

Racial Differences in Attitudes Toward Innovative Medical Technology*

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BACKGROUND: New medical technologies are used at different rates among whites and blacks. This variation may be partially explained by racial differences in patient innovativeness—the propensity of patients to adopt unfamiliar therapies.

OBJECTIVE: To measure how innovativeness varies among patients and how it may influence patients' attitudes toward new medical technologies.

DESIGN: Cross-sectional survey.

PARTICIPANTS: Primary care patients ($n=171-108$ blacks, 63 whites) at an urban Veterans Affairs medical center.

MEASUREMENTS: Respondents answered questions about their general innovativeness and innovativeness regarding medical technology, and they responded to a vignette describing either a hypothetical new prescription drug or implantable device.

RESULTS: There were no significant racial differences in general innovativeness, but whites had higher medical technology innovativeness ($P=.001$). Whites were also more likely to accept the new prescription drug ($P=.003$), but did not differ from blacks in acceptance of the new implantable device. In multivariate analyses, lower medical technology innovativeness scores among blacks were significantly associated with less favorable reactions to both the prescription drug ($P<.001$) and the medical device ($P<.001$). In contrast, although whites with lower medical technology innovativeness were similarly less inclined to accept the new implantable device ($P=.02$), there was no significant association between medical technology innovativeness and positive attitudes to the new prescription drug among whites.

CONCLUSIONS: Blacks and whites have differing attitudes toward medical innovation. These differences are associated with significant racial differences in response to particular health care technologies. These findings suggest potentially remediable causes for racial differences in the utilization of innovative medical technologies.

KEY WORDS: African Americans; technology; medical; attitude; diffusion of innovation; veterans.

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There are persistent differences in the rates that black and white patients receive new medical technologies such as prescription drugs, implantable devices, and medical procedures.¹⁻⁴ These differences have been found even in the Veterans Health Administration (VA), where access to care is purportedly equal.⁵⁻⁷ Patients' attitudes toward new medical

technologies are important factors influencing the likelihood that a medical procedure or device is received.^{6,7} In particular, patients with a greater propensity to innovate—to readily adopt new and unfamiliar ideas, concepts, processes, tools, or plans—may be more favorably oriented to new drugs, devices, or procedures.^{8,9} Such patients are likely to have higher medical technology utilization rates.⁹ When a technology confers a health benefit, innovative patients would have better health outcomes, on average, than patients who are more averse to new medical technologies.¹⁰

In his landmark studies of diffusion of innovation, sociologist Everett Rogers¹¹ defined the set of attitudes toward new ideas as *innovativeness*. This multicomponent personality trait can be described by a person's response to innovation in 5 distinct domains as follows: (1) relative advantage—perceiving a new idea as better than the old, (2) compatibility—perceiving a new idea as congruent with current beliefs or practice, (3) complexity—perceiving a new idea as straightforward and comprehensible, (4) trialability—perceiving a new idea as a testable concept, and (5) observability—perceiving that a new idea works well for others.¹² Differences in perceptions of a new technology along these 5 domains have been correlated with differences in technology adoption behavior.⁹

Although there is no evidence to suggest that blacks and whites are inherently different in their propensity to innovate, several characteristics identified by Rogers and others as correlated with being an “early adopter” of technology are potentially more likely to be associated, on average, with whites than blacks. These include socioeconomic factors (e.g., higher educational attainment, literacy, and social status, and greater upward social mobility and wealth) and social factors (e.g., greater exposure to new ideas by having greater access to persons outside one's own community, more frequent distant travel, and exposure to a larger number of information sources).¹¹ It is also possible that personality factors associated with innovativeness, such as having a more favorable attitude toward science, greater risk-tolerance, and a heightened belief in the ability of individuals to control their future, may differ between whites and blacks.¹¹

Our study had 3 goals. The first goal was to assess the feasibility of measuring innovativeness among blacks and whites in a VA primary care setting. The second objective was to explore whether differences in innovativeness toward medical technology in general were correlated with differences in attitudes to a hypothetical new implantable medical device or prescription drug. Our third aim was to determine whether

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racial differences in innovativeness persisted after adjustment for important socioeconomic and experiential differences among patients.

