Genetics in Medicine (2023) 25, 100800

ELSEVIER

Genetics in Medicine
An Official Journal of the ACMG
www.journals.elsevier.com/genetics-in-medicine

ARTICLE

# Primary care physician use of patient race and polygenic risk scores in medical decision-making

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ARTICLE INFO

*Article history:*
Received 24 July 2022
Received in revised form
1 February 2023
Accepted 1 February 2023
Available online 4 February 2023

*Keywords:*
Cardiovascular disease
Health disparities
Polygenic risk scores
Prevention
Prostate cancer

ABSTRACT

**Purpose:** The use of patient race in medicine is controversial for its potential either to exacerbate or address health disparities. Polygenic risk scores (PRSs) have emerged as a tool for risk stratification models used in preventive medicine. We examined whether PRS results affect primary care physician (PCP) medical decision-making and whether that effect varies by patient race.

**Methods:** Using an online survey with a randomized experimental design among PCPs in a national database, we ascertained decision-making around atherosclerotic cardiovascular disease prevention and prostate cancer screening for case scenario patients who were clinically identical except for randomized reported race.

**Results:** Across 369 PCPs (email open rate = 10.8%, partial completion rate = 93.7%), recommendations varied with PRS results in expected directions (low-risk results, no available PRS results, and high-risk results). Still, physicians randomized to scenarios with Black patients were more likely to recommend statin therapy than those randomized to scenarios with White patients (odds ratio = 1.74, 95% CI = 1.16-2.59, $P = .007$) despite otherwise identical clinical profiles and independent of PRS results. Similarly, physicians were more likely to recommend prostate cancer screening for Black patients than for White patients (odds ratio = 1.58, 95% CI = 1.06-2.35, $P = .025$) despite otherwise identical clinical and genetic profiles.

**Conclusion:** Despite advances in precision risk stratification, physicians will likely continue to use patient race implicitly or explicitly in medical decision-making.



## Introduction

The use of patient race in medical decision-making is controversial. Race is a social construct that correlates poorly with a complex interplay of genetic variation, socioeconomic status, and other social determinants of health.[1-3] Despite the widespread understanding that race has no biological meaning, it is explicitly included as a variable or risk factor in dozens of clinical prediction rules or management guidelines in use today.[4] Although some have pointed out that the inclusion of race in clinical algorithms perpetuates existing health disparities,[4,5] others have

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doi: https://doi.org/10.1016/j.gim.2023.100800
1098-3600/Published by Elsevier Inc. on behalf of American College of Medical Genetics and Genomics.

countered that race-blind medicine ignores these disparities and can hinder progress toward addressing them.[1,2,6] For some diseases, the use of race in medical decision-making was historically but erroneously justified as a surrogate for causal genetic differences in disease susceptibility. The advent of increasingly large genetic data sets and better understanding of the genetic architecture of disease have positioned patient genotype, not the social construct of race, as a more direct measure of underlying biological differences[7] although not accounting for social determinants of health, such as environmental exposures, access to health care, and prior history of discrimination.

Polygenic risk scores (PRSs) have emerged as an approach to improving the precision of risk stratification models currently used in disease prevention. Research is actively examining whether PRSs enable the identification of patients whose genetic susceptibility might make them more or less likely to benefit from established prevention strategies recommended for the general population. The number of commercial laboratories offering PRS tests continues to increase,[8-11] and some health care systems are now implementing clinical PRS programs.[12,13] To date, the accuracy of PRSs in ancestrally diverse populations has been limited by the European bias of most genome-wide association studies from which the PRS are derived, representing a health equity concern as PRSs are implemented clinically.[14-16]

Primary care physicians (PCPs) oversee most routine health screenings and primary prevention interventions and will thus be on the front line of any mainstreaming of PRSs in preventive medicine. It remains unknown whether and how PCPs will use PRSs to change their medical decision-making and whether that effect will vary by the social construct of patient race. Physicians might increasingly rely on patient genotype instead of race in explicit or implicit risk stratification. Given that PRSs are a new technology whose limitations might be unfamiliar, it is unknown whether physicians might downweigh their value for risk stratification in patients whose genetic ancestries they perceive to be underrepresented in genetic studies. We examined these questions through a national survey of PCPs using a randomized experimental design to identify whether patient race affects physician decision-making in the presence of PRS results.

