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PILOT DATA ANALYSIS

A Pilot Analysis of Patient Portal Use and Breast Cancer Screening Among Black Patients in a Large Academic Health System

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Introduction: Patient portals may facilitate breast cancer screening and could be an important factor to address inequities; however, this association is not well characterized. The authors sought to examine this association in a large academic health system to inform interventions to address breast cancer screening inequities.

Methods: The authors conducted a cross-sectional study among Black patients in a large academic health system using logistic regression to examine the association between breast cancer screening and portal use, adjusting for multilevel covariates and interactions. The authors estimated average marginal effects to examine the additive probability of breast cancer screening completion given portal use in the prior 12 months.

Results: In the unadjusted model, portal use was associated with an estimated mean 24.8 percentage points (95% CI=20.7, 29.0) increased likelihood of completing breast cancer screening. In the adjusted model, portal use was associated with an estimated mean 16.2 percentage points (95% CI=11.2, 21.3) increased likelihood for completing breast cancer screening.

Conclusions: Improving portal access and use among racialized groups who face both portal and breast cancer screening inequities could be one strategy to address inequities. These pilot data will inform subsequent community-engaged research to better understand this association and develop and test a portal intervention to facilitate breast cancer screening access among Black patients eligible for screening.

INTRODUCTION

Black people are 22% more likely to die from breast cancer than White people, adjusting for sociodemographic and treatment factors; this inequity is at least partly due to lack of screening and subsequent later-stage disease at diagnosis.[1,2] Patient portals can lower barriers to breast cancer screening (BCS) through reminders, online mammogram scheduling, and secure messaging. Yet, Black people have lower rates of portal use.[3–6] A recent analysis of national survey data demonstrated a significant

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2773-0654/$36.00
https://doi.org/10.1016/j.focus.2024.100305

association between portal use and BCS and that the probability of completed screening increased with more frequent portal use.[7] Other analyses have shown significant associations between functions of portals, secure messaging and online mammogram scheduling, and BCS.[8–10]

The potential association between unequal portal use among Black and White people and disparate BCS rates is an example of an intervention-generated inequity (IGI). IGIs are inequities in health outcomes that arise from differential access, uptake, use, and/or effectiveness of an intervention that exacerbate existing inequities.[11,12] Black people are offered portals less than White people, causing unequal portal access, and Black people may also face greater barriers to digital access (e.g., devices, internet), causing unequal portal uptake.[3–6]

In a large academic health system, the authors observed racial inequities in both BCS completion and portal use; portal use inequities persisted when stratified by clinic group (i.e., community based, academic hospital based, and county hospital based) (Appendix Table 1, available online). The authors developed an adapted IGI explanatory framework for how differential portal access, uptake, use, and effectiveness could contribute to BCS inequities (Figure 1).[11] The authors then sought to characterize the association between portal use and BCS completion among Black patients in the health system to help inform health system interventions to address BCS inequities.

METHODS

The authors used intersectionality as the conceptual framework for this analysis.[13–15] Intersectionality scholars view inequities as arising from interlocking imbalances in power and privilege.[13–15] Understanding within-group (or intracategorical) heterogeneity is one approach to intersectionality analysis.[16] Intracategorical analysis helps to center the experiences of oppressed groups. Intracategorical analyses focus on intragroup heterogeneity, which helps to promote tailored approaches to inequities and avoid one-size-fits-all solutions. Therefore, after establishing that inequities existed in BCS and portal use (Appendix Table 1, available online), the authors focused the main analysis on Black patients eligible for BCS, without comparing with any other groups. The authors acknowledge that multiple racialized groups face BCS inequities.[17] This analysis was designed to inform research with established community partners with the goal to develop interventions to address BCS inequities among Black people, which is the rationale for this study population.