METHODS

Instrument Design

We designed a self-administered survey to measure attitudes toward innovation among primary care patients at an urban VA hospital. Patients first recorded their age, sex, race, and ethnicity, and categorized their household income and educational attainment. We then asked patients about their burden of chronic illness, previous experiences with medical technology, current number of prescription medications, and attitudes toward risk-taking. The second section of the survey was a previously validated, 6-item instrument measuring general innovativeness (i.e., attitudes toward new concepts in general).^{13,14} This was followed by a 6-item instrument measuring innovativeness toward medical technology, in which patients were asked their attitudes toward new medical drugs, devices, and procedures. These 6 questions were derived from a previously validated, product-specific innovativeness instrument published in the business marketing literature.¹⁵⁻¹⁷ The general innovativeness instrument was used without modification in its validated form, while the product-specific innovativeness instrument was modified so that the "product" was the phrase "new prescription drugs, medical devices or procedures" and references to "buying the product" were replaced with "asking my doctor if I can try it" (Appendix A).

The final survey component was a single-page vignette describing either a hypothetical implantable device or new prescription drug, each designed to reduce the risk of heart disease among patients at average risk. Patients were given information typical of the content of an informed consent discussion for receiving a new treatment, including a synopsis of the prior clinical testing of the new technology, the estimated risks of treatment, and the potential benefits (Appendix B). Respondents were asked a series of questions about their attitudes toward the new technology.

All survey questions in the innovativeness modules as well as the vignette were in 5-point Likert-scale format, with responses ranging from "strongly agree" to "strongly disagree." The wording of the survey items was varied so that an equal number of statements were positively oriented (e.g., "I am usually among the first of my friends and family to try new things") and negatively oriented (e.g., "I rarely trust new ideas").

Before administering the survey to the study cohort, we pilot-tested the instrument for readability, comprehensibility, and communicational effectiveness via "think aloud" exercises with consecutive patients. For each survey item, the respondent was asked to describe aloud what he/she believed the question was asking and what her/his thoughts were in formulating a response. These responses were recorded and transcribed, and subsequent versions of the survey were modified to improve clarity.

Survey Recruitment and Implementation

The study was conducted among veterans in primary care clinics at the Philadelphia VA Medical Center from October of 2004 through May of 2005. Veterans in clinic waiting areas were asked to volunteer for the study via periodic verbal an-

nouncements and posters. Research staff described the study to potential enrollees as a VA-sponsored survey to better understand veterans' attitudes toward new technology in health care. Enrollees were not told at the time of the survey that race was the primary focus of the analysis. Respondents completed a paper version of the instrument while seated in the clinic waiting area. Participants were not given any verbal instructions from study staff other than clarification of the manner in which responses were to be recorded. When participants returned completed surveys, study staff attempted to rectify any ambiguous or illegible written responses in consultation with the respondent. Participants received a token gift (hat or carry-bag) for successfully completing the survey.

Data Analysis

Individual items were scored on a 0 to 4 scale, with 4 indicating a more innovative response (e.g., "strong agreement" with statements indicating enthusiasm for new ideas, or "strong disagreement" with statements indicating hesitancy to adopt change). General innovativeness, medical technology-specific innovativeness, and vignette subscale scores were calculated by averaging the individual item scores in each section. Missing scores for individual items were not included in these averages. Univariate comparisons between the subscale scores of blacks and whites were made using *t*-tests, and comparisons of proportions of patients with low innovativeness scores were made using Fisher's exact test. We subsequently fitted a series of ordinary-least-squares (OLS) regression models in which each subscale score (i.e., general innovativeness, medical technology innovativeness, and the vignette responses) was the dependent variable. Race, sex, age, annual income less than \$20,000, not having completed high school, having cardiovascular disease, having >2 comorbid conditions, having <2 prior medical procedures, and the risk-attitude score were included as independent variables in these models. Finally, we fitted a second series of OLS models in which the medical technology innovativeness subscale score and the interaction between medical technology innovativeness and race were included as additional independent variables in the models predicting vignette responses. All statistical analyses were performed using SAS 9.1 (Cary, NC) or STATA 8.2 (College Station, TX). All significance tests were 2-sided. We assumed a *P*-value of less than .05 to be statistically significant.