## Materials and Methods

We followed the Checklist for Reporting Results of Internet E-Surveys (CHERRIES) in presenting this research (Supplemental Checklist).[17]

### Survey development

The full survey is available in the Supplement and included both novel questions and questions adapted from previous surveys of PCPs on implementation and understanding of genetic and genomic medicine technologies. The survey was piloted among 8 primary care practitioners for comprehension and interpretation of questions. The survey began with a brief introduction to PRS, including a statement that they have been most extensively studied in populations of European descent; respondents were not explicitly told that PRS performance varies by genetic ancestry. Survey questions consisted of 3 major sections: (1) clinical case scenarios, (2) questions about PCPs' perceived utility and barriers to the use of PRS, and (3) respondent's education and demographics. This manuscript presents the results of the clinical case scenarios.

### Case scenarios

We developed novel clinical scenarios, modeled after previous surveys of PCPs,[18,19] for the use of PRS in primary care for 2 common diseases: atherosclerotic cardiovascular disease (ASCVD) and prostate cancer. We chose these 2 diseases as examples because they have validated multi-ancestry PRSs[20,21] and clinical guidelines for prevention that are evidence based but also allow for clinician judgment and patient preference.[22,23] We specifically chose patient profiles illustrating common "gray areas" for these diseases to examine how PRS and race might influence PCP decision-making in cases in which they have the most discretion. All scenarios assumed to have shared decision-making and stated that the patient expressed no preference for or against a certain action and asked for the PCP's recommendation. The case scenarios were reviewed by a medical education expert to ensure consistency with the presentation of patient race and genetic ancestry in medical board questions.

#### *ASCVD*

Standard of care for the primary prevention of ASCVD includes estimating a patient's 10-year risk and tailoring statin therapy to that level of risk. Guidelines differ on whether to initiate statin therapy for patients at 5% to 10% (intermediate) 10-year risk.[23,24] We designed a case scenario of a generally healthy 60-year-old man with a 10-year ASCVD risk of 7.5%, a value indicating intermediate risk at which guidelines recommend consideration of statin initiation if consistent with patient preferences.[23] After seeing a brief summary of current clinical guidelines of the primary ASCVD prevention, respondents were shown a series of 3 patients with identical clinical characteristics (all with 10-year ASCVD risk of 7.5%) except that 1 had no available PRS results, 1 had PRS results indicating high genetic risk of coronary artery disease, and 1 had PRS results indicating low genetic risk of coronary artery disease.[25] For each of the 3 patients, respondents were asked to indicate their level of agreement with recommending statin therapy, ordering additional cardiac testing, or referring to a cardiology or genetics specialist using a 5-item Likert response ranging from strongly disagree to strongly agree.

**Table 1** Characteristics of physician survey noninvitees and invitees

| | Noninvitees ($N$ = 235,226) | Nonrespondents ($N$ = 26,631) | Partial or Full Completers ($N$ = 369) | Effect-Size Estimates by Respondent Status |
|---|---|---|---|---|
| Age, mean (SD), y | 50.1 (14.1) | 52.5 (13.7) | 55.1 (13.0) | $\eta^2 < 0.01$ (0.00, 0.00) |
| Time since medical school graduation, mean (SD), y | 22.7 (14.2) | 24.6 (13.8) | 27.3 (13.4) | $\eta^2 < 0.01$ (0.00, 0.00) |
| Gender, *n* (%) | | | | Cramér's V 0.01 (0.01, 0.01) |
| Female | 98,091 (41.7)[a] | 10,662 (40.0) | 137 (37.1) | |
| Male | 137,129 (58.3)[a] | 15,969 (60.0) | 232 (62.9) | |
| Specialty, *n* (%) | | | | Cramér's V 0.04 (0.03, 0.04) |
| Internal medicine | 121,072 (51.5) | 13,497 (50.7) | 202 (54.7) | |
| Family medicine | 108,999 (46.3) | 12,472 (46.8) | 159 (43.1) | |
| General practice | 5155 (2.2) | 662 (2.5) | 8 (2.2) | |
| US region, *n* (%) | | | | Cramér's V 0.01 (0.01, 0.01) |
| Midwest | 52,758 (22.4) | 5742 (21.6) | 82 (22.2) | |
| Northeast | 47,201 (20.0) | 4976 (18.7) | 83 (22.5) | |
| South | 78,693 (33.5) | 9405 (35.3) | 98 (26.6) | |
| West | 56,574 (24.1) | 6508 (24.4) | 106 (28.7) | |

