Effectiveness of Patient Navigation to Increase Cancer Screening in Populations Adversely Affected by Health Disparities: a Meta-analysis

Heidi D. Nelson, MD, MPH, MACP, FRCP^{1,2} , Amy Cantor, MD, MPH^{1,3},
Jesse Wagner, MA¹, Rebecca Jungbauer, DrPH, MPH, MA¹, Rongwei Fu, PhD^{1,4},
Karli Kondo, PhD, MA^{5,6}, Lucy Stillman, BS¹, and Ana Quiñones, PhD, MS⁴

¹Pacific Northwest Evidence-based Practice Center, Department of Medical Informatics and Clinical Epidemiology, Oregon Health & Science University, Portland, OR, USA; ²Department of Medicine, Oregon Health & Science University, Portland, OR, USA; ³Department of Family Medicine, Oregon Health & Science University, Portland, OR, USA; ⁴School of Public Health, Oregon Health & Science University-Portland State University, Portland, OR, USA; ⁵Evidence-based Synthesis Program, Portland VA Health Care System, Portland, OR, USA; ⁶Office of Research Integrity, Oregon Health & Science University, Portland, OR, USA.

BACKGROUND: This study evaluates the effectiveness of patient navigation to increase screening for colorectal, breast, and cervical cancer in populations adversely affected by health care disparities.

METHODS: Eligible studies were identified through English-language searches of Ovid® MEDLINE®, PsycINFO®, SocINDEX, and Veterans Affairs Health Services database (January 1, 1996, to July 5, 2019) and manual review of reference lists. Randomized trials and observational studies of relevant populations that evaluated the effectiveness of patient navigation on screening rates for colorectal, breast, or cervical cancer compared with usual or alternative care comparison groups were included. Two investigators independently abstracted study data and assessed study quality and applicability using criteria adapted from the U.S. Preventive Services Task Force. Discrepancies were resolved by consensus with a third reviewer. Results were combined using profile likelihood random effects models.

RESULTS: Thirty-seven studies met inclusion criteria (28 colorectal, 11 breast, 4 cervical cancers including 3 trials with multiple cancer types). Screening rates were higher with patient navigation for colorectal cancer overall (risk ratio [RR] 1.64; 95% confidence interval [CI] 1.42 to 1.92; $I^2 = 93.7\%$; 22 trials) and by type of test (fecal occult blood or immunohistochemistry testing [RR 1.69; 95% CI 1.33 to 2.15; $I^2 = 80.5\%$; 6 trials]; colonoscopy/endoscopy [RR 2.08; 95% CI 1.08 to 4.56; $I^2 = 94.6\%$; 6 trials]). Screening was also higher with navigation for breast cancer (RR 1.50; 95% CI 1.22 to 1.91; $I^2 = 98.6\%$; 10 trials) and cervical cancer (RR 1.11; 95% CI 1.05 to 1.19; based on the largest trial). The high heterogeneity of cervical cancer studies prohibited meta-analysis. Results were similar for

colorectal and breast cancer regardless of prior adherence to screening guidelines, follow-up time, and study quality.

CONCLUSIONS: In populations adversely affected by disparities, colorectal, breast, and cervical cancer screening rates were higher in patients provided navigation services. Registration: PROSPERO: CRD42018109263

KEY WORDS: prevention; cancer screening; patient navigation; health disparity; health equity.

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INTRODUCTION

The U.S. Preventive Services Task Force (USPSTF) recommends screening for colorectal, breast, and cervical cancer based on its effectiveness in reducing cancer mortality. Colorectal cancer screening is recommended annually when using stool-based tests (fecal occult blood test [FOBT]; fecal immunochemical test [FIT]) or every 5 to 10 years using direct visualization tests (colonoscopy; flexible sigmoidoscopy) starting at age 50 years and continuing until age 75 years.¹ Screening mammography is recommended biennially for all women aged 50 to 74 years, although may be appropriate for individual women beginning at age 40.² The USPSTF recommends screening for cervical cancer every 3 years with cervical cytology alone in women aged 21 to 29 years, and every 3 to 5 years based on the type of test for women aged 30 to 65 years.³

While the USPSTF screening recommendations are based on research of benefits and harms, they are complex and may be difficult for clinicians to implement and for patients to access in real-world clinical settings. Use of preventive health services, such as cancer screening, falls below recommended rates in the USA.⁴ Access to and utilization of preventive healthcare pose additional barriers for populations adversely affected by disparities^{5–9} including racial and ethnic minority

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populations, socioeconomically disadvantaged populations, underserved rural populations, sexual and gender minority populations, and others subject to discrimination.¹⁰ These populations have poorer health outcomes attributed to being socially disadvantaged, including outcomes related to cancer.¹⁰

Strategies to improve use of preventive health services have potential to increase screening rates for cancer and ultimately reduce cancer incidence and mortality. One approach, patient navigation, refers to services that improve engagement in healthcare by providing **personal guidance through the healthcare system**. Patient navigators may have medical, legal, financial, advocacy, or administrative roles that address an individual patient's needs during the course of care.

The goal of this study is to evaluate the effectiveness of patient navigation services in increasing colorectal, breast, and cervical cancer screening rates in populations adversely affected by disparities by conducting a meta-analysis of studies conducted in clinical practice settings in the USA.

METHODS

The meta-analysis is based on studies of the effectiveness of patient navigation services identified from a systematic review on Achieving Health Equity in Preventive Services.¹¹ The systematic review included five key questions on the effects of barriers that create disparities in preventive health services and the effectiveness of strategies and interventions to reduce them to inform a National Institutes of Health (NIH) Pathway to Prevention Workshop.¹² Members of an NIH planning committee and a nonfederal Technical Expert Panel determined the scope and key questions for the review.

Investigators developed a protocol (PROSPERO: CRD42018109263) according to established methods¹³ with input from experts and the public (full protocol available at <https://effectivehealthcare.ahrq.gov/topics/health-equity-preventive/protocol>). Additional details of the methods are available in a technical report.¹¹ Two key questions relevant to patient navigation included the effectiveness of interventions to reduce disparities in the use of preventive services primarily based within clinician practices or healthcare organizations and systems.