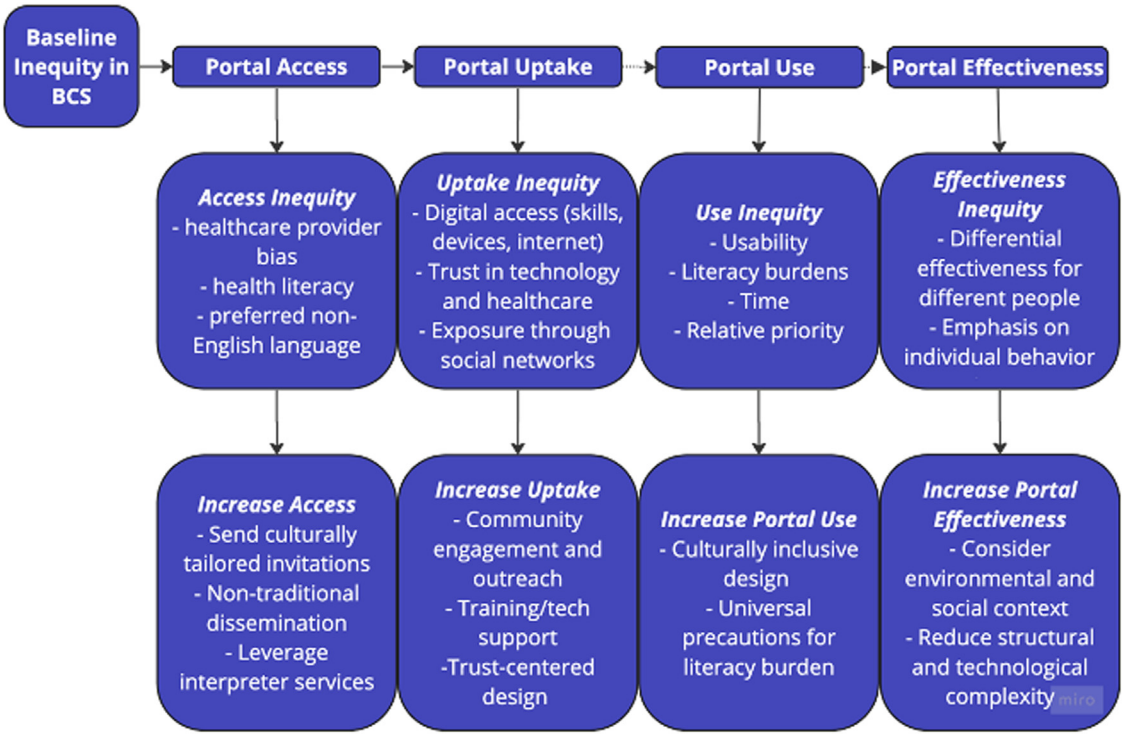

Figure 1. Explanatory framework for patient portal generated inequities.[11]
BCS, breast cancer screening.

Study Population

The authors conducted a cross-sectional study of patients who received primary care (i.e., had at least 1 visit in the last 3 years) in a large academic health system, University of Washington Medicine. University of Washington Medicine operated 26 primary care clinics across western Washington during the time of this study. The authors used data from the institutional electronic health record (EHR) and quality improvement data warehouse over the period July 2019−November 2021. The authors included patients who self-identified as Black/African American, were eligible for BCS, and noted English as their preferred language in the EHR (given the compounding barriers between language and portal use) (Appendix Figure 1, available online).[18] The authors excluded patients with metastatic cancer because screening may not be beneficial for those patients (n=30). Additional inclusion and exclusion criteria were aligned with the National College of Quality Assurance Healthcare Effectiveness Data and Information Set measure for BCS (the quality measure used by the health system): ages 50−74 years, female sex at birth without history of bilateral mastectomy and without diagnostic codes for palliative care, and advanced illness and/or frailty.[19]