RESULTS

We initially distributed survey instruments to 226 patients, of whom 190 participants returned completed survey instruments to study staff. Among these, 171 patients identified themselves as either white or black, and these subjects (108 blacks and 63 whites) were included in the comparative analyses presented here (Table 1). Nineteen respondents (10% of survey respondents) were excluded because they indicated more than one racial group or indicated that their race was neither white nor black. The vast majority of patients were male, and the mean age of respondents was 55 years. Most respondents were from low-income households, and substantial numbers of both black and white participants had not finished high school. Although most participants of either race had multiple chronic medical conditions, blacks were twice as likely as whites to have received fewer than 2 prior medical

Table 1. Characteristics of White and Black Veterans Surveyed*

<i>n</i>	Black 108	White 63	P-Value NA
Age (years, standard deviation)	55 (10)	54 (11)	.52
Male	94%	97%	.71
Household income <\$20,000 per year	70%	58%	.11
Educational attainment less than high school diploma	19%	15%	.53
More than 2 comorbid conditions	55%	60%	.47
Cardiovascular disease	65%	60%	.45
Less than 2 prior medical procedures	50%	25%	.002

*Data presented are percentages of enrollees in each column, unless otherwise specified.

procedures. The age, race, and sex distribution of our study population was similar to the general population of veterans in primary care clinics (excluding women's health clinics) at the Philadelphia VA Medical Center, based on comparisons with the hospital's outpatient primary care demographic statistics obtained from the VA's outpatient databases (Austin, TX).

Regression Model Assumptions and Goodness-of-Fit

In all of our regression models, Shapiro-Wilk tests for normality of the residuals failed to reject the null hypotheses that the residuals were normally distributed (*P* values ranged from .23 to .9),¹⁸ meeting the Gauss-Markov normality assumption of ordinary least squares regression. Regression models had *R*² values ranging from .24 to .30, which indicate an acceptable fit in social science applications.¹⁹

General Innovativeness

There were no significant differences in general innovativeness raw scores between black and white respondents (Appendix C). Thirty percent of blacks compared with 21% of whites had general innovativeness scores less than 2 on a 0 to 4 scale (*P*=.21). In multivariate analysis, higher risk-tolerance scores were associated with higher innovativeness scores (*P*<.001). Black race was not a significant predictor of general innovativeness (*P*=.59).

Medical Technology Innovativeness

Whites had significantly higher mean medical technology innovativeness scores compared with blacks (*P*=.001 for the difference, Appendix C). Twenty-one percent of blacks, compared with 11% of whites, had medical technology innovativeness scores lower than 2 (*P*=.10). In multivariate analysis, black race remained significantly associated with lower medical technology innovativeness scores (*P*=.01), with the expected difference in innovativeness score being 0.24 points lower for blacks compared with whites. As was the case for general innovativeness, greater risk tolerance was strongly associated with higher innovativeness (*P*<.001). Women were also more likely to have higher medical technology innovativeness, with adjusted scores being 0.56 points higher than men (*P*=.005) (Table 2).

Vignettes

Ninety patients (55 blacks, 35 whites) completed the vignette describing a new implantable cardiovascular device, while 78 patients (52 blacks, 26 whites) completed the vignette describing a new prescription drug. Fourteen percent of blacks versus 19% of whites had scores indicating low innovativeness toward a hypothetical new medical device (*P*=.57). Conversely, blacks had lower mean innovativeness scores toward a hypothetical new prescription drug (*P*=.003), with 31% of blacks versus 19% of whites having scores below 2 (*P*=.29). In multivariate analysis, having >2 comorbid conditions (*P*<.001) and greater risk tolerance (*P*=.002) were associated with more favorable attitudes toward the device, but there was no significant racial difference in attitudes (*P*=.33). In contrast, for new prescription drugs, blacks (*P*=.01) and older patients (*P*=.02) were less favorably oriented, while patients with greater risk tolerance were more favorably oriented (*P*=.02) to the new technology.