Data Sources and Searches

A research librarian conducted electronic database searches of Ovid® MEDLINE®, PsycINFO®, and SocINDEX (January 1, 1996, to July 5, 2019) for relevant English-language publications. Investigators also reviewed the Veterans Affairs Health Services database and reference lists of systematic reviews and articles; reports produced by government agencies and healthcare provider organizations; and suggestions from experts.

Study Selection

Two investigators independently reviewed abstracts and full-text articles to identify studies meeting pre-specified eligibility criteria; disagreements were resolved by discussion and consensus. Investigators tracked results in an EndNote® database (Thomson Reuters, New York, NY).

Eligibility criteria for studies of patient navigation included randomized controlled trial (RCT) or observational study design with usual or alternate care comparison groups, participants from populations adversely affected by disparities, relevance to clinical practice in the USA, and outcomes expressed as screening rates. This review applied a broad definition of patient navigation to include the wide range of services relevant to clinicians and currently in practice. These include services provided entirely within a clinical practice or healthcare system and those provided in community settings in connection with healthcare systems. The intervention was identified as patient navigation when it was described as such in the study, or it included core components of patient navigation, such as assistance with patient scheduling or follow-up or with travel to and from an appointment. Studies that did not explicitly state that the intervention involved patient navigation or navigators and described their interventions as educational sessions or home visits, for example, were not included in the meta-analysis.

Data Extraction and Quality Assessment

A single investigator initially extracted data from eligible studies including characteristics of study participants with particular emphasis on populations adversely affected by disparities as described by the original study, interventions, comparators, outcomes, study designs, settings, and methods. A second investigator verified data extractions for completeness and accuracy. Two investigators independently assessed the quality and applicability of individual studies, rating them as good, fair, or poor using predefined criteria adapted from the USPSTF.¹⁴ Disagreements were resolved by consensus involving a third reviewer.

Statistical Meta-analysis

Meta-analysis was conducted separately for studies of screening for colorectal, breast, and cervical cancer. When a study reported outcomes for more than one type of cancer screening, results were included in multiple relevant meta-analyses. In these studies, the screening populations and navigation services differed by cancer type. To determine the appropriateness of meta-analysis, investigators considered clinical and methodological differences and assessed statistical heterogeneity. Small study effects (potential publication bias) were assessed using a funnel plot and the Egger test when the number of studies in the meta-analysis was larger than 10.¹⁵

Risk ratio (RR) was the effect measure of the binary screening outcome (screened/not screened). Adjusted RRs or odds

ratios (OR) were used in the meta-analysis if reported (an adjusted OR was first converted to an adjusted RR).¹⁶ Otherwise, the RR was calculated from the reported raw numbers. The overall analysis was based on results from longer follow-up times when a study reported outcomes at more than one time point. In studies with two intervention arms with navigation components,¹⁷ results of the two arms were first combined before they were included in the meta-analysis. Meta-analysis was conducted separately for RCTs and observational studies. A profile likelihood random effects model was used to combine RRs to account for variation among studies.^{18, 19} Statistical heterogeneity was assessed using Cochran's χ^2 tests, and the magnitude of heterogeneity using the I^2 statistic.²⁰

Subgroup analysis was performed to obtain combined estimates by study level characteristics when this information was available from studies to assist with interpretation of the overall effects. Subgroup analysis based on patient population was not conducted because definitions of population subgroups varied widely across studies. Basic descriptions of the different population groups are included for each study in tables accompanying the forest plots.

For colorectal cancer screening studies, subgroup analysis was based on type of screening test (fecal occult blood test/fecal immunohistochemistry test, colonoscopy/endoscopy, any type), screening guideline adherence at baseline (no adherence, some adherence), follow-up time point (6 months, 1 year, 18 months, 5 years), and study quality rating (good, fair, poor) when at least two studies reported results. For breast cancer screening studies, subgroup analysis was based on screening guideline adherence at baseline (no adherence, some adherence), follow-up time point (6 months, 1 year, 18 months, 2 years, 5 years, other), and study quality rating (good, fair, poor). Subgroup analysis for cervical cancer screening was not performed because of few studies.

Annualized percentage estimates of screening rates with navigation compared with controls were created by standardizing the screening data to 12 months assuming consistent screening rates over time. These were calculated as simple unweighted proportions across studies, and percent navigation divided by percent control does not equal the pooled RR. While these estimates do not provide formal inferences, they are intended to provide clinical context and facilitate the interpretation of the combined RRs.

All analyses were performed by using STATA® 14.2 (StataCorp, College Station, TX), and all results were provided with 95 percent confidence intervals (CI). Data are available from the corresponding author on reasonable request.

Role of the Funding Source

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content area expert group, and a technical expert panel helped refine the project scope. The draft report was presented at an NIH Office of Disease Prevention Pathways to Prevention Workshop. Experts in the field, AHRQ and NIH partners, and the public reviewed earlier drafts of the full technical report. The investigators are solely responsible for the content and the decision to submit the manuscript for publication.

RESULTS

Thirty-seven studies evaluating the effectiveness of patient navigation to increase screening for colorectal,^{17, 21–47} breast,^{23, 27, 30, 32, 48–54} and cervical cancer^{23, 27, 55, 56} in populations adversely affected by disparities met inclusion criteria (Supplementary Appendix Fig. 1). Studies included 29 RCTs^{17, 21–24, 26–32, 34–36, 38–40, 42, 44, 45, 47–50, 52–55} and 8 observational studies^{25, 33, 37, 41, 43, 46, 51, 56}; 3 RCTs provided data for more than one type of cancer screening.^{23, 27, 30}

In these studies, navigation services typically included outreach activities involving letters or calls, educational materials and sessions, assessment and addressing of barriers to screening, language translation, appointment scheduling and reminders, bowel prep assistance, mailed supplies and kits, transportation and appointment attendance as needed, and point-of-care prompts, among others. Types and combinations of services varied widely across studies and were inconsistently described (Table 1). Comparison groups included patients receiving usual care or alternative care without patient navigation, such as a single mailing or educational encounter.