Measures

The outcome of interest was receipt of a mammogram within 27 months prior to October 2021 aligned with the National College of Quality Assurance Healthcare Effectiveness Data and Information Set BCS measure. These data include mammograms completed outside the health system (which are automatically imported if the outside health system uses the same EHR and are manually inputted by primary care team members if the health system uses a different EHR product or is an unaffiliated imaging center). The study's main independent variable was portal use, defined as logging into the portal within the previous 12 months. At the time of this evaluation, the portal included health reminders for BCS on the portal home screen, secure messaging that healthcare team members could use to actively send messages about BCS and/or patients could use to request mammogram referral and/or ask questions about BCS, and online mammogram scheduling. Online mammogram scheduling was relatively new, starting in October 2020. The authors selected covariates on the basis of prior research on multilevel factors that affect BCS and the intersectional conceptual model (Figure 2).[7,10,20−24] The authors measured individual characteristics, including age, ethnicity, number of primary care and specialty visits in the past year, smoking status, medical conditions, insurance status, and Area Deprivation Index (ADI) (measure of neighborhood disadvantage).[25] Smoking status was included as a variable because recent research demonstrates an inverse association between tobacco use and BCS among women of color.[22] Medical conditions were measured by a composite variable (i.e., 0, 1, 2, ≥3) of several conditions regularly tracked by the health system. The authors used the following for insurance status: commercial, Medicaid, Medicare, and other (including self-pay). The authors calculated state-level ADI using the Neighborhood Atlas.[25] The authors created ADI categories for adequate group sizes for analysis: ADI 1−2, 3−4, 5−6, and 7−10 (increasing scores indicate greater degree of neighborhood disadvantage). The authors also measured provider characteristics, including provider training, specialty, and clinical full-time

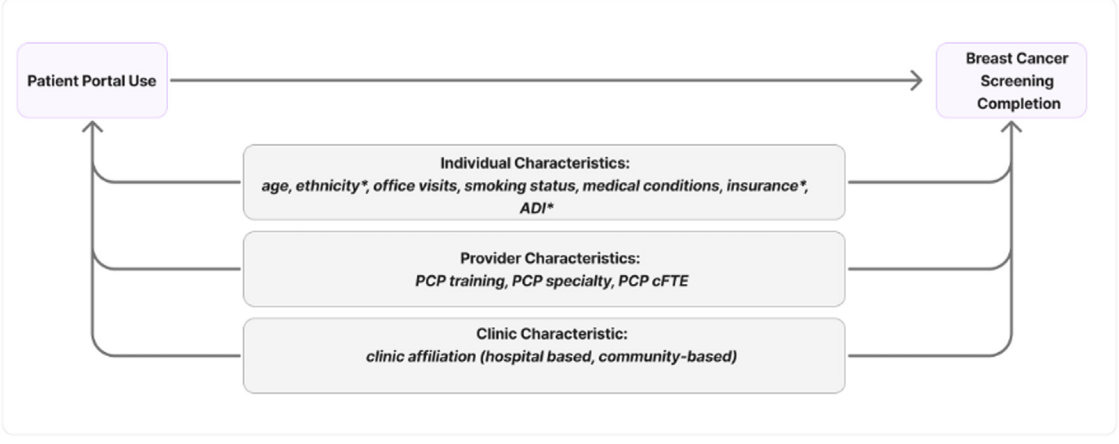

Figure 2. Conceptual framework for association of patient portal use on breast cancer screening.
*Characteristic with asterisk indicates inclusion as effect modifier in the analysis.
ADI, area Deprivation Index; cFTE, clinical full time equivalent; PCP, primary care provider.

equivalent (FTE). The authors used a binary variable for clinical FTE to denote whether the primary care practitioner was at least 50% clinical. The authors measured one clinic characteristic: academic hospital–based, county hospital–based, or community-based primary care clinic affiliation. The county hospital is the safety-net health system for the region.

Statistical Analysis

The authors conducted logistic regression analyses of portal use on BCS, unadjusted and adjusted for potential confounders and included interaction terms for effect modifiers. The authors selected the effect modifiers (ethnicity, insurance status, ADI) on the basis of prior literature demonstrating change in association magnitude between portal use and BCS (or other comparable health outcomes) for different levels of each covariate (Figure 2).[7,26,27]

The authors calculated average marginal effects (AMEs) to estimate additive difference in probability because AMEs are more interpretable than ORs when the outcome is not rare such as in BCS.[28] In this analysis, the AME estimates the additive change in probability of receiving BCS as attributable to portal use. The authors used complete case analysis for missing data except when the category was large and/or meaningful, in which case the authors categorized missing covariate data in the regression. The authors adhered to STROBE guidelines for observational studies.[29] The authors conducted analyses using R, Version 2021.09.0. The University of Washington IRB approved this study.