Trust and Risk-taking

Although our instrument was not designed to assess patient trust fully, we found that blacks (16%) were more likely than whites (6%) to agree with the statement: "I would avoid a new prescription drug, medical device, or procedure if I had not heard about it from several people other than just my doctor" (*P*=.09 for the difference). However, blacks (12%) did not

Table 2. Multivariate Regression Results*

	General Innovativeness	Medical Technology Innovativeness	Device Vignette	Drug Vignette
Black race	-0.06 (-0.26,0.15)	-0.24 [‡] (-0.42, -0.06)	0.11 (-0.11,0.34)	-0.36 [†] (-0.64, -0.08)
Female	0.29 (-0.16,0.73)	0.56 [‡] (0.17, 0.96)	0.30 (-0.32, 0.91)	-0.21 (-0.70,0.28)
Age	-0.18 (-0.39, 0.02)	-0.06 (-0.23,0.12)	-0.15 (-0.37,0.08)	-0.31 [‡] (-0.58, -0.04)
Income <\$20,000 per year	0.07 (-0.11,0.30)	-0.14 (-0.32,0.05)	-0.001 (-0.25,0.25)	0.03 (-0.22,0.29)
Education <high school diploma	-0.08 (-0.32,0.22)	-0.08 (-0.30,0.14)	-0.03 (-0.34,0.29)	-0.10 (-0.42,0.22)
More than 2 comorbid conditions	0.08 (-0.14,0.31)	0.14 (-0.05,0.34)	0.52 [‡] (0.26,0.76)	0.05 (-0.26,0.35)
History of cardiovascular disease	-0.08 (-0.31,0.14)	0.01 (-0.19,0.21)	-0.14 (-0.39, 0.12)	0.05 (-0.24, 0.34)
Less than 2 prior procedures	-0.08 (-0.30,0.14)	-0.08 (-0.28,0.11)	-0.01 (-0.26,0.23)	0.11 (-0.18,0.40)
Risk attitude	0.22 [‡] (0.14,0.29)	0.16 [‡] (0.09,0.23)	0.14 [‡] (0.05,0.23)	0.12 [‡] (0.02,0.22)

*Coefficients indicate the expected change in innovativeness score for patients in each category versus patients not in each category (for age, expected change in innovativeness score per additional 10 years of age; for risk attitude, expected change in innovativeness score with a unit increase in risk-tolerance score).

[†]*P*<.05;

[‡]*P*<.01.

significantly differ from whites (8%) in agreement with the statement, "I rarely trust new ideas until I can see whether the vast majority of people around me accept them" ($P=.45$). A larger fraction of blacks (15%) compared with whites (5%) expressed discomfort with taking risks ($P=.05$).

Correlation Between Medical Technology Innovativeness and Vignette Responses

A multivariate model predicting patients' vignette responses and including all covariates in the models above, as well as medical technology innovativeness and a race-innovativeness interaction term, indicated that higher medical technology innovativeness scores were correlated with higher favorability ratings for the vignettes. For blacks, each additional point on the medical technology innovativeness scale was associated with a 0.46 ($P<.001$) higher score for the device vignette and a 0.48 ($P<.001$) higher score for the drug vignette. Among whites, each additional point on the medical technology innovativeness scale yielded a 0.36 ($P=.02$) increase in the response score to the device vignette, but there was no change ($P=.75$) in the drug vignette scores for whites with higher medical technology innovativeness.

DISCUSSION

Medical technology innovativeness differed between white and black veterans in an urban, primary care setting. Innovativeness was correlated with a greater likelihood that patients were favorably oriented to new medical devices and prescription drugs. Blacks, who had generally lower medical technology innovativeness, were correspondingly more likely to be hesitant about adopting particular new technologies. We found that both blacks and whites with low innovativeness were hesitant to embrace a new medical device, but that whites with low innovativeness were more likely to adopt a new prescription drug than blacks with low innovativeness. Conversely, both blacks and whites with higher innovativeness were more favorably oriented to a hypothetical new implantable medical device. Yet, although innovative black patients were more favorably oriented toward a new prescription drug, innovative whites did not view the new drug more favorably.