Participants included patients from multiple racial and ethnic groups, racial and ethnic minority groups with low income, any group with low income, undefined underserved groups, and rural areas. Studies were based primarily in primary care clinics, community-based sites, community health or safety-net clinics, and hospitals in the USA. Across studies, methodologic limitations included lack or inadequate reporting of randomization and allocation concealment, masking of outcome assessors, lack of intention to treat analysis, failure to control for confounding variables, and high or unclear attrition and loss to follow-up.

Effects of Patient Navigation on Colorectal Cancer Screening (Fig 1)

Twenty-two RCTs^{17, 21–24, 26–32, 34–36, 38–40, 42, 44, 45, 47} and 6 observational studies^{25, 33, 37, 41, 43, 46} evaluated the effectiveness of patient navigation compared with usual or alternative care to increase colorectal cancer screening (Supplementary Appendix Table 1). Results of all but 5 studies^{22, 24, 31, 33, 36} indicated higher screening rates with patient navigation, despite variability across studies in the type of navigation, patient population, study design and quality, and comparison groups.

Table 1 Components of Patient Navigation in Screening Studies

Author, Year (ref)	Population	Description	Education	GI Prep	Scheduling	Transportation	Information	Financial	Physician	Referral	Reminder
Colorectal cancer screening											
Baker, 2014 ²¹	LJ	Screening navigator	X	X	X	X	X				
Braun et al., 2015 ²³	Haw/Fil	Lay navigator	X	X	X	X		X	X		X
Blumenthal, 2010 ²²	AA	Health educator	X		X	X		X	X		
Christie, 2008 ²⁴	His/AA	Patient navigator	X	X	X	X				X	X
Cole, 2017 ¹⁷	AAM	Nurse manager	X								
Davis et al., 2013 ^{25*}	LJ	Lay navigator	X	X	X	X			X		
DeGroff et al., 2017 ²⁶	LJW	Prevention care manager	X	X	X	X			X		X
Dietrich et al., 2006 ²⁷	LJW	Prevention care manager	X	X	X	X			X		X
Dietrich et al., 2013 ²⁸	LJW	Prevention care manager	X	X	X	X			X		X
Enard et al., 2015 ²⁹	LIHis	Navigator	X	X	X		X			X	X
Fiscella et al., 2011 ³⁰	LJ	Community health worker	X				X				
Ford et al., 2006 ³¹	AAM	Case manager	X	X	X	X	X	X		X	
Fortuna et al., 2014 ³²	LJ	Outreach worker	X	X	X	X	X			X	
Goldman et al., 2015 ³⁵	LJ	Navigator	X	X	X		X		X		
Guillaume et al., 2017 ³⁶	LJ	Screening navigator	X			X		X			X
Honeycutt et al., 2013 ^{37*}	LJ	Patient navigator	X								
Home et al., 2015 ³⁸	AA	Patient navigator	X	X	X						X
Jandorf et al., 2005 ³⁹	LJ	Patient navigator	X	X						X	
Lasser et al., 2011 ⁴⁰	LIRE	Patient navigator	X	X					X		
Leone et al., 2013 ^{33*}	LJ	Patient navigator	X	X	X	X					X
Ma et al., 2009 ^{41*}	Kor	Health educator	X	X	X	X		X	X		X
Myers et al., 2014 ⁴²	AA	Navigator	X	X							X
Myers et al., 2019 ⁴⁴	His	Patient navigator	X	X	X						X
Nash et al., 2006 ^{43*}	LIRE	Patient navigator	X	X	X					X	X
Nguyen et al., 2015 ⁴⁴	Viet	Lay health worker	X	X	X					X	X
Percac-Lima et al., 2009 ⁴⁵	LJ	Patient navigator	X	X	X	X	X	X			X
Percac-Lima et al., 2014 ^{46*}	His	Patient navigator	X	X	X	X	X				X
Reuland et al., 2017 ⁴⁷	LIRE	Patient navigator	X	X							
Breast cancer screening											
Braun et al., 2015 ²³	Haw/Fil	Lay navigator	X	X	X	X		X	X		X
Dietrich et al., 2006 ²⁷	LJ	Prevention care manager	X	X	X	X			X		X
Fiscella et al., 2011 ³⁰	LJ	Community health worker	X			X	X				
Fortuna et al., 2014 ³²	LJ	Outreach worker	X	X	X					X	
Marshall et al., 2016 ⁵⁰	AA	Patient navigator	X	X	X				X		
Paskett et al., 2006 ⁴⁸	LIRE	Lay health advisor	X	X	X						
Percac-Lima et al., 2012 ^{51*}	LIRE	Patient navigator	X	X	X	X		X	X		X
Phillips et al., 2011 ⁵²	LIRE	Patient navigator	X	X	X	X			X		X
Powell et al., 2005 ⁵³	RAA	Home health educator	X	X	X			X	X	X	
Russell et al., 2010 ⁴⁹	AALJ	Lay health advisor	X	X	X	X	X	X		X	X
Weber et al., 1997 ⁵⁴	LJ	Health educator	X	X	X			X	X		X
Braun et al., 2015 ²³	Haw/Fil	Lay navigator	X	X	X	X			X		X
Dietrich et al., 2006 ²⁷	LJ	Prevention care manager	X	X	X	X	X				X
Fiscella et al., 2011 ³⁰	LJ	Community health worker	X								
Cervical cancer screening											
Braun et al., 2015 ²³	Haw/Fil	Lay navigator	X	X	X	X		X	X		X
Dietrich et al., 2006 ²⁷	LJ	Prevention care manager	X	X	X	X			X		X
Fang et al., 2017 ⁵⁵	Kor	Study navigator	X	X	X	X	X	X		X	
Wang et al., 2010 ^{56*}	LJCh	Health educator	X	X	X	X	X	X		X	