RESULTS

The authors identified 1,445 patients who met inclusion criteria. The study population mean age was 62 years, most were of non-Hispanic ethnicity (98%), and the most common insurance was commercial (41%) (Table 1). Patients who used portals differed in individual (age, tobacco use, insurance, chronic conditions, and visits), provider (training, specialty, and clinical FTE), and clinic (clinic affiliation) characteristics and had a higher rate of completing BCS (73.3% vs 46.3%) than those without portal use.

In the unadjusted logistic regression, the estimated AME was 24.8 percentage points (pps) (95% CI=20.7, 29.0), meaning that patients who used the portal in the last year were an estimated 24.8 pps more likely to complete BCS than those who had not used the portal, without adjusting for any confounders or interactions (Table 2). In the adjusted model, patients who used the portal had an estimated 16.2 pp (95% CI=11.2, 21.3) increased likelihood for completing BCS (Table 2 and Appendix Table 2, available online). The authors found no statistically significant interactions in the adjusted analysis.

DISCUSSION

Among Black patients in a large academic health system, the authors found a significant association between portal use and BCS completion in an unadjusted model and after adjusting for multilevel confounders and effect modifiers. These findings extend prior research demonstrating associations between portal use/portal functionalities and BCS completion, including a national survey that found that portal use was significantly associated with BCS completion and that the association was stronger with increased frequency of use.[7–10] These findings were stratified by racialized group, and association was greater among Hispanic and Black people.[7]

Portals could address known barriers to BCS among Black patients, including improving access to care (through online scheduling), standardizing provider recommendations (through reminders and population health outreach messages), and addressing questions about BCS (e.g., what to expect) (through secure messaging). Traditional outreach strategies are often resource intensive with only modest effects, must be repeated at screening intervals (e.g., annually), and are often disconnected from scheduling BCS.[30] In comparison, the portal facilitates BCS through reminders, online scheduling, and secure messaging to healthcare teams and may be an efficient and sustainable intervention to help improve access to BCS. To improve uptake of portals, health systems could employ existing strategies such as digital navigators (healthcare team members who specifically address digital access barriers with patients to use virtual care technologies).[31]

The authors did not find statistically significant interactions between portal use and ethnicity, insurance status, or ADI. Ethnicity had the strongest evidence for interaction effect given prior research showing higher magnitude of association between portal use and BCS among Hispanic people and higher use of online mammogram scheduling.[7,10] The lack of significant interaction effect in this study is difficult to interpret given the small number of Hispanic people; intersectional evaluation of portal use for BCS among Black Hispanic people is an area for future research. The authors included insurance status and ADI as effect modifiers, extrapolating evidence from other healthcare outcomes.[26,27] However, different levels of insurance status and ADI may not modify effectiveness of portal use for BCS; the results of this study are limited by relatively new online

