics

Variable	Disease Stages					Treatments		
	Stage I	Stage II	Stage III	Stage IV –	Stage IV +	Chemotherapy	Hormonal	Radiation
	Mean (95% CI)							
Overall	0.68 (± 0.06)	0.61 (± 0.06)	0.56 (± 0.06)	0.42 (± 0.06)	0.41 (± 0.06)	0.48 (± 0.06)	0.54 (± 0.07)	0.61 (± 0.07)
Race								
White	0.79 (± 0.08)	0.72 (± 0.07)	0.64 (± 0.08)	0.41 (± 0.09)	0.38 (± 0.08)	0.53 (± 0.09)	0.65 (± 0.09)	0.68 (± 0.09)
Black	0.56 (± 0.10)	0.48 (± 0.10)	0.46 (± 0.09)	0.43 (± 0.10)	0.43 (± 0.10)	0.45 (± 0.10)	0.45 (± 0.10)	0.54 (± 0.11)
Other	0.72 (± 0.19)	0.64 (± 0.19)	0.59 (± 0.16)	0.39 (± 0.18)	0.45 (± 0.18)	0.40 (± 0.18)	0.44 (± 0.20)	0.54 (± 0.21)
P value	.002	<.001	.01	.92	.59	.31	.009	.11
Age								
<50	0.72 (± 0.07)	0.66 (± 0.08)	0.61 (± 0.07)	0.45 (± 0.08)	0.44 (± 0.08)	0.48 (± 0.08)	0.60 (± 0.09)	0.63 (± 0.08)
≥ 50	0.64 (± 0.10)	0.55 (± 0.10)	0.51 (± 0.09)	0.37 (± 0.09)	0.37 (± 0.09)	0.48 (± 0.09)	0.47 (± 0.10)	0.58 (± 0.10)
P value	.22	.09	.08	.18	.24	.92	.06	.52
Education								
≤ High school	0.61 (± 0.08)	0.52 (± 0.08)	0.48 (± 0.08)	0.42 (± 0.08)	0.39 (± 0.08)	0.48 (± 0.08)	0.50 (± 0.09)	0.60 (± 0.09)
> High school	0.77 (± 0.08)	0.71 (± 0.08)	0.66 (± 0.08)	0.41 (± 0.09)	0.43 (± 0.09)	0.48 (± 0.09)	0.59 (± 0.10)	0.61 (± 0.10)
P value	.01	.001	.001	.84	.46	.88	.19	.91
Household income								
≥ \$25,000	0.79 (± 0.08)	0.73 (± 0.08)	0.67 (± 0.07)	0.40 (± 0.08)	0.40 (± 0.08)	0.54 (± 0.08)	0.64 (± 0.09)	0.66 (± 0.09)
< \$25,000	0.58 (± 0.09)	0.48 (± 0.08)	0.45 (± 0.08)	0.43 (± 0.09)	0.42 (± 0.09)	0.42 (± 0.09)	0.44 (± 0.09)	0.56 (± 0.10)
P value	<.001	<.001	<.001	.57	.73	.07	.003	.13
Marital status								
Partner	0.74 (± 0.09)	0.68 (± 0.08)	0.62 (± 0.08)	0.41 (± 0.09)	0.38 (± 0.09)	0.57 (± 0.09)	0.68 (± 0.09)	0.72 (± 0.09)
Single	0.65 (± 0.08)	0.56 (± 0.08)	0.52 (± 0.08)	0.42 (± 0.08)	0.43 (± 0.08)	0.42 (± 0.08)	0.45 (± 0.09)	0.53 (± 0.09)
P value	.18	.07	.09	.95	.45	.02	<.001	.01
Breast cancer in family								
Yes	0.75 (± 0.08)	0.68 (± 0.08)	0.61 (± 0.08)	0.41 (± 0.08)	0.38 (± 0.09)	0.47 (± 0.09)	0.53 (± 0.10)	0.58 (± 0.10)
No	0.62 (± 0.09)	0.54 (± 0.09)	0.52 (± 0.08)	0.42 (± 0.09)	0.44 (± 0.09)	0.50 (± 0.08)	0.55 (± 0.09)	0.63 (± 0.09)
P value	.05	.02	.11	.90	.29	.65	.76	.49

Shown are utilities for each health state according to socio-demographic characteristics. Means were compared with 1-way ANOVA. P values < .05 are shown in bold.

Table 4. Association Between Socio-Demographic Characteristics and the Modeled Treatment Decision

Variable	Odds Ratios (95% Confidence Interval)		
	Univariate	Multivariate	Reduced Model
Age over 50	0.05 (0.01 to 0.18)	0.01 (0.002 to 0.07)	0.02 (0.003 to 0.08)
Black race	0.18 (0.08 to 0.43)	0.12 (0.02 to 0.65)	0.18 (0.05 to 0.63)
Other race	1.30 (0.35 to 4.83)	1.15 (0.16 to 8.27)	
More than high school education	1.59 (0.72 to 3.51)	0.30 (0.07 to 1.25)	
<\$25,000 income	0.12 (0.04 to 0.38)	0.05 (0.008 to 0.33)	0.09 (0.02 to 0.40)
Married or significant other	9.37 (2.70 to 32.5)	3.91 (0.92 to 16.7)	4.04 (1.34 to 12.2)
Family with breast cancer	1.59 (0.72 to 3.49)	5.07 (0.85 to 30.3)	
Friend with breast cancer	1.24 (0.57 to 2.69)	0.97 (0.21 to 4.56)	
High Gail risk	0.65 (0.19 to 2.22)	0.18 (0.02 to 1.87)	

Shown are the adjusted odds ratios for the simulated decision to accept chemotherapy for surgically resected stage II breast cancer. Statistically significant values ($P < .05$) are shown in bold. There was little change in predictive power between the multivariate and reduced models (pseudo- R^2 .58 and .53, respectively).

dergo lung cancer surgery. The difference in expected survival between treatment options was much greater in the lung cancer scenario than in our analysis, potentially overwhelming the effect of differences in utilities.