AA, African American; AALJ, African American low income; AAM, African-American men; Fil, Filipino American; Haw, Native Hawaiian; His, Hispanic/Latino; LJ, low income; LIHis, Hispanic/Latino low income; LJCh, low-income Chinese; LIRE, low-income racial/ethnic minority; LJW, low-income women; RAA, rural African American; Viet, Vietnamese American. *Observational study; others are RCTs

Fig. 1 Meta-analysis of randomized controlled trials of the effect of patient navigation on colorectal cancer screening rates. AA, African American; AAM, African-American men; Fil, Filipino American; Haw, Native Hawaiian; His, Hispanic/Latino; LI, low income; LIHis, Hispanic/Latino low income; LIR, low-income racial/ethnic minority; LIW, low-income women; Viet, Vietnamese American; Colo, colonoscopy; Endo, endoscopy (colonoscopy and flexible sigmoidoscopy); FIT, fecal immunohistochemistry test; FOBT, fecal occult blood test.

Combining results of studies in meta-analysis indicated increased colorectal cancer screening with navigation in both RCTs (RR 1.64; 95% CI 1.42 to 1.92; $I^2 = 93.7\%$; 22 trials) and observational studies (RR 2.63; 95% CI 1.46 to 4.85; $I^2 = 90.9\%$; 6 studies) (Table 2). In RCTs, navigation was associated with higher screening rates in trials reporting results specifically for FOBT/FIT (RR 1.69; 95% CI 1.33 to 2.15; $I^2 = 80.5\%$; 6 trials) and colonoscopy/endoscopy (RR 2.08; 95% CI 1.08 to 4.56; $I^2 = 94.6\%$; 6 trials), and trials reporting combined results that included all types of tests (RR 1.72; 95% CI 1.43 to 2.08; $I^2 = 93.9\%$; 14 trials) (Supplementary Appendix Figs. 2 and 3).

Patient navigation was associated with increased colorectal cancer screening for patients not adherent with screening recommendations at baseline (RR 1.74; 95% CI 1.48 to 2.09; $I^2 = 87.4\%$; 17 trials), as well as for mixed populations of adherent and nonadherent patients (RR 1.38; 95% CI 1.01 to 1.89; $I^2 = 93.9\%$; 5 trials) (Supplementary Appendix Fig. 4). While screening was increased in studies reporting various lengths of follow-up time (6 months, 1 year, 18 months, 5 years), point estimates were highest in studies with shorter follow-up times (6-month RR 2.06; 95% CI 1.53 to 2.89; $I^2 = 82.4\%$; 8 trials; 1-year RR 1.72; 95% CI 1.41 to 2.15; $I^2 = 82.7\%$; 8 trials) (Supplementary Appendix Fig. 5). Screening rates were increased with navigation in studies meeting criteria for good (RR 2.26; 95% CI 1.44 to 3.17; $I^2 = 0.0\%$; 2 trials), fair (RR 1.54; 95% CI 1.29 to 1.86; $I^2 = 95.4\%$; 12 trials), or poor (RR 1.74; 95% CI 1.27 to 2.53; $I^2 = 75.6\%$; 8 trials) quality ratings (Supplementary Appendix Fig. 6).

The included studies demonstrated small study effects (asymmetric funnel plot, Supplementary Appendix Fig. 7; Egger test, $P < 0.001$), which may be attributed to publication bias where the small studies with null or negative results were not published. However, screening rates remained higher with patient navigation for colorectal cancer when only large clinical trials were included in the meta-analysis (data available from investigators).

Effects of Patient Navigation on Breast Cancer Screening

Ten RCTs^{23, 27, 30, 32, 48–50, 52–54} and one before-after observational study⁵¹ evaluated the effectiveness of patient navigation compared with usual or alternative care to increase breast cancer screening (Supplementary Appendix Table 2). All but one study⁵³ indicated higher screening rates with patient navigation regardless of the type of navigation, patient population, study design and quality, and comparison groups.

Combining results of all RCTs in meta-analysis indicated increased breast cancer screening with navigation (RR 1.50; 95% CI 1.22 to 1.91; $I^2 = 98.6\%$; 10 trials) (Fig. 2; Table 3). The single observational study showed similar results (RR 1.52; 95% CI 1.16 to 2.00). Patient navigation was associated with increased breast cancer screening for patients not adherent with screening recommendations at baseline (RR 2.30; 95% CI 1.87 to 2.81; $I^2 = 0\%$; 4 trials), as well as for mixed populations of adherent and nonadherent patients (RR 1.20; 95% CI 1.07 to 1.38; $I^2 = 93.3\%$; 6 trials). Screening rates

were higher with navigation versus comparison regardless of follow-up time (1 year, 18 months, 2 years, 5 years) (Supplementary Appendix Fig. 8) and study quality, although CIs crossed 1.0 for poor-quality studies (Supplementary Appendix Fig. 9).

Effects of Patient Navigation on Cervical Cancer Screening

Three RCTs^{23, 27, 55} and one observational study⁵⁶ evaluated the effectiveness of patient navigation compared with usual or alternative care to increase cervical cancer screening (Table 4; Supplementary Appendix Table 3). All studies indicated statistically significantly higher screening rates with patient navigation regardless of the type of navigation, patient population, study design and quality, and comparison groups. Studies were not appropriate for meta-analysis because they demonstrated high statistical heterogeneity, estimates of effect varied widely, and the combined estimate did not reflect the results of the included studies. The largest RCT, enrolling 1390 low-income women and meeting criteria for fair-quality reported increased screening for navigation after 18 months of follow-up (RR 1.11; 54% CI 1.05 to 1.19)²⁷.