Table 1. Multilevel Characteristics of Individuals With and Without Portal Use

Characteristic	No portal use (*n*=516)	Portal use (*n*=929)	Total (N=1,445)
Age, year			
Mean (SD)	62.3 (6.06)	61.0 (6.11)	61.5 (6.12)
Median (Min, Max)	62.0 (52.0, 74.0)	60.0 (52.0, 74.0)	61.0 (52.0, 74.0)
Ethnicity			
non-Hispanic	494 (95.7%)	874 (94.1%)	1,368 (94.7%)
Hispanic	7 (1.4%)	16 (1.7%)	23 (1.6%)
Missing	15 (2.9%)	39 (4.2%)	54 (3.7%)
Insurance status			
Commercial	129 (25.0%)	457 (49.2%)	586 (40.6%)
Medicaid	147 (28.5%)	126 (13.6%)	273 (18.9%)
Medicare	219 (42.4%)	320 (34.4%)	539 (37.3%)
Other	21 (4.1%)	25 (2.7%)	46 (3.2%)
Missing	0 (0%)	1 (0.1%)	1 (0.1%)
Area Deprivation Index			
1–2	107 (20.7%)	237 (25.5%)	344 (23.8%)
3–4	140 (27.1%)	247 (26.6%)	387 (26.8%)
5–6	102 (19.8%)	169 (18.2%)	271 (18.8%)
7–10	98 (19.0%)	163 (17.5%)	261 (18.1%)
Missing	69 (13.4%)	113 (12.2%)	182 (12.6%)
Number of chronic conditions[a]			
None	64 (12.4%)	169 (18.2%)	233 (16.1%)
1	122 (23.6%)	277 (29.8%)	399 (27.6%)
2	110 (21.3%)	219 (23.6%)	329 (22.8%)
≥3	220 (42.6%)	264 (28.4%)	484 (33.5%)
Primary care visits			
No visits	111 (21.5%)	56 (6.0%)	167 (11.6%)
1 visit	98 (19.0%)	217 (23.4%)	315 (21.8%)
2 visits	88 (17.1%)	181 (19.5%)	269 (18.6%)
3 visits	59 (11.4%)	152 (16.4%)	211 (14.6%)
≥4 visits	160 (31.0%)	323 (34.8%)	483 (33.4%)
Nonprimary care visits			
No visits	265 (51.4%)	381 (41.0%)	646 (44.7%)
1 visit	84 (16.3%)	155 (16.7%)	239 (16.5%)
2 visits	43 (8.3%)	93 (10.0%)	136 (9.4%)
3 visits	26 (5.0%)	73 (7.9%)	99 (6.9%)
≥4 visits	98 (19.0%)	227 (24.4%)	325 (22.5%)
Tobacco use			
No	352 (68.2%)	803 (86.4%)	1,155 (79.9%)
Yes	112 (21.7%)	85 (9.1%)	197 (13.6%)
Missing	52 (10.1%)	41 (4.4%)	93 (6.4%)
Primary care provider training			
Attending physician	431 (83.5%)	762 (82.0%)	1,193 (82.6%)
Resident/fellow physician	39 (7.6%)	50 (5.4%)	89 (6.2%)
Advanced practice practitioner	46 (8.9%)	117 (12.6%)	163 (11.3%)
Primary care provider specialty			
Family medicine	198 (38.4%)	505 (54.4%)	703 (48.7%)
Internal medicine	261 (50.6%)	356 (38.3%)	617 (42.7%)
Other	26 (5.0%)	25 (2.7%)	51 (3.5%)
Unknown	31 (6.0%)	43 (4.6%)	74 (5.1%)

(*continued on next page*)

Table 1. Multilevel Characteristics of Individuals With and Without Portal Use (*continued*)

Characteristic	No portal use (*n*=516)	Portal use (*n*=929)	Total (N=1,445)
PCP clinical FTE			
<50%	283 (54.8%)	338 (36.4%)	621 (43.0%)
≥50%	233 (45.2%)	591 (63.6%)	824 (57.0%)
Clinic type			
Academic hospital affiliated	34 (6.6%)	113 (12.2%)	147 (10.2%)
County hospital affiliated	240 (46.5%)	172 (18.5%)	412 (28.5%)
Community	224 (43.4%)	634 (68.2%)	858 (59.4%)
Missing	18 (3.5%)	10 (1.1%)	28 (1.9%)
Breast cancer screening completed			
No	277 (53.7%)	248 (26.7%)	525 (36.3%)
Yes	239 (46.3%)	681 (73.3%)	920 (63.7%)

[a]Chronic conditions: nonmetastatic cancer, cerebrovascular disease, substance use disorder, chronic obstructive pulmonary disease, depression, diabetes, chronic kidney disease, end-stage renal disease, heart failure, HIV, hypertension, coronary artery disease, other psychiatric diagnoses, liver disease, rheumatoid arthritis.
FTE, full-time equivalent; Max, maximum; Min, minimum; PCP, primary care practitioner.