This racial difference in reactions to different technologies may have occurred because many whites did not generally view new prescription drugs as "innovative"—thus, there would have been no greater propensity to use this technology among whites who were generally more enthusiastic about new technology compared with whites who were not. Blacks, however, may have viewed the new prescription drug in a manner similar to a new implantable device, i.e., as new and risky, and thus less innovative blacks may have shunned the technology. This difference may also reflect greater comfort with prescription drugs across the spectrum of patient innovativeness among whites, greater distrust of new prescription drugs by some blacks (particularly among those who are hesitant to adopt new concepts), or both.

Our multivariate analyses adjusted for many potential confounders of the relationship between race and innovativeness, including lower income and education, limited prior health care experiences, and risk aversion. In particular, blacks were less likely to have had prior medical procedures and were more risk-averse than whites. Nevertheless, racial

differences in innovativeness persisted despite adjustment for these differences. Among the unmeasured factors that may have contributed to racial differences in innovativeness include varying sources of medical information, differences in the size and diversity of peer networks, differences in social mobility, and varying degrees of optimism about future prospects, all of which have been identified as contributors to innovativeness.¹¹ Other vital mediators of medical technology innovativeness may include health information accessibility, doctor-patient communication quality, and trust. In particular, racial differences in trust in health care providers were suggested by selected items in our survey, suggesting that this may be a key factor.

This study confirms prior findings that innovativeness influences patient behavior. Armstrong et al.⁹ determined that women with higher innovativeness were more likely to pursue genetic testing for breast cancer. Sedlis et al.⁷ found that refusal of cardiac procedures by black veterans may partially explain racial differences in receipt of new technology in the VA health care system. Heidenreich et al.²⁰ determined that black Medicare beneficiaries refused coronary angiography after myocardial infarction more frequently than white beneficiaries. In contrast, Kressin et al.²¹ found few differences in medical technology attitudes among black and white veterans with a recent, positive cardiac nuclear imaging study, although the authors' study design may have preferentially enrolled patients who were more willing to undergo procedures.

Persons of any race with lower levels of innovativeness are likely to require more information and/or the endorsement of trusted sources before adopting a new technology.^{22,23} For health care innovations, it is possible that health care providers and systems could enhance patients' decision making regarding medical technology, particularly for those patients whose interpersonal networks, education, health literacy, or income constraints limit the quantity and quality of information available to them. Peer counseling, culturally sensitive multimedia resources, expanded Internet access for minority patients, and minority community outreach are all potential remedial interventions of the "innovativeness gap." Each of these represents a testable intervention by which providers and health care systems could address low innovativeness among patients of all races.

Limitations

We used a convenience sample of veterans that may have produced a biased sample, particularly if innovativeness was correlated with the likelihood of enrolling in a health care research survey. However, the age, sex, and race distribution of our respondents closely matched the distribution of all primary care patients at the Philadelphia VA Medical Center. As age and race were correlated with innovativeness, we would have expected our population to be disproportionately younger and have a higher percentage of white patients if patients with low innovativeness were opting out. As we did not observe this, we do not believe that biased study entry produced the observed racial differences in innovativeness. A second shortcoming of the study was that we could not assess whether differences in innovativeness influenced actual health care choices, but instead we measured patients' responses to hypothetical situations. It is possible that patients' actual behavior when confronted with real treatment decisions would have differed from

their reported responses to hypothetical treatments. It is also possible that differences between reported responses and actual behavior might be more pronounced in 1 racial group, thus presenting the appearance of a racial difference when none actually exists.

Conclusions

There are measurably different attitudes toward medical technology innovations among otherwise similar black and white VA primary care patients. These differences in innovativeness are associated with significant racial differences in response to particular health care technologies. Blacks with lower levels of innovativeness are less likely than comparable whites to have favorable attitudes toward new prescription drugs. Both blacks and whites with low innovativeness are less favorably oriented to new implantable medical devices. These findings suggest potentially remediable causes for persistent differences in the uptake and utilization of innovative prescription drugs, devices, and procedures among blacks and whites.

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Supplementary Material

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

- Appendix A.**
- Appendix B.**
- Appendix C.**