DISCUSSION

Meta-analyses of 37 studies of patient navigation interventions for colorectal, breast, and cervical cancer screening in populations adversely affected by health care disparities indicated increased screening rates with navigation. Results are

consistent regardless of the type of cancer screening, components of navigation, patient population, study design and quality, and comparison groups. Results for colorectal cancer screening are supported by a meta-analysis of 28 studies, breast cancer screening by a meta-analysis of 11 studies, and cervical cancer screening by 4 studies. Although the evidence base includes several small, poor-quality studies, results of additional large, well-conducted studies were similar.

While results consistently indicated positive effects of navigation on screening across studies, the magnitude of the observed effects was highest for colorectal cancer screening (RR 1.64; 95% CI 1.42 to 1.92; $I^2 = 93.7\%$; 22 trials) followed by breast cancer screening (RR 1.50; 95% CI 1.22 to 1.91; $I^2 = 98.6\%$; 10 trials). However, these differences could be related to the numbers of trials and amount of data contributing to the estimates rather than to differences based on the type of screening. Risk ratios varied so widely with cervical cancer screening that studies could not be reliably combined in meta-analysis.

Components and delivery of the navigation services varied across studies and it is unclear which aspects were most effective. This heterogeneity reflected tailoring for specific populations by providing services most important for them, such as lay health workers, language translation, and reminder calls. These services likely enhanced the effect of navigation, although additional effects of these services could not be determined from the studies themselves. Other reviews of interventions to reduce health disparities for various types of health services also found that tailored interventions including personnel (e.g., care managers, community health

Table 2 Results of Meta-analyses of Colorectal Cancer Screening Studies

Study component	Subgroup	Number of studies	Risk ratio (95% CI)	I^2 , P value	Annualized percentage screened (%) navigation; control*
Overall	RCT	22	1.64 (1.42 to 1.92)	93.7%, < 0.0001	37.8; 25.1
	Observational	6	2.63 (1.46 to 4.85)	90.9%, < 0.0001	66.2; 39.4
Screening test	FOBT/FIT RCT	6	1.69 (1.33 to 2.15)	80.5%, < 0.0001	35.6; 27.7
	FOBT/FIT observational	1	1.60 (1.06 to 2.42)	NA	60.6; 38.5
	Colon/endo RCT	6	2.08 (1.08 to 4.56)	94.6%, < 0.0001	42.3; 37.3
	Colon/endo observational	1	4.44 (2.99 to 6.59)	NA	90.0; 20.3
	Any test RCT†	14	1.72 (1.43 to 2.08)	93.9%, < 0.0001	37.4; 21.3
	Any test observational†	4	2.65 (1.20 to 5.85)	91.7%, < 0.0001	61.4; 40.6
Screening adherence‡	None	17	1.74 (1.48 to 2.09)	87.4%, 0.0001	41.8; 26.4
	Some	5	1.38 (1.01 to 1.89)	93.9%, < 0.0001	27.3; 21.3
Follow-up time	6 months	8	2.06 (1.53 to 2.89)	82.4%, < 0.0001	77.0; 57.9
	1 year	8	1.72 (1.41 to 2.15)	82.7%, < 0.0001	31.4; 20.2
	18 months	2	1.28 (1.09 to 1.53)	5.5%, 0.144	26.6; 20.4
	5 years	4	1.21 (0.96 to 1.58)	82.0%, < 0.0001	12.2; 11.3
Study quality rating	Good	2	2.26 (1.44 to 3.17)	0.0%, 0.259	57.4; 31.6
	Fair	12	1.54 (1.29 to 1.86)	95.4%, < 0.0001	37.3; 26.8
	Poor	8	1.74 (1.27 to 2.53)	75.6%, < 0.0001	36.1; 15.8

CI, confidence interval; Colon/endo, colonoscopy/endoscopy; FIT, fecal immunohistochemistry test; FOBT, fecal occult blood test; NA, not applicable; RCT, randomized controlled trial

*Calculated by standardizing the screening data to 12 months assuming consistent screening rates over time

†Studies reported combined results for both types of tests

‡Adherence at baseline

Fig. 2 Meta-analysis of randomized controlled trials of the effect of patient navigation on breast cancer screening rates. AA, African American; AALI, African American low income; Fil, Filipino American; Haw, Native Hawaiian; LI, low income; LIRE, low-income racial/ethnic minority; RAA, rural African American.

workers) and providing increased connectedness between patients and the healthcare systems were most effective.⁵⁷ These interventions included care coordination, care management, community outreach, and culturally tailored education interventions.

Limitations of this review include using only English-language articles and studies applicable to the USA, although this focus improves its relevance to the Pathways to Prevention Workshop on Achieving Health Equity in Preventive Services.^{58, 59} This review demonstrated small study effects for colorectal cancer screening, which may be due to publication bias. Screening rates remained higher with patient navigation when only large clinical trials were included in the

meta-analysis suggesting that interventions were effective regardless of study size, although large studies could overestimate the effect size. Small study effects could not be evaluated for breast or cervical cancer screening because there were fewer studies available. Enrollment in studies was limited to groups characterized by race and ethnicity, low income, and rural location. While these are important populations to consider when reducing health disparities, no studies were identified that studied other groups, such as sexual and gender minorities and specific immigrant populations.

Similar to other reviews, most studies identified in this review included a single population and evaluated the effectiveness of interventions within the population group, rather

Table 3 Results of Meta-analyses of Breast Cancer Screening Studies

Study component	Subgroup	Number of studies	Risk ratio (95% CI)	I^2 , P value	Annualized percentage screened (%) navigation; control*
Overall	RCT	10	1.50 (1.22 to 1.91)	98.6%, < 0.0001	33.8; 25.8
	Observational	1	1.52 (1.16 to 2.00)	NA	67.0; 44.0
Screening adherence†	None	4	2.30 (1.87 to 2.81)	0%, 0.531	42.1; 17.9
	Some	6	1.20 (1.07 to 1.38)	93.3%, < 0.0001	32.7; 26.9
Follow-up time	6 months	1	2.71 (1.86 to 3.94)	NA	100; 35.6
	1 year	5	1.56 (1.16 to 2.13)	73.2%, 0.003	44.0; 27.9
	18 months	1	1.17 (1.08 to 1.27)	NA	45.3; 38.7
	2 years	1	1.07 (1.05 to 1.10)	NA	46.6; 43.8
	5 years	1	1.16 (1.13 to 1.20)	NA	17.3; 15.3
	Other	1	2.23 (1.48 to 3.34)	NA	25.2; 9.8
Study quality rating	Good	1	1.81 (1.21 to 2.72)	NA	27.5; 17.8
	Fair	6	1.51 (1.08 to 2.16)	96.9%, < 0.0001	31.0; 22.6
	Poor	3	1.43 (0.94 to 2.37)	89.1%, < 0.0001	44.9; 37.8