Table 2. Average Marginal Effects of Portal Use on Breast Cancer Screening Completion

	Breast cancer screening completed	
Predictors	Average marginal effect pp (95% CI)	*p*-value
Unadjusted analysis		
Patient portal use: yes	24.84 (95% CI=20.67, 29.01)	**<0.0001**
Adjusted analysis		
Patient portal use: yes	16.24 (95% CI =1.17, 21.32)	**<0.0001**

Note: This table reports the estimated AMEs from unadjusted and adjusted logistic regression model coefficient for patient portal use. The AME for patient portal use can be interpreted as people who used the patient portal having a 16.24 pp higher likelihood to have completed breast cancer screening adjusting for individual-, provider-, and clinic-level factors and potential interactions from Area Deprivation Index, insurance status, and Hispanic ethnicity. Bolded results indicate statistical significance at alpha < 0.05.
AME, average marginal effect; pp, percentage point.

mammogram scheduling at the time of analysis. Further studies of more established online mammogram scheduling programs could evaluate for insurance status and ADI interaction effects in the association between portal use and BCS.

Limitations

This study has limitations. First, the authors conducted a cross-sectional analysis; longitudinal studies could better characterize this association over time and evaluate, for example, the association between increasing portal use and BCS rates. Second, on the basis of data limitations, the authors could not determine whether patients used the portal prior to BCS or whether they specifically used the portal for BCS. The authors can only draw conclusions that people who had not used the portal in the prior year were more likely to be overdue for BCS. Third, the authors may have missed records for completed mammograms outside of the health system. Primary care teams actively outreach and input BCS data if completed outside the system; however, it is possible that some mammogram records were missing, introducing possibility for misclassification. Fourth, both BCS rates and portal use were impacted by the coronavirus disease 2019 (COVID-19) pandemic.[32–34] Although the data were measured in late 2021, about a year after BCS rates rebounded from the pandemic nadir, the authors appreciate that the pandemic may have still influenced decisions to use portals and complete BCS.[34] Studies using more recent data will be helpful to better contextualize the findings. Finally, the adjusted model was limited by small group sizes (e.g., Hispanic ethnicity), limiting the authors' ability to detect interactions and confounding effects from these groups. The authors decided to include these groups and conceptually acknowledge

potential intersectional impacts; however, the authors appreciate statistical limitations.[35]

CONCLUSIONS

Patient portals can facilitate BCS through multiple portal features (e.g., reminders and online mammogram scheduling); therefore, addressing intersectional inequities in access, uptake, and use of portals could help to improve BCS inequities. Although more research is needed to understand this association, portal use outreach may be one health system strategy to help address BCS inequities. This analysis will inform future community-engaged qualitative research examining perspectives and experiences with portals to facilitate BCS and subsequent codesign and evaluation of a portal outreach intervention to increase BCS access among Black patients.

ACKNOWLEDGMENTS

Disclaimer: The content is solely the responsibility of the authors and does not necessarily represent the official views of Agency for Healthcare Research and Quality, the PhRMA Foundation, American Foundation for Pharmaceutical Education, or National Cancer Institute.

Funding: LMM and SK were supported by grant Number K12HS026369 from the Agency for Healthcare Research and Quality. SK was also supported by the Predoctoral Fellowship in Health Outcomes Research from the PhRMA Foundation and the American Foundation for Pharmaceutical Education Predoctoral Fellowship in Health Outcomes Disparities. RBI was supported by grant Number K08CA241296 from the National Cancer Institute.

Declaration of interest: none.

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SUPPLEMENTARY MATERIALS

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.focus.2024.100305.