Noninvitees are defined as eligible primary care physicians in the IQVIA *ONEKEY* physician database who were not selected to receive the survey invitation. Nonrespondents are defined as physicians who received the email invitation but did not complete at least the patient case scenario questions (Q1-Q6). Partial or full completers are defined as respondents completing at least the patient case scenario questions (Q1-Q6) of the survey. Among-group effects were assessed via Cramér's V with 95% CI for nominal variables (where values ≤0.2 indicate weak association) and $\eta^2$ with 95% CI for continuous variables (the ratio of variance explained by invitee/respondent status, see Supplement).

[a]Six noninvitees are categorized as gender "unknown" in the database.

*Prostate cancer*

Because the harms of prostate cancer screening with prostate-specific antigen (PSA) testing do not significantly outweigh the risks for most men, guidelines, including those from the United States Preventive Services Task Force (USPSTF), do not recommend universal screening.[22,26,27] The USPSTF considers family history and African American race as prostate cancer risk factors but does not make separate screening recommendations for these groups. We designed a case scenario of a 45-year-old man asking his PCP for recommendation about prostate cancer screening. Similarly to the ASCVD cases, respondents were shown a series of 3 patients with identical clinical characteristics except that 1 had no available PRS results, 1 had PRS results indicating high genetic risk of prostate cancer, and 1 had PRS results indicating low genetic risk.[20] For each of the 3 patients, assuming shared decision-making, respondents were asked to indicate whether they would recommend prostate cancer screening at age 45, 50, 55, or 60 years or whether they would not recommend screening.

*Randomization*

Respondents were randomly assigned to 1 of 4 versions of the survey, which varied the race of the patients in the clinical case scenarios, ie, respondents saw clinical cases about ASCVD prevention in men of either self-identified European-American (White) or African-American (Black) race and independently saw clinical cases about prostate cancer screening in men of either White or Black race. This within-disease randomization ensured that respondents were not influenced by an explicit comparison between their own management decisions for a White patient and those for a Black patient.

**Respondent characteristics**

The survey concluded with questions about prior genetics education[28] and self-reported race and ethnicity using US Census categories. Other respondent characteristics were obtained by linking individual survey responses to the IQVIA *ONEKEY* database (detailed in Population and sampling strategy section): age, years in practice, gender, practice specialty, practice size, and geography by state (Tables 1 and 2).

## Population and sampling strategy

We defined the target population as PCPs who care for adult patients, including physicians practicing family medicine, general practice, or internal medicine. We worked with database licensee IQVIA to recruit respondents from the *ONEKEY* national physician database of more than 250,000 active physicians who have opted in to receiving email survey invitations. The database includes demographic, training, and practice-related data from the American Medical Association Physician Masterfile and other sources.

## Recruitment, consent, and enrollment

Staff at IQVIA sent email invitations to the survey to a random sample of 27,000 eligible PCPs from the database. These emails described the survey as a 8- to 10-minute survey about precision prevention in primary care using genetic risk scores. Respondents clicked a unique web link to access the survey, hosted by the Qualtrics Survey Tool (Qualtrics). The survey link brought physicians to a brief informed consent page, at the bottom of which respondents

**Table 2** Additional characteristics of survey respondents

| Characteristics | *n* (%) |
|---|---|
| Self-reported race | |
| Asian | 73 (19.8) |
| Black or African American | 12 (3.3) |
| Native Hawaiian or other Pacific Islander | 5 (1.4) |
| White | 232 (62.9) |
| Multiracial | 7 (1.9) |
| Prefer not to answer/other/missing | 40 (10.8) |
| Self-reported ethnicity | |
| Hispanic/Latinx | 15 (4.1) |
| Not Hispanic/Latinx | 330 (89.4) |
| Prefer not to answer/missing | 24 (6.5) |
| Genetics training beyond medical school[a] | |
| No additional training | 335 (90.8) |
| Genetics residency/fellowship | 5 (1.4) |
| Genetics education course | 18 (4.9) |
| Residency rotation in genetics | 3 (0.8) |
| Graduate degree | 2 (0.5) |
| Other training | 12 (3.3) |
| Missing | 4 (1.1) |

Data are from 369 survey respondents with at least partial (Q1-Q6) survey completion.