CI, confidence interval; NA, not applicable; RCT, randomized controlled trial

*Calculated by standardizing the screening data to 12 months assuming consistent screening rates over time

†Adherence at baseline

Table 4 Results of Cervical Cancer Screening Trials

Author, year (ref)	Screening adherence	Follow-up	Quality rating	Risk ratio (95% CI)	No. events, treatment	No. events, control
Braun et al., 2015 ²³	Some	5 years	Poor	1.57 (1.20 to 2.06)	73/128	48/132
Dietrich et al., 2006 ²⁷	Some	18 months	Fair	1.11 (1.05 to 1.19)	543/696	486/694
Fang et al., 2017 ⁵⁵	No	1 year	Fair	9.14 (6.79 to 12.30)	209/347	30/358
Wang et al., 2010 ⁵⁶	No	1 year	Poor	6.30 (2.92 to 13.58)	56/80	6/54

CI, confidence interval; No., number

than across comparison groups. Also, subgroup analyses based on population group was not done because groups were often not well defined and frequently overlapping in studies. In addition, it is not known how results based on populations from unique settings translate to others. Studies based in specific healthcare systems may not be relevant to others, particularly small studies with highly tailored interventions. Healthcare organizations or systems may differ due to geographic location, policies, access to resources, or capacity, and studies may not translate to general primary care or primary care-referable settings. Many studies meeting inclusion criteria incorporated elements of community-based participatory research, which are necessarily unique to the local organization or system context.

Patient navigation provides high-touch services that are designed to troubleshoot multiple types of barriers and respond to the needs of individual patients. These types of interventions are difficult to combine and assess collectively and to apply broadly because of their heterogeneity. Nonetheless, they demonstrate effectiveness in increasing cancer screening rates. Additional research to identify the most effective and efficient methods to implement patient navigation and reminders into different healthcare settings would be a useful next step. These studies could also describe the most common barriers encountered and how they were remedied to inform planning of services.

CONCLUSIONS

Thirty-seven studies of patients from populations adversely affected by disparities indicated that screening rates for colorectal, breast, and cervical cancer were higher for patients provided navigation services than those given usual or alternative care.

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Corresponding Author: Heidi D. Nelson, MD, MPH, MACP, FRCP; Pacific Northwest Evidence-based Practice Center, Department of Medical Informatics and Clinical Epidemiology, Oregon Health & Science University Portland, OR, USA (e-mail: nelsonh@ohsu.edu).

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REFERENCES

- Colorectal Cancer: Screening. 2016. Accessed at U.S. Preventive Services Task Force at <https://www.uspreventiveservicestaskforce.org/uspstf/recommendation/colorectal-cancer-screening> on May 30, 2020.
- Breast Cancer: Screening. 2016. Accessed at U.S. Preventive Services Task Force at <https://www.uspreventiveservicestaskforce.org/uspstf/recommendation/breast-cancer-screening> on May 30, 2020.
- Cervical Cancer: Screening. 2018. Accessed at U.S. Preventive Services Task Force at <https://www.uspreventiveservicestaskforce.org/uspstf/recommendation/cervical-cancer-screening> on May 30, 2020.
- McGlynn EA, Asch SM, Adams J, et al. The quality of health care delivered to adults in the United States. *N Engl J Med*. 2003;348:2635-45.
- Hou SI, Sealy DA, Kabiru CW. Closing the disparity gap: cancer screening interventions among Asians—a systematic literature review. *Asian Pac J Cancer Prev*. 2011;12(11):3133-9.
- Jones TP, Katapodi MC, Lockhart JS. Factors influencing breast cancer screening and risk assessment among young African American women: An integrative review of the literature. *J Am Assoc Nurse Pract*. 2015;27(9):521-9.
- Joseph DA, Redwood D, DeGross A, Butler EL. Use of evidence-based interventions to address disparities in colorectal cancer screening. *MMWR Suppl*. 2016;65(1):21-8.
- Martinez ME, Ward BW. Health care access and utilization among adults aged 18-64, by poverty level: United States, 2013-2015. *NCHS Data Brief*. 2016;(262):1-8.
- Centers for Disease Control and Prevention 2015. Accessed at U.S. Department of Health and Human Services at ftp://ftp.cdc.gov/pub/Health_Statistics/NCHS/Dataset_Documentation/NHIS/2015/srvy-desc.pdf on May 23, 2019.
- HD Pulse. 2017. Accessed at National Institute on Minority Health and Health Disparities at <https://hdpulse.nlm.nih.gov/> on May 30, 2020.
- Nelson HD, Cantor A, Wagner J, Jungbauer R, Quiñones A, Fu R, Stillman L, Kondo K. Achieving Health Equity in Preventive Services. Comparative Effectiveness Review No. 222. (Prepared by the Pacific Northwest Evidence-based Practice Center under Contract No. 290-2015-00009-I.) AHRQ Publication No. 20-EHC022-EF. Rockville, MD: Agency for Healthcare Research and Quality; November 2019. Posted