REFERENCES

1. Hardy D, Du DY. Socioeconomic and racial disparities in cancer stage at diagnosis, tumor size, and clinical outcomes in a large cohort of women with breast cancer, 2007–2016. *J Racial Ethn Health Disparities.* 2021;8(4):990–1001. https://doi.org/10.1007/s40615-020-00855-y.
2. Ahmed AT, Welch BT, Brinjikji W, et al. Racial disparities in screening mammography in the United States: a systematic review and meta-analysis. *J Am Coll Radiol.* 2017;14(2):157–165.e9. https://doi.org/10.1016/j.jacr.2016.07.034.
3. Anthony DL, Campos-Castillo C, Lim PS. Who isn't using patient portals and why? Evidence and implications from a national sample of U.S. adults. *Health Aff (Millwood).* 2018;37(12):1948–1954. https://doi.org/10.1377/hlthaff.2018.05117.
4. Peacock S, Reddy A, Leveille SG, et al. Patient portals and personal health information online: perception, access, and use by U.S. adults. *J Am Med Inform Assoc.* 2017;24(e1):e173–e177. https://doi.org/10.1093/jamia/ocw095.
5. Gordon NP, Hornbrook MC. Differences in access to and preferences for using patient portals and other eHealth technologies based on race, ethnicity, and age: a database and survey study of seniors in a large health plan. *J Med Internet Res.* 2016;18(3):e50. https://doi.org/10.2196/jmir.5105.
6. Wallace LS, Angier H, Huguet N, et al. Patterns of electronic portal use among vulnerable patients in a nationwide practice-based research network: from the OCHIN Practice-Based Research Network (PBRN). *J Am Board Fam Med.* 2016;29(5):592–603. https://doi.org/10.3122/jabfm.2016.05.160046.
7. Kim H, Chang CF. Effectiveness of using personal health records to improve recommended breast cancer screening and reduce racial and geographic disparities among women. *J Cancer Educ.* 2022;37(2):343–351. https://doi.org/10.1007/s13187-020-01821-2.
8. Kindratt TB, Allicock M, Atem F, Dallo FJ, Balasubramanian BA. E-mail patient-provider communication and cancer screenings among U.S. adults: cross-sectional study. *JMIR Cancer.* 2021;7(3):e23790. https://doi.org/10.2196/23790.
9. Ambinder EB, Wang A, Oluyemi E, Myers KS, Mullen LA. Self-scheduling of screening mammograms using an online patient portal: initial 8-year experience at a multisite academic institution. *J Am Coll Radiol.* 2024;21(1):141–146. https://doi.org/10.1016/j.jacr.2023.06.040.
10. Sadeghi B, Tran J, Tsai IS, Sadigh G. Role of online patient portal self-scheduling and self-referral pathways to decrease health disparity for screening mammography. *J Am Coll Radiol.* 2024;21(1):147–153. https://doi.org/10.1016/j.jacr.2023.06.027.
11. Veinot TC, Mitchell H, Ancker JS. Good intentions are not enough: how informatics interventions can worsen inequality. *J Am Med Inform Assoc.* 2018;25(8):1080–1088. https://doi.org/10.1093/jamia/ocy052.
12. Lorenc T, Oliver K. Adverse effects of public health interventions: a conceptual framework. *J Epidemiol Community Health.* 2014;68(3):288–290. https://doi.org/10.1136/jech-2013-203118.
13. Crenshaw K. Mapping the margins: intersectionality, identity politics, and violence against women of color. *Stanford Law Rev.* 1991;43(6):1241–1299. https://doi.org/10.2307/1229039.
14. Combahee River Collective. The Combahee River Collective Statement. In: Smith B, editor. Home Girls: A Black Feminist Anthology. Kitchen Table: Women of Color Press, 1977:272–282.
15. Collins PH. *Black Feminist Thought: Knowledge, Consciousness, and the Politics of Empowerment*. London, United Kingdom: Routledge & CRC Press, 2009.
16. McCall L. The complexity of intersectionality. *Signs J Women Cult Soc.* 2005;30(3):1771–1800. https://doi.org/10.1086/426800.
17. Chen JC, Stover DG, Ballinger TJ, et al. Racial disparities in breast cancer: from detection to treatment. *Curr Oncol Rep.* 2024;26(1):10–20. https://doi.org/10.1007/s11912-023-01472-8.
18. Casillas A, Abhat A, Vassar SD, et al. Not speaking the same language-lower portal use for limited English proficient patients in the Los Angeles safety net. *J Health Care Poor Underserved.* 2021;32(4):2055–2070. https://doi.org/10.1353/hpu.2021.0182.