[a]Proportions sum to greater than 100% because multiple selections were allowed.

electronically documented consent by clicking to proceed to the first page of the survey. Neither race nor ancestry was mentioned in the invitation email or consent page. Upon accessing the survey link, respondents were randomly allocated in a 1:1:1:1 ratio to the 4 versions of the survey. The first email campaign was launched on April 18, 2021 and offered respondents a $25 Amazon gift card for completing the survey. On April 27, 2021, a second invitation offering a $50 Amazon gift card was emailed to PCPs who had opened the first email but not yet accessed the survey link from the first email. The survey was closed on August 27, 2021.

## Hypotheses

For ASCVD prevention, we hypothesized that compared with a patient with no PRS results, respondents would be more likely to initiate statin for a patient with a high-risk coronary artery disease PRS and less likely to initiate statin for a patient with a low-risk PRS. Given the weaker performance of PRS among non-European ancestry groups, we hypothesized that the magnitude of these effects would be smaller for the case scenario with a Black patient than that with a White patient; such an observation would require that physicians were aware of this limitation. Similarly, for prostate cancer screening, we hypothesized that compared with a patient with no PRS results, respondents would be more likely to screen a patient with a high-risk prostate cancer PRS and less likely to screen a patient with a low-risk prostate cancer PRS and that the magnitude of these effects would be smaller for the scenarios with a Black patient.

Details about data validation and statistical analysis are described in the Supplemental Methods and Supplemental Table 1.

# Results

## Participant response and characteristics

Of 25,803 physicians who received the email invitation without bounce back, 2776 opened the email (email open rate = 10.8%) and 409 participants clicked the hyperlink to view the survey website (survey view rate = 409/2776, 14.7%). Of PCPs who viewed the survey, 394 consented to study participation (participation rate = 394/409, 96.3%) and 366 PCPs completed the entire survey (completion rate 366/394, 92.9%). An additional 3 participants completed the clinical scenarios (Q1-Q6) but did not complete the survey in its entirety (partial completion rate 369/394, 93.7%).

Respondents had similar demographic characteristics to physicians in the database who were not invited to participate and to physicians who were invited but did not respond (Table 1). Among the 369 respondents, 232 (62.9%), 73 (19.8%), 12 (3.3%), and 5 (1.4%) self-reported White, Asian, Black/African American, and Native Hawaiian/Other Pacific Islander race, respectively; 15 (4.1%) self-reported Hispanic/Latinx ethnicity (Table 2). The majority (335, 90.8%) reported no additional genetics training beyond medical school (Table 2).

## ASCVD case scenarios

In the ASCVD case scenarios, 38%, 56%, and 89% of respondents agreed with recommending statin therapy for patients with a low-risk PRS, no PRS, and a high-risk PRS for coronary artery disease, respectively (Supplemental Table 2); 29%, 47%, and 70% agreed with recommending additional cardiac testing for patients with a low-risk PRS, no PRS, and a high-risk PRS, respectively; and 8%, 9%, and 38% agreed with specialist referral for patients with a low-risk PRS, no PRS, and a high-risk PRS, respectively. In ordinal logistic regression models, compared with patients with no available PRS results, respondents were less likely (odds ratio [OR] = 0.51, 95% CI = 0.41-0.64, $P < .001$) and more likely (OR = 5.26, 95% CI = 3.53-7.85, $P < .001$) to recommend statin therapy to patients with low-risk and high-risk PRS, respectively (Figure 1).

In each level of PRS result in the ASCVD scenarios, more respondents agreed with recommending statin therapy for the Black patients than for the White patients: 41% vs 35% (low-risk PRS), 63% vs 49% (no PRS), and 95% vs 84% (high-risk PRS, Supplemental Table 2); 31% and 26% (low-risk PRS), 52% and 42% (no PRS), and 73% and 67% (high-risk PRS) agreed with recommending additional cardiac testing for the Black and White patients, respectively; and 10% and 7% (low-risk PRS), 8% and 10% (no PRS),