- final reports are located on the Effective Health Care Program search page. <https://doi.org/10.23970/AHRQEPCCER222>.
12. Pathways to Prevention: Achieving Health Equity in Preventive Services. 2019. Accessed at National Institutes of Health Office of Disease Prevention at <https://prevention.nih.gov/research-priorities/research-needs-and-gaps/pathways-prevention/achieving-health-equity-preventive-services> on May 30, 2020.
 13. Methods Guide for Effectiveness and Comparative Effectiveness Reviews. AHRQ Publication No. 10(14)-EHC063-EF. Rockville, MD; 2014.
 14. U.S. Preventive Services Task Force Procedure Manual. 2018; Accessed at <https://www.uspreventiveservicestaskforce.org/Page/Name/procedure-manual> on May 30, 2020.
 15. Egger M, Davey Smith G, Schneider M, Minder C. Bias in meta-analysis detected by a simple, graphical test. *Bmj*. 1997;315(7109):629-34.
 16. Zhang J, Yu KF. What's the relative risk? A method of correcting the odds ratio in cohort studies of common outcomes. *Jama*. 1998;280(19):1690-1.
 17. Cole H, Thompson HS, White M, Browne R, Trinh-Shevrin C, Braithwaite S, et al. Community-based, preclinical patient navigation for colorectal cancer screening among older black men recruited from barbershops: The MISTER B Trial. *Am J Public Health*. 2017;107(9):1433-40.
 18. Hardy RJ, Thompson SG. A likelihood approach to meta-analysis with random effects. *Stat Med*. 1996;15(6):619-29.
 19. Morton SC, Murad MH, O'Connor E, Lee CS, Booth M, Vandermeer BW, et al. Quantitative synthesis—an update. Methods Guide for Effectiveness and Comparative Effectiveness Reviews. (Prepared by the Scientific Resource Center under Contract No. 290-2012-0004-C). AHRQ Publication No. 18-EHC007- EF. Rockville, MD: Agency for Healthcare Research and Quality; 2008.
 20. Higgins JP, Thompson SG. Quantifying heterogeneity in a meta-analysis. *Stat Med*. 2002;21(11):1539-58.
 21. Baker DW, Brown T, Buchanan DR, Weil J, Balsley K, Ranalli L, et al. Comparative effectiveness of a multifaceted intervention to improve adherence to annual colorectal cancer screening in community health centers: a randomized clinical trial. *JAMA Intern Med*. 2014;174(8):1235-41.
 22. Blumenthal DS, Smith SA, Majett CD, Alema-Mensah E. A trial of 3 interventions to promote colorectal cancer screening in African Americans. *Cancer*. 2010;116(4):922-9.
 23. Braun KL, Thomas WL, Jr., Domingo JL, Allison AL, Ponce A, Haunani Kamakana P, et al. Reducing cancer screening disparities in Medicare beneficiaries through cancer patient navigation. *J Am Geriatr Soc*. 2015;63(2):365-70.
 24. Christie J, Itzkowitz S, Lihau-Nkansa I, Castillo A, Redd W, Jandorf L. A randomized controlled trial using patient navigation to increase colonoscopy screening among low-income minorities. *J Natl Med Assoc*. 2008;100(3):278-84.
 25. Davis T, Arnold C, Rademaker A, Bennett C, Bailey S, Platt D, et al. Improving colon cancer screening in community clinics. *Cancer*. 2013;119(21):3879-86.
 26. DeGross A, Schroy PC, 3rd, Morrissey KG, Slotman B, Rohan EA, Bethel J, et al. Patient navigation for colonoscopy completion: results of an RCT. *Am J Prev Med*. 2017;53(3):363-72.
 27. Dietrich AJ, Tobin JN, Cassells A, Robinson CM, Greene MA, Sox CH, et al. Telephone care management to improve cancer screening among low-income women: a randomized, controlled trial. *Ann Intern Med*. 2006;144(8):563-71.
 28. Dietrich AJ, Tobin JN, Robinson CM, Cassells A, Greene MA, Dunn VH, et al. Telephone outreach to increase colon cancer screening in Medicaid managed care organizations: a randomized controlled trial. *Ann Fam Med*. 2013;11(4):335-43.
 29. Enard K, Nevarez L, Hernandez M, Hovick S, Moguel M, Hajek R, et al. Patient navigation to increase colorectal cancer screening among Latino Medicare enrollees: a randomized controlled trial. *Cancer Causes Control*. 2015;26(9):1351-9.
 30. Fiscella K, Humiston S, Hendren S, Winters P, Idris A, Li SX, et al. A multimodal intervention to promote mammography and colorectal cancer screening in a safety-net practice. *J Natl Med Assoc*. 2011;103(8):762-8.
 31. Ford ME, Havstad S, Vernon SW, Davis SD, Kroll D, Lamerato L, et al. Enhancing adherence among older African American men enrolled in a longitudinal cancer screening trial. *Gerontologist*. 2006;46(4):545-50.
 32. Fortuna RJ, Idris A, Winters P, Humiston SG, Scofield S, Hendren S, et al. Get screened: a randomized trial of the incremental benefits of reminders, recall, and outreach on cancer screening. *J Gen Intern Med*. 2014;29(1):90-7.
 33. Leone LA, Reuland DS, Lewis CL, Ingle M, Erman B, Summers TJ, et al. Reach, usage, and effectiveness of a Medicaid patient navigator intervention to increase colorectal cancer screening. Cape Fear, North Carolina, 2011. *Prev Chronic Dis*. 2013;10:E82.
 34. Myers RE, Stello B, Daskalakis C, Sifri R, Gonzalez ET, DiCarlo M, et al. Decision support and navigation to increase colorectal cancer screening among Hispanic patients. *Cancer Epidemiol Biomark Prev*. 2019;28(2):384-91.
 35. Goldman SN, Liss DT, Brown T, Lee JY, Buchanan DR, Balsley K, et al. Comparative effectiveness of multifaceted outreach to initiate colorectal cancer screening in community health centers: a randomized controlled trial. *J Gen Intern Med*. 2015;30(8):1178-84.
 36. Guillaume E, De Jardin O, Bouvier V, De Mil R, Berchi C, Pornet C, et al. Patient navigation to reduce social inequalities in colorectal cancer screening participation: a cluster randomized controlled trial. *Prev Med*. 2017b;103:76-83.
 37. Honeycutt S, Green R, Ballard D, Hermstad A, Brueder A, Haardorfer R, et al. Evaluation of a patient navigation program to promote colorectal cancer screening in rural Georgia, USA. *Cancer*. 2013;119(16):3059-66.
 38. Horne HN, Phelan-Emrick DF, Pollack CE, Markakis D, Wenzel J, Ahmed S, et al. Effect of patient navigation on colorectal cancer screening in a community-based randomized controlled trial of urban African American adults. *Cancer Causes Control*. 2015;26(2):239-46.
 39. Jandorf L, Gutierrez Y, Lopez J, Christie J, Itzkowitz SH. Use of a patient navigator to increase colorectal cancer screening in an urban neighborhood health clinic. *J Urban Health*. 2005;82(2):216-24.
 40. Lasser KE, Murillo J, Lisboa S, Casimir AN, Valley-Shah L, Emmons KM, et al. Colorectal cancer screening among ethnically diverse, low-income patients: a randomized controlled trial. *Arch Intern Med*. 2011;171(10):906-12.
 41. Ma GX, Shive S, Tan Y, Gao W, Rhee J, Park M, et al. Community-based colorectal cancer intervention in underserved Korean Americans. *Cancer Epidemiol*. 2009;33(5):381-6.
 42. Myers RE, Sifri R, Daskalakis C, DiCarlo M, Geethakumari PR, Crocrot J, et al. Increasing colon cancer screening in primary care among African Americans. *J Natl Cancer Inst*. 2014;106(12).
 43. Nash D, Azeez S, Vlahov D, Schori M. Evaluation of an intervention to increase screening colonoscopy in an urban public hospital setting. [Erratum appears in *J Urban Health*. 2007 May;84(3):459]. *J Urban Health*. 2006;83(2):231-43.
 44. Nguyen BH, Stewart SL, Nguyen TT, Bui-Tong N, McPhee SJ. Effectiveness of lay health worker outreach in reducing disparities in colorectal cancer screening in Vietnamese Americans. *Am J Public Health*. 2015;105(10):2083-9.
 45. Percac-Lima S, Grant RW, Green AR, Ashburner JM, Gamba G, Oo S, et al. A culturally tailored navigator program for colorectal cancer screening in a community health center: a randomized, controlled trial. *J Gen Intern Med*. 2009;24(2):211-7.
 46. Percac-Lima S, Lopez L, Ashburner JM, Green AR, Atlas SJ. The longitudinal impact of patient navigation on equity in colorectal cancer screening in a large primary care network. *Cancer*. 2014;120(13):2025-31.
 47. Reuland DS, Brenner AT, Hoffman R, McWilliams A, Rhyne RL, Getrich C, et al. Effect of combined patient decision aid and patient navigation vs usual care for colorectal cancer screening in a vulnerable patient population: a randomized clinical trial. *JAMA Intern Med*. 2017;177(7):967-74.
 48. Paskett E, Tatum C, Rushing J, Michielutte R, Bell R, Long Foley K, et al. Randomized trial of an intervention to improve mammography utilization among a tri-racial rural population of women. *J Natl Cancer Inst*. 2006;98(17):1226-37.
 49. Russell KM, Champion VL, Monahan PO, Millon-Underwood S, Zhao G, Spacey N, et al. Randomized trial of a lay health advisor and computer intervention to increase mammography screening in African American women. *Cancer Epidemiol Biomark Prev*. 2010;19(1):201-10.
 50. Marshall JK, Mbah OM, Ford JG, Phelan-Emrick D, Ahmed S, Bone L, et al. Effect of patient navigation on breast cancer screening among African American Medicare beneficiaries: a randomized controlled trial. *J Gen Intern Med*. 2016;31(1):68-76.
 51. Percac-Lima S, Milosavljevic B, Oo SA, Marable D, Bond B. Patient navigation to improve breast cancer screening in Bosnian refugees and immigrants. *J Immigr Minor Health*. 2012;14(4):727-30.