19. HEDIS. NCQA. https://www.ncqa.org/hedis/. Accessed December 10, 2024.
20. Schueler KM, Chu PW, Smith-Bindman R. Factors associated with mammography utilization: a systematic quantitative review of the literature. *J Womens Health (Larchmt).* 2008;17(9):1477–1498. https://doi.org/10.1089/jwh.2007.0603.
21. Weir S, Posner HE, Zhang J, et al. Disparities in routine breast cancer screening for Medicaid managed care members with a work-limiting disability. *Medicare Medicaid Res Rev.* 2011;1(4). 001.04.a02. https://doi.org/10.5600/mmrr.001.04.a02.
22. Llaneza DH, Kim H, Correa-Fernández V. A health inequity: associations between cigarette smoking status and mammogram screening among women of color. *Nicotine Tob Res.* 2023;25(1):66–72. https://doi.org/10.1093/ntr/ntac175.
23. Bhatia D, Lega IC, Wu W, Lipscombe LL. Breast, cervical and colorectal cancer screening in adults with diabetes: a systematic review and meta-analysis. *Diabetologia.* 2020;63(1):34–48. https://doi.org/10.1007/s00125-019-04995-7.
24. Kasper G, Momen M, Sorice KA, et al. Effect of neighborhood and individual-level socioeconomic factors on breast cancer screening adherence in a multi-ethnic study. *BMC Public Health.* 2024;24(1):63. https://doi.org/10.1186/s12889-023-17252-9.
25. Kind AJH, Buckingham WR. Making neighborhood-disadvantage metrics accessible — the neighborhood atlas. *N Engl J Med.* 2018;378(26):2456–2458. https://doi.org/10.1056/NEJMp1802313.
26. Horvath M, Levy J, L'Engle P, Carlson B, Ahmad A, Ferranti J. Impact of health portal enrollment with Email reminders on adherence to clinic appointments: a pilot study. *J Med Internet Res.* 2011;13(2):e41. https://doi.org/10.2196/jmir.1702.
27. Singh P, Jonnalagadda P, Morgan E, Fareed N. Outpatient portal use in prenatal care: differential use by race, risk, and area social determinants of health. *J Am Med Inform Assoc.* 2022;29(2):364–371. https://doi.org/10.1093/jamia/ocab242.
28. Davies HTO, Crombie IK, Tavakoli M. When can odds ratios mislead? *BMJ.* 1998;316(7136):989–991. https://doi.org/10.1136/bmj.316.7136.989.
29. von Elm E, Altman DG, Egger M, et al. The strengthening the reporting of observational studies in epidemiology (STROBE) statement: guidelines for reporting observational studies. *Int J Surg.* 2014;12(12):1495–1499. https://doi.org/10.1016/j.ijsu.2014.07.013.
30. Copeland VC, Kim YJ, Eack SM. Effectiveness of interventions for breast cancer screening in African American women: a meta-analysis. *Health Serv Res.* 2018;53(suppl 1):3170–3188. https://doi.org/10.1111/1475-6773.12806.
31. Rodriguez JA, Charles JP, Bates DW, Lyles C, Southworth B, Samal L. Digital healthcare equity in primary care: implementing an integrated digital health navigator. *J Am Med Inform Assoc.* 2023;30(5):965–970. https://doi.org/10.1093/jamia/ocad015.
32. Ahmed N, Sanghavi K, Mathur S, McCullers A. Patient portal use: persistent disparities from pre- to post-onset of the COVID-19 pandemic. *Int J Med Inform.* 2023;178:105204. https://doi.org/10.1016/j.ijmedinf.2023.105204.
33. Mai F, Ko DG, Shan Z, Zhang D. The impact of accelerated digitization on patient portal use by underprivileged racial minority groups during COVID-19: longitudinal study. *J Med Internet Res.* 2023;25:e44981. https://doi.org/10.2196/44981.
34. Oakes AH, Boyce K, Patton C, Jain S. Rates of routine cancer screening and diagnosis before vs after the COVID-19 pandemic. *JAMA Oncol.* 2023;9(1):145–146. https://doi.org/10.1001/jamaoncol.2022.5481.
35. Lett E, Asabor E, Beltrán S, Cannon AM, Arah OA. Conceptualizing, contextualizing, and operationalizing race in quantitative health sciences research. *Ann Fam Med.* 2022;20(2):157–163. https://doi.org/10.1370/afm.2792.