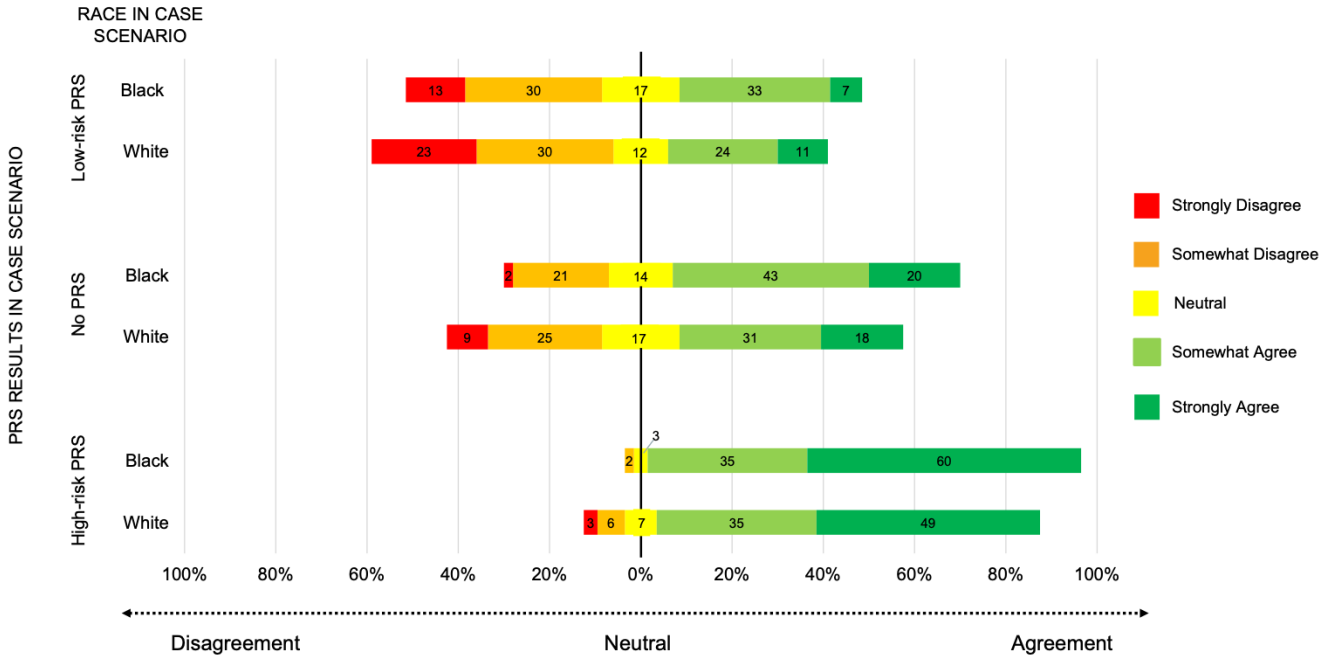


**Figure 1 Physician agreement with initiating statin therapy for atherosclerotic cardiovascular disease risk reduction using PRS result and race of scenario patient.** PRS, polygenic risk score.

and 37% and 39% (high-risk PRS) agreed with specialist referral for the Black and White patients, respectively. In regression models accounting for within-person responses across all PRS scenarios, PCPs were more likely to agree with recommending statin therapy for the Black patients than for the White patients (OR = 1.74, 95% CI = 1.16-2.59, $P$ = .007), despite identical absolute risk estimates presented in the case scenarios (Supplemental Table 3). We did not observe a significant interaction between patient race and PRS results (Supplemental Tables 4 and 5). Physicians were not significantly more likely to recommend additional cardiac testing (OR = 1.24, 95% CI = 0.89-1.73, $P$ = .21) or specialist referral (OR = 0.98, 95% CI = 0.68-1.42, $P$ = .92) for the Black patients than for the White patients (Supplemental Figures 1 and 2).

## Prostate cancer screening case scenarios

Across all respondents, 17%, 23%, 27%, and 5% recommended prostate cancer screening for the case patient with no PRS results beginning at age 45, 50, 55, and 60 years, respectively; 28% did not recommend screening at any age (Supplemental Table 2). For the patients with a low-risk PRS, no PRS, and a high-risk PRS for prostate cancer, 59%, 72%, and 98% of respondents recommended screening at some age, respectively. More respondents recommended screening at some age for the Black patients than for the White patients: 63% vs 53% (low-risk PRS), 81% vs 66% (no PRS), and 98% vs 97% (high-risk PRS).