52. **Phillips CE, Rothstein JD, Beaver K, Sherman BJ, Freund KM, Battaglia TA.** Patient navigation to increase mammography screening among inner city women. *J Gen Intern Med.* 2011;26(2):123-9.
53. **Powell ME, Carter V, Bonsi E, Johnson G, Williams L, Taylor-Smith L, et al.** Increasing mammography screening among African American women in rural areas. *J Health Care Poor Underserved.* 2005;16(4 Suppl A):11-21.
54. **Weber BE, Reilly BM.** Enhancing mammography use in the inner city. A randomized trial of intensive case management. *Arch Intern Med.* 1997;157(20):2345-9.
55. **Fang CY, Ma GX, Handorf EA, Feng Z, Tan Y, Rhee J, et al.** Addressing multilevel barriers to cervical cancer screening in Korean American women: a randomized trial of a community-based intervention. *Cancer.* 2017;123(6):1018-26.
56. **Wang X, Fang C, Tan Y, Liu A, Ma GX.** Evidence-based intervention to reduce access barriers to cervical cancer screening among underserved Chinese American women. *J Women's Health.* 2010;19(3):463-9.
57. **Guñones AR, O'Neil M, Saha S, Freeman M, Henry SR, Kansagara D.** Interventions to Reduce Racial and Ethnic Disparities. VA-ESP Project #05-225; 2011.
58. **Carey TS, Bekemeier B, Campos-Outcalt D, Koch-Weser S, Millon-Underwood S, Teutsch S.** National Institutes of Health Pathways to Prevention Workshop: achieving health equity in preventive services. *Ann Intern Med.* 2020;172:272-278.
59. **Nelson HD, Cantor A, Wagner J, Jungbauer R, Guñones A, Stillman L, Kondo K.** Achieving health equity in preventive services: Systematic review for a National Institutes of Health Pathways to Prevention Workshop. *Ann Intern Med.* 2020;172:258-271.

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