Our results mirror work on socio-demographic variation in prostate cancer utilities.^{50,51} In one analysis of a predominantly white population, men with a social partner cited higher utilities for incontinence or impotence than men without partners.⁵⁰ In a second study in a more racially diverse population, blacks gave lower utilities than whites for less impaired health states but similar utilities for health states with moderate or severe impairment.⁵¹ We have additionally shown that variation in utility may lead to variation in a modeled treatment decision.

Utilities are multidimensional, representing both physical and mental well-being plus other domains as well, such as finances, family, and spirituality.⁵² We did not instruct participants on domains that they should, or should not, consider in their determination of utilities nor did we pursue the causes for differences in utilities. Participants' utilities may have differed from one another either because they included different domains, valued included domains differently, or because they differed in the degree to which they felt the health state affected one or several domains. Unsolicited participant comments support this hypothesis. Some women mentioned family as important to their responses, but in different ways. Some wanted to be certain about seeing a child's milestones, and were less willing to accept risk of death or trade time, resulting in higher utilities. Others wanted to avoid becoming dependent on their children, accepting greater risk of mortality to avoid debilitated states, resulting in lower utilities.

The characteristics associated with reduced acceptance of chemotherapy in our analysis are analogous to known breast cancer disparities,¹⁻¹⁷ raising the possibility that utilities reflect the IOM defined sources of disparity beyond preference.²⁵ Such sentiments may be less frequently expressed than those relating to family, and none were spontaneously voiced by our participants. Some women may have cited lower utilities due to perceived difficulty in negotiating a medical system with which they have little experience or trust. Lack of insurance, treatment copays, or loss of income during treatment may have led to lower utilities for less affluent women. Certain social considerations, including accommodation or support in the workplace or child-care needs during treatment may also have

affected some women's utilities. Whereas it is appropriate for individuals with these concerns to express different utilities, society may prefer, as evidenced by the IOM report,²⁵ that such domains did not affect health care decisions.

Our analysis has several limitations. Whereas white and black women were well represented in our cohort, other races were not. We did not include women who could not speak English and few of our participants were at high risk for breast cancer. Our results cannot, therefore, be generalized to these groups. Although our participants represent diverse socio-demographic backgrounds, research participants may not represent the population at large.

To isolate the role of utilities in this treatment decision, we assumed that chemotherapy was uniformly efficacious. Although race does not affect response to chemotherapy, the relative risk reduction for older women is less.²⁶ We may, therefore, overestimate the proportion of older women for whom chemotherapy maximizes quality-adjusted life expectancy, biasing our analysis towards the null hypothesis of no difference in treatment decision with age.

We also assumed a fixed discount rate, implying that all participants viewed future identical events similarly. In practice, however, there is substantial person-to-person variation in time preference.⁴⁷ Measuring, and accounting for individual discount rates in addition to utilities may have altered our results.

Our analysis was based on a theoretical decision for which we assumed participants adhered to the axioms of expected utility theory.^{30,53} In practice, however, those axioms are not always upheld.^{46,54,55} Participants may have responded differently if asked directly about selecting chemotherapy for a hypothetical cancer, or if faced with the actual decision. Expected utility remains a useful framework to evaluate differences in the way women consider this decision. In another study of breast cancer patients making an actual chemotherapy decision, older women were less likely to choose treatment than younger women, but neither income nor race had such an association.²⁷ The population studied was predominantly white, however, so the power to detect such a difference was limited.

The proportion of women with utilities favoring chemotherapy in our cohort was greater than the roughly 50% of women with stage II breast cancer who actually receive chemotherapy.^{15,16} The first reason for this discrepancy is that our population included more younger participants than would be anticipated among actual patients. Second, we modeled chem-

otherapy as being equally as efficacious for older women, biasing our model toward acceptance of chemotherapy for older women.

In addition to providing utilities for a complete spectrum of breast cancer disease stages and treatment modalities, we have also found socio-demographic variation both in specific utilities as well as a treatment decision modeled from those utilities in a pattern analogous to known disparities. Further analyses should determine the degree to which causes of disparity beyond preference, including access to care, structure of the health care system and discrimination, influence utilities. Utility theory, manifest in decision models such as ours, may be used to design and evaluate interventions designed to alleviate health care disparities.

This project and Mark Schleinitz were supported by NIH, Office of Research in Women's Health BIRCWH Grant HD43447, administered through Women and Infants' Hospital, Providence, RI.

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Supplementary Material

The following supplementary material is available for this article online at www.blackwell-synergy.com

Appendix: Health State Descriptions