In logistic regression models, compared with the patients with no available PRS results, respondents were less likely (OR = 0.56, 95% CI = 0.46-0.68, $P$ < .001) and more likely (OR = 16.1, 95% CI = 8.46-30.70, $P$ < .001) to recommend prostate cancer screening to the patients with PRS indicating low and high prostate cancer risk, respectively (Figure 2). Across all PRS results, physicians were more likely to recommend PSA testing for the Black patients than for the White patients (OR = 1.58, 95% CI = 1.06=2.35, $P$ = .025, Supplemental Table 3). Among respondents who recommended screening, physicians were 3 times more likely (OR = 2.97, 95% CI = 1.71-5.18, $P$ < .001) to recommend screening at age 45, 10 years before the USPSTF guidelines recommend screening initiation, for the Black patients than for the White patients, irrespective of PRS results. Supplemental Table 6 shows the likelihood of statin initiation and PSA testing by patient race, stratified by PRS category. In exploratory models, there were no significant interactions between self-reported race and ethnicity of the PCP respondents and the likelihood of recommending statins or prostate cancer screening (Supplemental Table 7).

## Discussion

Together, the results of these randomized clinical scenarios suggest that, at least in the early days of precision prevention, both PRS and patient race influence physicians' medical decisions in some contexts. Physicians' recommendations varied with PRS results in the expected directions, but patient race remained a strong independent predictor. Physicians were more likely to recommend statin therapy and prostate cancer screening to the Black patients than to the White patients despite otherwise identical clinical and genetic risk profiles. The findings suggest that

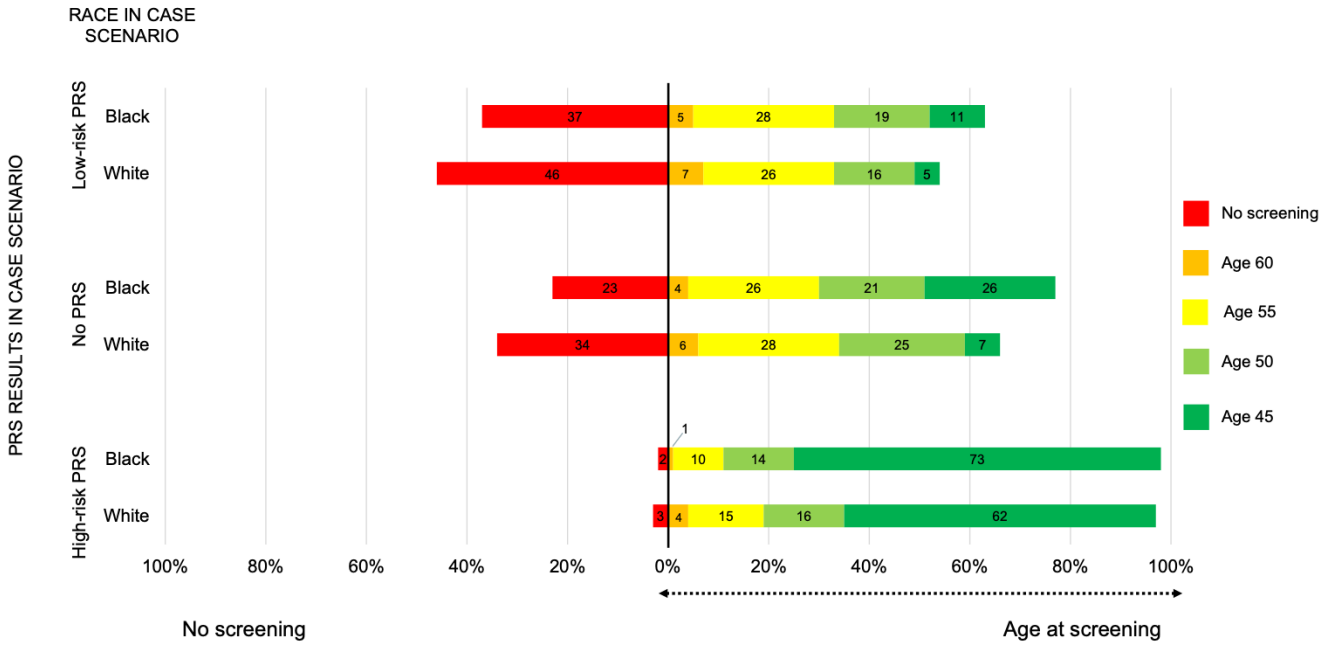


**Figure 2 Physician recommendation for whether and at what age to recommend prostate cancer screening using PRS result and race of scenario patient.** PRS, polygenic risk score.

physicians found clinical utility in PRS for genotype-informed risk stratification; however, independent of PRS, physicians still used patient race either implicitly or explicitly in medical decision-making.

These observations prompt 2 main questions: why did PCP recommendations differ by patient race and do those differences represent racial biases that could result in patient harm? Our results cannot definitively answer these questions. For the first question, the survey's randomized design allowed the unconfounded isolation of a strong effect of patient race in PCP decision-making, independent of PRS, both in a context when Black race is explicitly mentioned in clinical guidelines (prostate cancer prevention) and another when it is assumed to be accounted for in risk calculation (ASCVD prevention). We could not observe the cognitive processes underlying these differences, which may have differed between the 2 disease scenarios. For the ASCVD prevention scenarios, respondents were told that all patients had identical absolute 10-year risk estimates of 7.5% as determined by the American College of Cardiology/American Heart Association (ACC/AHA) pooled cohort equations (PCE) that were developed and validated in racially diverse populations.[29,30] Respondents may have implicitly brought in their own additional risk perceptions and biases or misunderstanding of the PCE in recommending statins more often for Black patients in the scenarios. For the prostate cancer scenarios, respondents were told that guidelines list African-American race as a risk factor but do not make separate screening recommendations. Respondents' perception of increased *absolute* risk for Black men as compared with White men likely persisted despite otherwise identical patient characteristics and measures of *relative* genetic risk. What is clear from our findings, however, is that PRS results did not remove the influence of race on PCP decision-making.

A second important question then is whether the observed racial differences in PCP recommendations are appropriate in these precision prevention scenarios or whether they represent harmful racial biases. This question does not have an easy answer. It may be reassuring that physicians recommended *more* preventive services (statin therapy and prostate cancer screening) for Black patients than for otherwise identical White patients. Still, all medical interventions carry some risk of harm, therefore racial differences in care merit scrutiny. Black American men have a 33% higher lifetime risk of prostate cancer and are twice as likely to die of the disease than White men.[31] Although USPSTF guidelines do not include separate screening recommendations, they do mention Black race as an additional risk factor.[22] Given these disparities, what would it have meant if we had observed that survey respondents' did not recommend screening more often to Black patients? In contrast, the ACC/AHA developed the PCE specifically to address the concern that previous risk models were not well calibrated to African-Americans,[29,30] and yet our survey respondents were still more likely to recommend statins for the Black patients with identical ACC/AHA estimates. Significant racial disparities in cardiovascular disease persist in the United States; Black individuals have higher prevalence of ASCVD risk factors, such as hypertension and diabetes and are more than twice as likely to die of cardiovascular disease, than White individuals.[32] Although we observed racial differences in PCP recommendations, it is not clear that these differences indicate harmful biases or health inequities in these 2 scenarios.

Nonetheless, our findings offer insights for some of the pressing questions for research and clinical implementation programs already propelling PRS into the clinic.[12,13] First, if PRS are to be included in clinical risk prediction, what, if anything, is the appropriate role of the social construct of race in such models? Although much more work remains, methodological advances in PRS derivation are continually improving the validity of PRS interpretations across genetic ancestry and racial groups,[16,20,33,34] and research studies such as the Genomic Medicine at VA (GenoVA) Study have begun implementing such PRS clinically.[35] Other studies such as the Women Informed to Screen Depending on Measures of Risk (WISDOM) Study and the Electronic Medical Records and Genomics (eMERGE) Network are additionally incorporating PRS into existing clinical prediction models for conditions such as breast cancer and ASCVD that include other risk factors such as race, family history, and smoking status.[13,36] Of course, racial categories themselves belie significant within-group heterogeneity. In an ideal future, prevention guidelines would be based on risk models that include more precisely measured causal risk factors, including causal genetic variants, environmental exposures, and other social determinants of health, although such models might become too unwieldy for clinical implementation. Moreover, it is inconceivable that any clinical prediction model could accurately include all human diversity that are causally relevant for a given disease, from genetic factors to sociocultural determinants. In the meantime, race remains a problematic proxy for disease risk. Many concerns about the inclusion of race in clinical prediction models have focused on the perpetuation of existing health disparities through underdiagnosis and under-referral to specialty care.[4] However, in some contexts, such as the large prostate cancer risk disparity observed for Black men, to ignore race in clinical prediction models and guidelines might inappropriately limit screening in this higher-risk group. If race is to be included in a prediction model, the downstream consequences for clinical care should be considered. In the 2 scenarios in our study, we did not observe that physicians' implicit or explicit use of race in decision-making limited the care Black patients received.

Second, as prediction models grow increasingly complex through the inclusion of PRSs, what support will PCPs need for their appropriate use? Consensus is emerging on how researchers and laboratories should transparently report the development and validation of a given PRS including any limitations of performance in different population groups.[35,37,38] As warranted by the evidence, clinical guidelines should be updated to specify the appropriate (and inappropriate) uses of PRS for a given disease; such guidelines should explicitly state and justify whether and how race as a social construct is relevant in the guideline.[35-37] This should be done only as a means of addressing health disparities and without suggesting that race has biological or genetic meaning. Health care systems can play a role in designing support systems to standardize the appropriate use of genetic results, including evidence-based care pathways for the management of common PRS results, ideally integrated within electronic medical records;[39-41] care teams comprising some combination of genetic counselors, genetic care coordinators, and relevant specialists;[39,40,42] and educational resources, such as synchronous or asynchronous courses with continuing medical education credit.[28,40-42] Nonetheless, even if epidemiology can develop perfect prediction models and health care systems can implement PCP support, our randomized study suggests physicians might still use race explicitly or implicitly in medical management. If our observations represent racial bias, there are no easy solutions to closing the gap. A recent systematic review of interventions designed to reduce biases among health care providers found that interventions targeting implicit bias recognition and management can promote bias awareness but have not been shown to effect sustained reduction of bias or improvement in patient care or health disparities.[43] More work is needed from the individual provider to systems levels to address this entrenched problem.

Finally, patients should play a role in the equitable implementation of clinical PRSs. Patient engagement efforts have already elucidated some relevant perspectives, including a preference to receive PRS results even if less accurate in certain genetic ancestry groups.[38,44] For each individual patient, a clinician should transparently convey the strengths and limitations of PRSs. Doing so will allow the patient to participate in shared decision-making, an approach through which patients and clinicians discuss the best available evidence, consider options, and develop informed preferences for a health care decision.[45] Some patients may choose to eschew decision-making based on data from populations they feel do not represent them, and others may prefer using imperfect data in their medical decisions over having no data.

Limitations of this study include the invitation email open rate of 10.8% and survey view rate of 14.7%, although these compare favorably with those of other large national physician surveys.[46-48] Survey respondents may not be representative of all US PCPs, but the randomized experimental design of the patient scenarios ensured the unconfounded internal validity of the between-group comparisons. Second, although we observed significant differences in PCP decision-making by patient race and PRS results, we may have had limited power to detect statistically significant race–PRS interactions. Third, physician responses to the case scenarios may not correspond to their actual practice in real-world patient care. By design, the case scenarios were narrowly described, to allow us to isolate the effects of PRS results and patient race in common decision-making contexts. As a result, respondents did not have access to other patient information they might otherwise have, including social determinants of health and other clinical risk factors. We also do not know how physician decision-making would vary, if at all, for patients of racial identities other than Black and White.

In conclusion, results of this national survey suggest that physicians will use both PRS and the social construct of

race, implicitly or explicitly, in the precision prevention era. Researchers, clinicians, and policymakers must ensure that the use of PRS and race in medical decision-making, if they are used at all, promotes improved health outcomes for all patients.

## Data Availability

The data set supporting the current study is available from the corresponding author on request.

## Acknowledgments

The authors thank Kopika Kuhathaas for her assistance in preparing data figures.

## Funding

This work was funded by the National Human Genome Research Institute/National Institutes of Health (R35 HG010706, J.L.V.).

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## Ethics Declaration

The study was approved by the Harvard Longwood Campus Institutional Review Board (Protocol #20-2098). Informed consent was obtained from all respondents.

## Conflict of Interest

C.A.B., A.A.A., and J.L.V. are employees of the United States Department of Veterans Affairs. The views expressed in this manuscript do not represent those of the US government or United States Department of Veterans Affairs. All other authors declare no conflicts of interest.

## Additional Information

The online version of this article (https://doi.org/10.1016/j.gim.2023.100800) contains supplementary material, which is available to authorized users.

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